THE MINISTRY OF EDUCATION AND SCIENCE OF THE RUSSIAN FEDERATION

ST. PETERSBURG NATIONAL RESEARCH UNIVERSITY
OF INFORMATION TECHNOLOGIES, MECHANICS AND OPTICS

XIX International Joint Conference
"Internet and Modern Society" (IMS-2016)

EVA 2016 SAINT PETERSBURG

Electronic Imaging & the Visual Arts

INTERNATIONAL CONFERENCE

St. PETERSBURG, JUNE 23rd-24th, 2016

Conference Proceedings

ITMO UNIVERSITY

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ITMO UNIVERSITY

Университет ИТМО — ведущий вуз России в области информационных и фотонных технологий, один из немногих российских вузов, получивших в 2009 году статус национального исследовательского университета. С 2013 года Университет ИТМО — участник программы повышения конкурентоспособности российских университетов среди ведущих мировых научно-образовательных центров, известной как проект «5 в 100». Цель Университета ИТМО — становление исследовательского университета мирового уровня, предпринимательского по типу, ориентированного на интернационализацию всех направлений деятельности.

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Arts & Technology

THE VIRTUAL REALITY TECHNOLOGY AND THE MONTAGE OF 'VIDEOS 360°' AS MODERN APPROACHES TO THE PRESENTATION OF CULTURAL EVENTS

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Abstract

The opportunities of applying virtual reality technologies to the presentation of cultural events (musical concerts, city excursions, theatrical performances and others) in virtual reality devices are described in this work. In the article we analyze challenges that appear during shooting video 360° and their solutions as well as the solutions for the montage. The experience of shooting more than 50 different videos is generalized.

1. Introduction

At the present time virtual reality technologies and their applications have developed intensively [1]. Using these technologies for Arts and Culture [2] allows for a wide variety of opportunities due to providing the user with the effect of presence in the very center of cultural events. One of the most prospective approaches of creating content for virtual reality systems is the 360° Video Technology [3]. This technology allows the creation of panoramic videos with different grades of interactivity where the user can change an angle shot (a camera angle) of video accordingly to his desire. The video can be viewed through virtual reality headsets (for example, Oculus Rift [4]) as well as on a smartphone, via a special app when the user rotates the video "around himself" by moving his head (Fig. 1) or turning a smartphone. The video can be watched on computers also. In this case, the user manages the foreshortening by using a mouse or a keyboard.

Using the 360° Video Technology is actual especially viable in the field of education. This technology can be widely applied to education of experts in different fields, where presence in the center of actions is necessary for gain the experience. The 360° Video Technology allows the analyzing of teamwork during solving different tasks that leads to the quality of the educational process enhancement.

The panoramic video plays an important role for preservation and provision of access to cultural heritage. The technology provides the unique opportunity to see not only closed for public access archives of museums but also reconstructed historical monuments that were destroyed by time or circumstances (3D virtual reconstruction). As for

Fig. 1. Watching 360° through Samsung Gear VR

Fig. 2. The concert in the format of 'video 360°'

entertainment, viewers can visit biggest cultural festivals, "present" on the stage near favorite musicians or watch a theatrical performance from the royal lodge.

The project of development and applying of the 360° Video Technology to culture and arts has been realized in the Center for Design and Multimedia of ITMO University [5]. The high quality of content was achieved within the frames of the project [5,6].

2. The 360° Video Technology

At present video cameras for filming video 360° are only being developed. However, it is possible to use regular video cameras with special equipment and software for this purpose. One of the outstanding examples is the project 360Heros [7] that offers special rigs (video

Fig. 3. The shooting in the State Hermitage – 'The Peacock Clock' in the format of video 360°

Fig.4. The banner from the distance

gears) for GoPro cameras HERO 4. The amount of cameras dependent on the tasks in the rig is from 6 to 14 (the stereo version).

Moreover, several big IT-companies and electronic manufacturers have announced their own fully-automated solutions for shooting content for virtual reality: Google Jump + GoPro Odyssey [8], Samsung Beyond [9], Nokia Ozo [10].

The team of project "video360production.com" films 360° videos with the help of its own invention – the camera 360°. This camera provides spherical quality up to 24K and creates several video streams that are afterwards combined into one panoramic video with the help of a special sequence of algorithms developed by programmers. This approach provides a high quality product decreasing parallax errors in panoramic videos that is a

Fig. 5. The distortion of the blurred banner

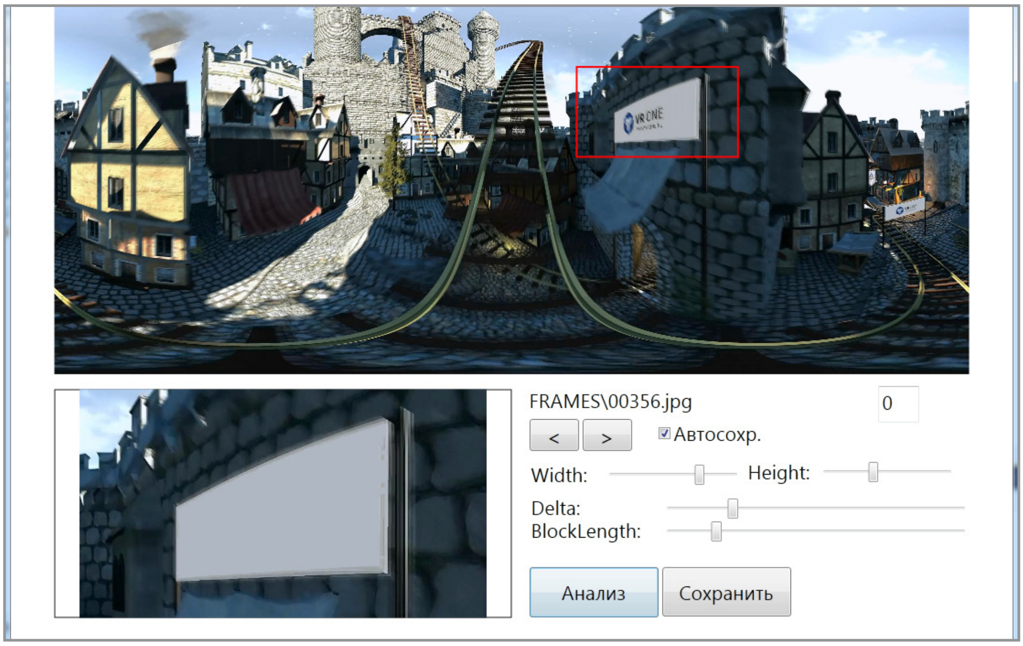

Fig. 6. The window of the program

complex issue to resolve. The “stitching” quality is the most challenging feature to maintain with the only help of the software. Often parallax errors can be eliminated only during the postproduction.

The team of project “video360production.com” unites experts from two fields - engineering (engineers, programmers, hardware and software experts) and art (stage directors, videographers). While one part of the team develops solutions for maintaining a high quality of video 360, the other part provides a creative approach to every case during the film production. Every video project requires not only a standard preparing (such as setting up lights, choosing the best camera angle, creating a scenario and a composition) but also individual approaches (unique for every case camera mounts, binaural audio recorders, and special ideas for video 360°) [12, 13].

Fig. 7. The workspace on the banners

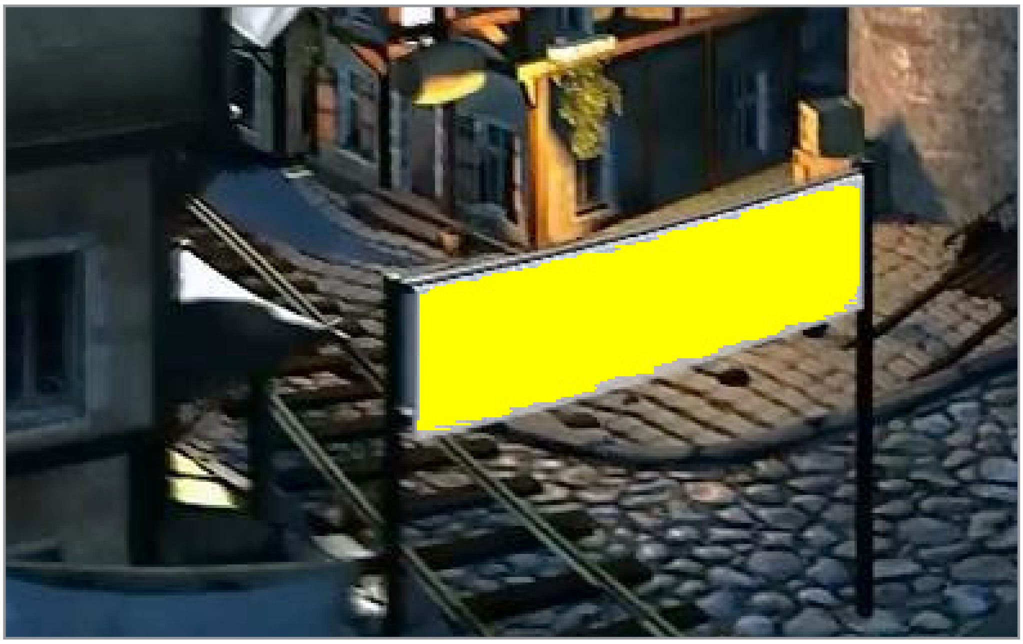

Fig. 8. Change of the background color

3. THE PRESENTATION OF CULTURAL EVENTS WITH THE HELP OF THE 360° VIDEO TECHNOLOGY

The team has filmed more than 50 different events for virtual reality glasses such as concerts, musical festivals, excursions in historical places, performances in theaters, different cultural events and technological processes. One example is the video 360° of the "Bravo" group concert (Fig. 2) [6, 11]. It was necessary to find a place where the camera angle was good enough but the device did not disturb musicians and moreover didn't attract the attention of the audience. The camera was placed in front of the stage.

The "technical" sound on stage is far from what is heard in the hall sound engineers combined the sound of a stereo microphone with studio recording. The quality of audio is rather high but the recording does not lose its liveliness, which means that while watching the recording, you can hear the audience sing.

The team of ITMO University has started the realization of the project 'The point of presence' with the State Hermitage. Within the frames of the project, the team will represent different events in halls of the museum with the help of the panoramic video (Fig.3).

All these projects and a great number of other cultural events, which were filmed with the help of the 360° Video Technology, are published in public access on the YouTube Channel [14].

4. The montage in the format of video 360°

The montage of static or dynamic objects in videos in the format of 'Video 360' is the challenge. The existing programs, which are widely used for the montage of 'normal' videos, cannot be applied to video 360°.

The team solved the following problem: it was necessary to 'clean' all banners in the video of an attraction, simulated with the help of 3D. There were some extra challenges (in addition to the usual problems - the high speed of a trolley, the complex structure of objects) – the non-typical image distortion (Fig.4). It means "bending" and stretching at the bottom and the top of the frame. The upper and lower parts of the frame are the poles of the sphere, stretched on a frame width.

From a distance the banner is almost rectangular (Fig.4). However, when 'the user' arrived closer to the banner it rounded up (Fig.5). An additional problem was the high rate of movement in some areas, the banner was blurred (Fig.5).

Using standard tools of tracking (for example, in After Affects) does not give a good result. It is difficult to capture the image (in this case, the banners) because of format of the video. Consequently, an insertion of the white background of the canvas banner is highly inaccurate.

The team has developed a program in an interactive style. The program may indicate an algorithm the starting point or an area to search the part of images, which should be replaced or deleted.

The sequence:

1. Modify video into a sequence of images accordingly to the frame rate;

2. Write an interactive program for C #/WPF. The program opens the frames of the original video, look in the defined by the user areas for objects, which must be replaced or deleted. Then the borders of this area is highlighted its borders and the program delete, replace or colored (depending of the task) the objects. The user can change the area as well as the parameters (the desired color, the size of the required area etc.) Moreover, the program should has ZOOM in order to work with small details;

3. If the algorithm works correctly, the user saves the processed frame and moves to the next;

4. The sequence of edited images is combined into a final video.

The program (Fig. 6) contains the following elements:

1. The current frame. The workspace, where the program searches for banners, is highlighted with the red frames;

2. The zoomed view of the workspace. The algorithm starts working automatically and immediately shows the result;

3. The settings panel, which contains the file name, a number of a frame, keys to the next / previous frame, the function "auto-save when switch to the next frame";

4. Width and height – an adjustment of the width and height of the red frames;

5. Delta, BlockLength - the parameters of the algorithm.

How the algorithm works:

1. The program search in the defined area (Fig. 7) for points that differ from the set "background" banner color for no more than 'Delta'. 'Delta' can be changed, thereby narrowing or expanding the number of colors;

2. The program analyzes rows and leave only those points that form a continuous group (the length –BlockLength) long, and two points in each row – the initial and the final (highlighted red). A border of the banner is created with necessary thickness BlockLength;

3. Straight lines connect blocks with the background color (marked in yellow – Fig. 8).

5. Conclusion

Multimedia Technology 360° is a new and perspective technological direction, which allows the creation of high quality innovative content for virtual reality in all areas of human activity (culture, arts, education, science, public administration, etc.).

As for the perspective of the entertainment industry, especially the creation of feature films as the video 360°, a number of new approaches and methodologies of creative and technological processes are expected to be developed in order to provide the user deeper immersion into a video content at a new virtual and interactive level to have more holistic perception.

References

1. Brooks F.: What's Real About Virtual Reality? Journal IEEE Computer Graphics and Applications archive Volume 19 Issue 6, 16-27 (1999)

2. Magnenat-Thalmann N., Papagiannakis G.: Virtual Worlds and Augmented Reality in Cultural Heritage Applications, http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.106.9743

3. Technology of 360° Panorama Videos, http://www.360-degree-video.com/

4. Oculus Rift, https://www.oculus.com

5. Centre for Design and Multimedia, ITMO University, http://cdm.ifmo.ru/

6. Project Video360production, http://video360production.com

7. The project 360Heros http://www.360heros.com/

8. Google Jump + GoPro Odyssey https://gopro.com/odyssey

9. Samsung Beyond http://thinktankteam.info/beyond/

10. Nokia Ozo https://ozo.nokia.com/

11. The Bravo band http://www.bravogroup.ru

12. Borisov N., Smolin A., Stolyarov D.: Multimedia 360° - new technology for arts and culture // EVA 2015 SAINT PETERSBURG. Electronic Imaging & the Visual Arts INTERNATIONAL CONFERENCE, St. PETERSBURG, JUNE 24th–25th, 2015 Conference Proceedings. SPb ITMO University, 18-31 (2015)

13. Borisov N., Smolin A., Stolyarov D., Trushin V.: Multimedia 360° technologies in art, culture and cultural heritage // SGEM International Multidisciplinary Scientific Conferences on Social Sciences and Arts, 189-197 (2015)

14. Video360Production.com youtube channel, http://youtube.com/video360production

RUSSIAN DIGITAL ART IN XXI CENTURY. NEW PARADIGM OF CONSERVATION

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Abstract

Theoretical approaches used in the field of museum preservation requestedreconceptualizing in the second half of the XX century. Mixed media, inclusion of time and site context, liberation from the material – these artistic achievements characterize contemporary art and require the fundamental revision of the tradition of conservation. Russian media art is in the risk zone as the local museum community has not raised a broad discussion concerning this issue yet. Developments realized by certain institutions are isolated and are not known in the professional field. This report examines the concept of an inter-institutional platfor for future preservation of media-born artworks.

INTRODUCTION

This article discusses one of the most challenging questions that were posed to the museum conservation in the second half of the XX century by new forms of art. Media art has become one of the leading trends in contemporary art, representing the broadest branching of directions: net-art, video art, post-internet art, time based and site specific art, digital poetry, sound art, biotech art, software art, performance, interactive art, etc. All these can be called "variable media art", introducing media as something inherently unstable that appears in an extreme and the newest way in different times.

So, for example, Dada practices in the 20s of the XX century can be attributed to media art, as dadaists have essentially moved away from the use of traditional materials. And further, each new artist-to-audience data transmission channel captured new areas, breaking into fields of science and technology. In fact, this article discusses artistic greatest achievements "oppose the commercialization of art, museumistic aestheticisation and the self-satisfied enjoyment of art to the conscious application of mediation strategies taken from museum practice." [1]

Of course, the traditional tools of the museum conservation turned out to be inapplicable to the storage of these new forms of art, where meaning is derived from the relationships between specific environment and time, characteristics of newer materials, interactivity. "New media artwork must keep moving to survive." –points Jon Ippolito, Curator of Media Arts at the Guggenheim.

NEW DIGITAL ART CONSERVATION . QUESTIONS AND CHALLENGES

At the end of the XX century in order to keep media art museums had to acquire new vocabulary, tools, create new repositories, where basic conditions as temperature and humidity had to be supplemented with new options because essentially digital art exists regardless to a non-digital, three-dimensional reality. Traditional inventory of artworks has become insufficient. Chemistry has ceased to be a fundamental science in the conservation of art. Restoration departments had to include besides technical art-historians, conservation scientists and conservators, also engineers, programmers, and even biologists (bio-art, soft tissue engineering).

The changes affected strategic, methodological, and even ethical fields, because the idea of "stabilizing" laid in the foundation of conservation ethics is contraindicated to the unstable time-based art. The basic postulates of conserving ethics had always been specific ideas that had meaning in any conservation work with the traditional forms of art – and they had a touch of versatility. Here, as the essence of conservating theory of the XX century, we can point main ideas, articulated by Cesare Brandi in his influential essay Theory of Restoration [2] published in 1963, at a time when a lot of avant-garde media art practices had already affected the world artistic process:

1. The unacceptability of creative conservation;
2. The preservation of the patina;
3. The reversibility;
4. To plan conservation always and exclusively on the basis of the specific needs and condition of the object in question.

Turn that occurred in the following decades, demanded new approaches, which had to be contrary to universal approach to any cultural heritage conservation – "art as Artifact" to "art as Information" turn, because, as we mentioned, most traditional preservation approaches pursued the goal of stabilization of the museum object. Hermetic preservation means death for media art. In relation to media works, we can discuss different levels of obsolescence:

- Obsolescence of the storage media
- Obsolescence of the information code

On the one hand, for example, optical discs are stored from 30 to 100 years, and audio and video tapes– only 10-20 years. This is the physical degradation dimension. And on the other hand, we can say that in fact works of digital art exist only in the form of encoded information (in C / C ++, Java, HTML, Python, Processing, Max / MSP and others). And obsolescence equally concerns hardware and software. Media is always instability and development. There is always a new media, being created right now. And often the artist himself appears in the role of creator, which always leaves the conservator and curator of a step behind.

The life of a work of art – it is a progression of physical states. In case of digital art there is a continuing risk of communication breakdown either in linguistics or in technological dimension with the previous state, and it is essential to fix as detailed as possible a wide range of information, gather multimedia documentation of creative processes and artistic intent. Referring to the classification proposed by Laurenson [3] the aspects of needed information are as follows:

1. Requirements – statements that identify the capabilities and characteristics of a digital artwork. This is the conceptual foundation for what has been created.

2. Architecture/Design – an overview of software that includes the software's relationship to its environment and construction principles used in design of the software components. Typically a system's architecture is documented as a collection of diagrams or charts that show its parts and their interconnections.

3. Technical – source code, algorithms, and interfaces are documented. Comments may be embedded within the system's source code and/or parts of external documentation.

4. End User – manuals are created (e.g. static documents, hypermedia, training videos, etc.) for the end-user, system administrators, and support staff.

5. Supplementary materials – anything else related to the system, including: legal documents, design histories, interviews, scholarly books, installation plans, drawings, models, documentary videos, websites, etc.

One missing criteria will be discussed further.

Storage and exhibiting of even the most basic single-composition works of video art require a large number of solutions. Some of them relate, for example, to the digitization process that swept the world institutions with the advent of digital technology as the alternative to analogue. Actually, this process leads to one degree removal from original artwork state which becomes replaced by its "digital documentation" that is also unstable in its own ways.

To illustrate the complexity of the issue we may point some questions which could be posed by conservator to artist: How much time must pass before the next upgrade and re-transfer of information? Every custodian has to decide the fate of the original medium – should it be still preserved while not potentially used anymore? And if yes, for how long? Should the software be shipped to exhibitions or it can be simply transferred? If yes, can artwork be shown simultaneously at various exhibitions? Whether the work presupposes the possibility of Internet broadcasting? Whether conservators should reproduce, and if so, in which form and by what means the characteristic clicking sound of the home projector, which created a special sonorant experience when playing movies or any other "peculiar properties" of the old device?

There are also natural difficulties associated with the accelerated development of technology. For example, the "The Legibile City" (1989) by Jeffrey Shaw was designed on Silicon Graphics computer which went out of production in 1997. Curators of ZKM Centre for Art and Media in Karlsruhe Germany which owned this work realized that it will be extremely problematic to keep work in this form, and it was decided to port it over to a Linux-based operating system. "This process took several years and was done in conjunction with the artist's wishes" – notes Bernhard Serexhe, the principal curator at ZKM's media museum with world's largest collection of digital art. [4] In any case, the transition in both classical and modern conservingtraditions is undesirable and specialists resort to it in the exceptional cases when threat of disappearance of the artwork is real (by the time of transmission the museum had only 10 of these computers left in reality). And conservators team has to try all possible ways to remain the artwork as close to its original state as possible. So as Bernhard Serexhe also notes in his interview, "Curators at ZKM foster connections with local dump managers who set aside old computers and audio visual machines in exchange for cigarettes". Here, we can use the terminology of Glenn Wharton [5] to classify the conservation metho-dology connected to new media:

- Refreshing (transferring onto new storage media)
- Migration (upgrading equipment and software)
- Emulation (duplication on entirely new media).

It is important to remember that besides software the work of Jaffrey Shaw also included environmental and interactive elements – there was a projection, a stationary bicycle, so the audience could cycle through giant 3D letters in three different cities, and the speed of pedaling influenced the speed of words appearing. Therefore, the work actually involves much more nuances for the subsequent exposure. A lot of artworks created since the 60s besides media included also environmental and temporal context, a performative action, viewer's reaction and own "montage". Let us examine in this context the work by Dan Graham "Body Press" (1972) (film installation 2 films, 16mm, color, silent, synchronous projection on 2 opposite walls 8 min (loop) Edition 2/3 + 1 A. P. Performers: Susan Ensley, Ed Bows) [6]. Two performance artists stood in a mirrored cylinder, backs to each other and shoot their reflections on the video swapping camera at the end of each full camera turn around one's axis. Video broadcasted on two opposite walls, between which the audience was located in very narrow space. In this work, each viewer chooseshis own channel of identity based on a distorted image, sliding in front of the camera. This work includes video, which essentially changes its function from the channel of the ephemeral perception to classical performance documentation. Exhibition of this work on the two opposite walls as the loop passed the indirect experience of one-time action occurred in 1970 during video performance. Here documentation replaces actual artwork. The inclusion of this work in the exhibition requires the exposure of additional materials (at least the artist's instructions) and special exposure conditions that minimally reflect the spatial (very large size on two opposite, but very close, room walls) and time (the films are projected at the same time on two loop projectors), dimensions of the video installation. In case of this particular work and many others, created by such artists as Steina and Woody Vasulka, Nam June Paik, Bruce Nauman, Gary Hill and others, artworks conservation as well as possible exposure demands multimediality. Thus, the work of Dan Graham contains photo and video documentation, as well as text and drawings. This is a classic example, but since then media art has moved much further, requiring more sophisticated knowledge and information carriers to save not only the actual physical embodiment and to reproduce time and space context, but also to preserve the meaning of the work.

"TACIT KNOWLEDGE" AS THE MISSING CRITERIA IN TECHNICAL APPROACH

A lot of works were produced specifically for exhibitions or festivals; some of them are principally inseparable from the context of space in time and continue their existence only as documentation. Other artworks can be reproduced in different conditions by the artist himself, or by assistants, curators and technical staff with the use of detailed instructions.

One of the most famous examples of "artist's instructions" are schemes and specifications that artist Soll Levitt has left to his aides in order to reconstruct his minimalist installations in different exhibition spaces.What is interesting and paradoxical, the circle of "initiated" assistants is limited. It means that in spite of the existence of rigor and detailed instructions, despite the fact that the reproducibility of the materials (plastic frames) remains possible and easily accessible with a modern industrial complex, still the artist established some "Order" that preserves the tacit knowledge about his art.

Here we look at the history of traditional art and see the example of the artist's workshop. In the classic tradition the high status artist needed a team of assistants, who were engaged in all rough work (from the preparation of a canvas to painting of a landscape), and sometimes completely replaced the hand of the artist. Workshop by Hans Holbein the Younger lasted about a hundred years, paintings by masters of the studio date back for decades after his death. That is to say that in addition to the formulas and techniques his team of assistants adopted his style, his vision – tacit knowledge. While working after his sketches and plot outlines, they have earned a place in the art history, in collections with the label "Hans Holbein the younger (studio of)". This tacit knowledge is an essential element in the documentation media works – it's the same knowledge that Soll Levitt's assistant and medieval artist's studios preserved. Western preservation tradition realizes a long and active research of strategies to fix artistic intent, leaving a minimal clearance for the subsequent conservator's interpretations. Such practices as an artist interviews, artist-conservator-curator collaborative discussions, conservation workshops take place in the conservation departments in the US and Europe. "Tacit knowledge can also be transmitted in other ways, for example by following the process of (re)creation or (re)installation of a work of art". [7] The museum serves as an assistant of the artist and curator and the custodian have to combine also the responsibility of media researcher and of curator.

"INHERENT VISE" OF EPHEMERAL MEDIA ARTWORKS

A lot of artworkshave been created as a fundamentally non-museum, ephemeral, critical to any form of museum conservation. In this case, the artist's intent becomes the cornerstone for the custodian and curator. As in the case of such "inherent vice" that leads to immediate death of the artwork, for example, a work of Gustav Metzger, who invented the term "auto-destructive art" [8]. He created his artworks as fundamentally impossible to save. A lot of media artists conceptualized the ephemeraty and temporality of their works, as the digital culture in comparison with the material one seemed unsteady from its beginning, it was revolutionary anti-capitalist and anti-consumer. Finnish pioneer of electronic music and art Erkki Kurenniemi pointed in his notes that any of his works could "be destroyed with a single command DELETE file" [9].

Ephemeral works call into question the legitimacy of any preservative activity realized institutionally. They express one of the fundamental paradoxes of modern storage - the main achievements of contemporary art contradict the process of their integration into the global cultural values. “The art market can be unstable and based in reputation or trend, but the museum collection is more long-term in its valuation and adds a more concrete character to the valuation process”. [10] Since the non-inclusion of media art in museum collections entails the exclusion from the collecting process in general, and therefore, the reduction of exhibition experience, that leads to decline of social and artistic impact. “Conservation, preservation, and documentation are tantamount to collecting, which is the primary tool of valuation within the art market”. [11] Due to lack of infrastructure and disunity of the professional community, many works of media art, created in the late XX – early XXI centuries have simply disappeared. Fragility of material and media is the “inherent vise” of great amount on artworks realized in last decades.

RUSSIAN EXPERIENCE

A great number of research projects and conferences devoted to the problems of modern storage is carried out by European and American institutions. Conservators of Tate Modern, MoMa, Whitney Museum, ZKM, Centre Pompidou and others who work with the most advanced technologies and methodologies have become world stars of international art community.

Russian media art is in the risk zone as the local museum community has not raised a broad discussion concerning this issue yet. Developments realized by certain institutions are isolated and are not examined enough in the professional field. In Russia there are no collectors interested in media art (to be fair it is necessary to note that in Europe there are few people involved in collecting of specifically media art that is for sure not comparable to the amount of digital artworks produced annually). Only few artists have a chance to sell their works to collectors and these few artists, what is significantly, take part in international festivals and exhibitions. Artists, curators and collectors do not produce new communication strategies to enhance the culture of media art preservation. At the same time media art is represented by the works of dozens of Russian artists. Media art appeared in Moscow in the mid-90s. At that time the first Russian media artists: Olga Lalin, BulatGaleev, Alexei Shulgin, GiaRigvava, Dmitry Bulnygin, Alexei Isaev, Andrey Giants and others, appeared. Now a new generation of artists is active, they operate with the new post-internet aesthetic and high technology. While digital technology is becoming inseparable from daily life, we must take steps to preserve digital culture. As Professor Monika Fleischmann puts it, “If we do not support electronic art and media culture, then we lose our cultural life while the domination of technology.” [12]

We need to create an inter-institutional platform that will contain the amount of the necessary information:

1. Conceptual foundation, basic characteristics;
2. Charts, diagrams showing software construction and relations either within it or environmental;
3. Source code, algorithms with comments;
4. Video guide and documentation, possible references for technical support;
5. Installation and design plans, documentation of previous exhibitions, models, video and photo;
6. Interviews, scholarly texts, archives, plots;
7. Institutional interactions documentation – texts and interviews of curators, system administrators, conservators, assistants, collectors, etc.

The project of Marayke van Varmerdam “Time goes by” - the first exhibition entirely dedicated to video art in the Hermitage -openedon November 20, 2014 at the Hermitage. This exhibition organized by Department of contemporary art started a series of projects aimed to acquaint visitors with the classic examples of the genre and the works of young artists. In 2016 the Pushkin Museum organized the Department of new media. We can say that now contemporary media art in Russia is finally gaining institutional positions. However, storage and collecting of Russian media art is an exotic experience – in the agreement on the acceptance of a work in the museum’s collection you can still find short-sighted point: “Installation of the work during the subsequent exhibition can be performed only in the presence of the artist.” We are in a unique position when, using the experience of western colleagues, can build a whole system of preservation of Russian media art, each new type of digital art, new technology used by artists, the works, which have no analogues both in the technical sense and by its effect on the audience, appearing in the future. That is why we should work with the concept of Metadata platform which can expand to include new categories as they appear. We should use the developments of such initiatives as: The Variable Media Questionnaire project by Forging the Future; DOCAM (Documentation and Conservation of the Media Arts Heritage) - an international research alliance, one of the extremely important innovative system;the Digital Repository for Museum Collections (DRMC) developed by MoM, which consists two parts: Binder, a Web application to manage the preservation of digital materials, and Archivematica, a state-of-the-art digital preservation system that analyzes digital materials and packages the results in obsolescence-proof text [13].

The start of inter-institutional dialogue requires three areas of development:

1. Preparation of the analytic base;
2. Preparation of technical base;
3. Popularization and work with collectors, foundations, curators, museums.

With the current rate of development of technology we can expect that in a hundred years the whole of modern storage system will enter the category of media archeology. We cannot hope that in the vaults of a museum we can keep all needed versions of hardware and software. The civilizational process lies is the accumulation and classification of human experience. In 2016 we have no right to stand aside from the global process of analysis and conservation of digital culture.

REFERENCES

1. Lizzie Frasco, "The Contingency of Conservation: Changing Methodology and Theoretical issues in Conserving Ephemeral Contemporary Artworks with Special Reference to Installation Art", University of Pennsylvania, p. 10, 2009.

2. Cesare Brandi, "Theory of restoration", Istitutocentrale per ilrestauro, Nardini in Roma, Firenze, 2005.

3. P. Laurenson, "Authenticity, Change and Loss in the Conservation of Time-Based Media Installations," Tate Papers, Autumn, (2006). Retrieved March 15, 2011 sited by Francis T. Marchese, "Conserving Digital Art for the Ages", Media in Transition 7: Unstable Platforms: The Promise and Peril of Transition, Boston, MIT, May 13-15, 2011.

4. Bernhard Serexhe's interview for BBC by Jen Copestake "Saving digital art from an early death at the ZKM museum", URL: http://www.bbc.com/news/technology-24585267, 22 October 2013.

5. Glenn Wharton, "The Challenges of Conserving Contemporary Art//Collecting the New: Museums and Contemporary Art", ed. BruceAltshuler. Princeton and Oxford: Princeton University Press, 2005.

6. The artist's instruction and illustration are presented at Generali Foundation Collection (GF0001860.00.0-1997). URL: http://foundation.generali.at/en/collection/artist/graham-dan/artwork/body-press.html#.V0ysYpOLR8c

7. IJsbrand Hummelen & Tatja Scholte,"Sharing knowledge for the conservation of contemporary art: changing roles in a museum without walls?", Studies in Conservation, 49:sup2, 208, 2004.

8. Read more: Gustav Metzger, "Auto-Destructive Art: Metzger at AA", London, October, 1965.

9. Writing and Unwriting (Media) Art History: Erkki-Kurenniemi in 2048, eds. Jussi Parikka and Joasia Krysa. Cambridge, MA: The MIT Press, 2015.

10. Jessica I. Hodin, "Can museums collect new media art? The need for a paradigm shift in museum conservation", Art Business Sotheby's Institute of Art – New York/University of Manchester, p. 3, 2009.

11. Ibid.

12. The statement by Professor Monika Fleischmann Institute of the media communications, Germany, at the Moscow Mediakongresse in 2000.

13. For further information read official press-release, "MoMA Unveils Open-Source System to Revolutionize Preservation and Analysis of Its Digital Collections", URL:http://press.moma.org/2015/09/moma-unveils-open-source-system-to-revolutionize-preservation-and-analysis-of-its-digital-collections/, 23.09.2015.

VIRTUAL CONCERT HALL - AN IMMERSIVE EXPERIENCE AT THE KONZERTHAUS BERLIN

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Abstract

This paper describes the prototype for an immersive virtual reality application developed and implemented in cooperation between the Konzerthaus Berlin[1], the research group Information and Communication Systems INKA[2] at HTW Berlin and NUST Windhoek[3]. The prototype combines two approaches to display a pre-recorded concert using the Samsung GearVR[4].

The first approach gives a clear view to the concert and enables its users to freely look in 360° around them. To mediate structure and interaction in music a new approach was chosen to represent the concert. This approach combines the 360° video with animated graphical elements to show the different themes in music and the interaction between the various groups of musicians.

[1] http://www.konzerthaus.de

[2] http://inka.htw-berlin.de

[3] http://www.nust.na

[4] https://www.oculus.com/en-us/gear-vr/

INTRODUCTION

In the past, immersive video installations were mostly realised by multiple projector setups [1]. Also expensive and specialised hardware is needed for the filming process [2] like the Fraunhofer UHD panoramic cam.

In cooperation with the Konzerthaus Berlin, NUST Windhoek and the research group INKA created an immersive virtual reality (VR) prototype for presenting classical concerts in a consumer head-mounted-display (HMD) recorded with consumer video devices.

Since the first version of the Oculus Rift was successfully crowd funded [5] in 2012 the topic of virtual reality (VR) is suddenly raising a lot of attention, despite not being a new concept. The concepts of AR and VRgo back to Ivan Sutherland, who introduced the first HMD in 1968 and developed the first concepts for AR and VR[3]. Especially in recent years a new trend in the fields of HMDscan be observed. HMDs are no longer specialized and costly hardware; they are a mass product suitable. However, the huge

[5] https://www.kickstarter.com/projects/1523379957/oculus-rift-step-into-the-game/description

success of the Oculus Rift might be the cause for the variety of VR-capable HMDs developed by different companies that are being released in the past two years.

APPLICATION CONCEPT

Together with the Konzerthaus Berlin the research group searched for a concept for an application that binds new visitors to the institution and excited for classical music while also being a new experience for regular visitors to enjoy. Already at the beginning of the project the parties involved agreed that the application should present a recorded concert to visitors. However, it should not be a normal recording thereby. For recording form a 360° movie is shown. This particular movie is offered to visitors through a HMD for playback.This special form of recording and playing offers a unique immersive experience, which gives the feeling of being in the middle of concert.

As the size of the camera used for recording the concert was relatively small, it was placed above the musicians. This granted the benefit that even regular visitors could enjoy the concert from a whole new point of view and added significance to the filming in 360º, as points of interests are located all around the users.

The application was split into two modes, and a menu to select one of them was added. The first of these modes is called “360° Musik”, which simply displays the recorded video as an immersive experience. The second mode is called “360° Musik plus” and is meant as an expert mode that contains the augmented information.

The expert mode tries to visualise the different, repeating themes in the symphony as varying musicians plays them.

This way a user may follow a melody from the lead violin to the violas that follow up one cadence later. These themes are visually represented by small animations that are displayed above the respective musicians in time. Overall four different themes were prepared and visualised throughout the play.

Finally, a last addition was made to the prototype, that allowed to stream the view of the current user to a standard monitor, as the content experienced through a HMD is only visible to the current user it is ineligible to attract passers-by.

FILMING AND EDITORIAL PROCESS

The filming took placeduring the Jupiter Symphony by W. A. Mozart on May 8th, 2015. To record the video for the VR-space, a special hardware was needed. For the recording, the solution from “360 Heros” was taken. This device is a rig that creates fully spherical 3d-video using 12 GoPro cameras[6]. The sphere is divided into six sectors. Two cameras do create the stereoscopic part of the 360-degree movie record for each of these sectors.

After viewing the footage, the post production was done. With the software Video Stitch Studio[7] the individual movies of each camera were combined to create an equirectangular video. A common example of equirectangular projection is a standard world map, which maps the surface of the world (a sphere) onto orthogonal coordinates.To create the video as a stereoscopic 360º video, the videos were processed for the right and left eyes separately with the software.

After the process of stitching, the videos were combined to one Top-and-Bottom video to enable stereoscopic viewing on the VR-device. These videos were compressed in height and arranged one above the other. Because the audio tracks are recorded separately with the standard concert hall equipment, the final video track had to be synchronized with the externally recorded audio track. Finally, some colour and brightness corrections have been made. In order to view the final video with the chosen VR-device the video was limited to a maximum width of 4096 and a maximum height of 2048 pixels. To achieve an optimum ratio between the file size and the display quality, different bit rates were tested in the compression of the video.

APPLICATION DEVELOPMENT

The project was realised using the Samsung GearVR, which is a not a typical HMD. To make the device a HMD, a Samsung smartphone is plugged into the glasses. The smartphone serves as image output, data storage and processing unit for displaying the content on the HMD.

To develop applications for the GearVR different approaches are possible. Besides a software developer kit (SDK) published by Oculus[8] and native Android-based development, the Unreal Engine[9] and Unity[10] include support for VR devices.

For this project Unity was used. The setup of the scene in Unity is user-centric and based on multiple spheres. These spheres are placed around the users point of view and are rendered using a shader that paints their textures on the inside of the spheres instead of outside. The 3d-scene uses a simple lighting model where textures are rendered unlit. This means they are unaffected by light sources and shadow and are simply rendered in a specific colour which is derived from the respective pixel of the footage of the live concert. As all rendering and other computations are calculated on the smartphone, complex lighting calculations were avoided, as they are not necessary. Especially regarding the video texture specular lights and shadows are not only unnecessary but also contra-productive. Shadows might imply depth perception in the wrong places, as the two dimensional texture is actually representing a three dimensional space.

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6 http://shop.360heros.com/3DH3PRO12-360-VIDEO-360-HEROS-3D-360-VIDEO-p/3dpro12.htm

7 http://www.video-stitch.com/

8 https://www.oculus.com/en-us/

9 https://www.unrealengine.com/

10 https://unity3d.com

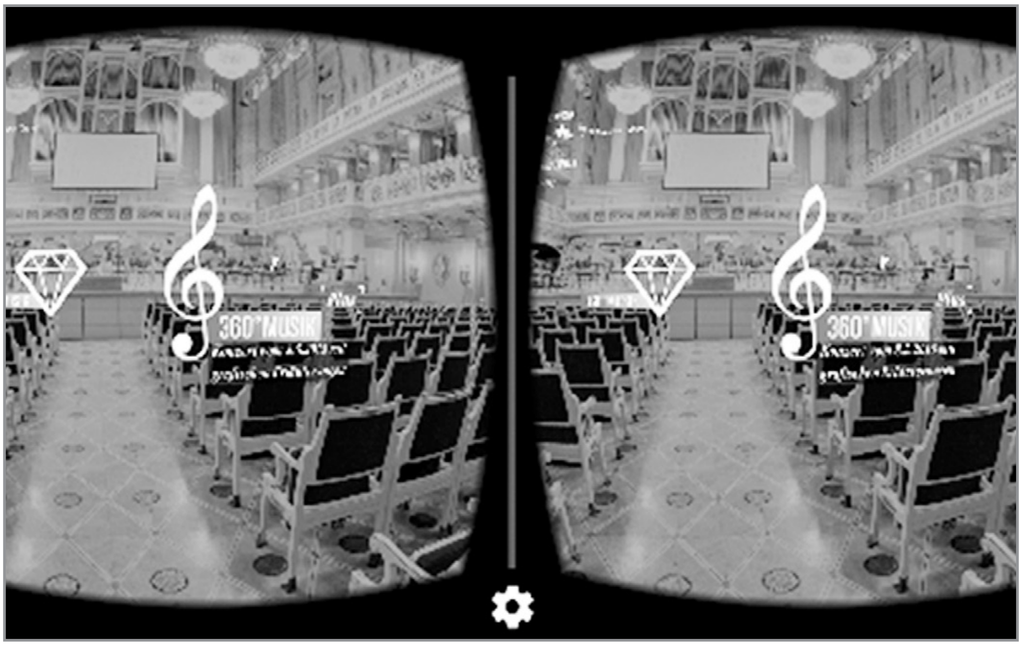

Fig. 1. Concert Hall view with menu on a HMD

Another important feature is the ability to stream the current view of the VR-application to the additional display, so that passers-by can see what the current user is experiencing. This could be implemented by setting up a video stream that sends the currently rendered content of the smartphone to a second computer. However, this would consume most if not all system resources of the smartphone and would negatively influence the overall system performance and is not viable for a real-time application. So the team decided to develop another approach.

Instead the smartphone only transmits the current orientation of the player object in the 3d- scene and a signal to start and stop the video synchronously. This orientation is updated whenever the user rotates its head and can be send to a second computer using only a fraction of the computation power and amount of data needed to stream the current view as a video. The second computer has a copy of the smartphones application, modified to be controlled using the networks input instead of a local controller.

INTERACTION DESIGN

With the addition of a menu that allows the selection of one of the two modes, the application needs to realise an interface to enable interaction. This interface needs to consider the fact that the user of a HMD does not see his surroundings nor his hands or other body parts. However, the GearVR includes a small touchpad that is elevated to ensure that a user can find it. This touchpad was used to enter a selection in the menu. The menu itself was realised as two billboards floating in front of the user in the virtual reality. Using the head tracking of the HMD a single ray cast in the direction of the users view is used to determine whether he is currently looking at one of the two billboards (see Fig.1).

If the ray does hit one of the billboards and the user does tap on the touch pad on the GearVR, the menus disappear and the selected mode is started. This approach was sufficient for the first prototype, but was refined in the later stages of the project. User tests revealed the difficulties for first time users to locate the touchpad on the GearVR. In addition to the existing solution a second way to select a menu entry was implemented: The second the ray cast from the users field of view hits one of the billboards in the virtual space, a circle is being build clock-wise and after a certain amount of time (in the current implementation it is set to 2 seconds) the circle is complete and the selection is locked in. The circle disappears and is reset every time the ray is moving away from the billboard.

To interact with this prototype, we also tried different other approaches for interaction in our research group. To control the behavior of media playback, gesture and speech recognition were implemented to the prototype and tested with small groups of students. In contrast to the implemented method of interaction in the menu selection, these forms of interaction are seen as an indirect interaction. The menu is visual part of the application and the interaction takes place directly by selecting one of the icons of the graphical representation. By directly interact with elements of the application this type of interaction is referred as direct interaction.

For the gesture-based interaction, an additional smartphone was used as remote control. Based on the metaphor of a pen, the gestures are drawn in the air with the device. To control the behavior of the media playback in

Fig. 2. Concert with Augmentation

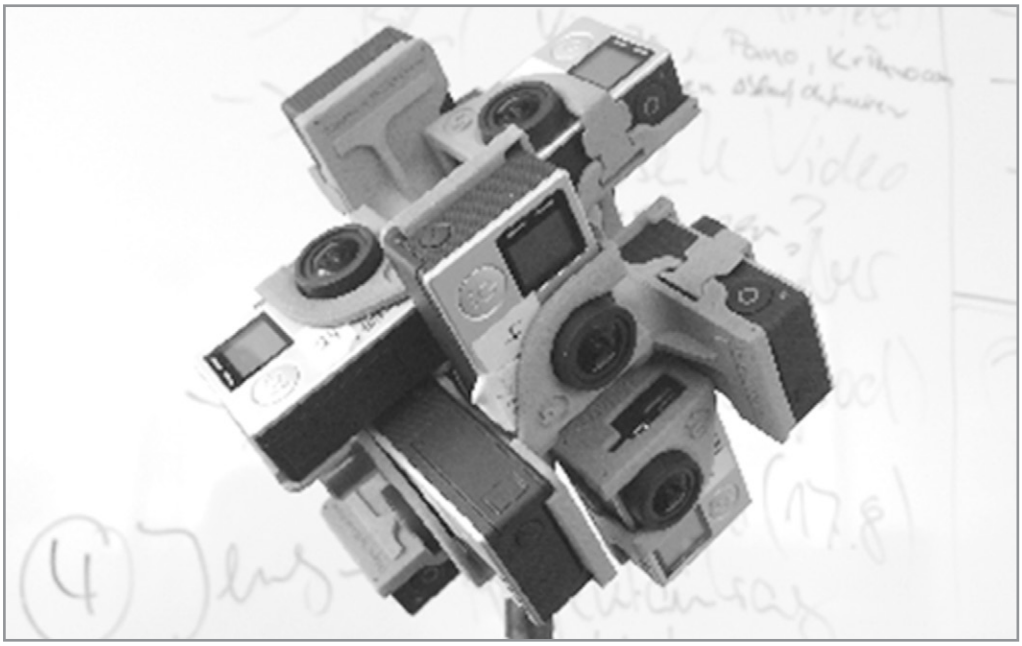

Fig. 3. Rig with mounted GoPros

the application, five gestures where implemented. These gestures are a circle to stop the playback, a left and right arrow to skip in time in the media playback, the letter “S” to stop the playback and the symbol for checkmark to make confirmations in the application. As shown in table 1, all gestures could perform with a high probability of successful detection.

The lower detection rates in some characters are based on the fact that the drawn characters differed by the test candidates greatly from the training data. Also the gestures must be known so that the user can apply them correctly.

As the second type of interaction to control the media player, the speech recognition was tested. The speech recognition represents the same level of control possibilities. For testing a keyword list of possible phrases were used as language model. The recognition rate of the voice commands is highly dependent on the keyword list and

Fig. 4. Distorted video and projected video inside a sphere

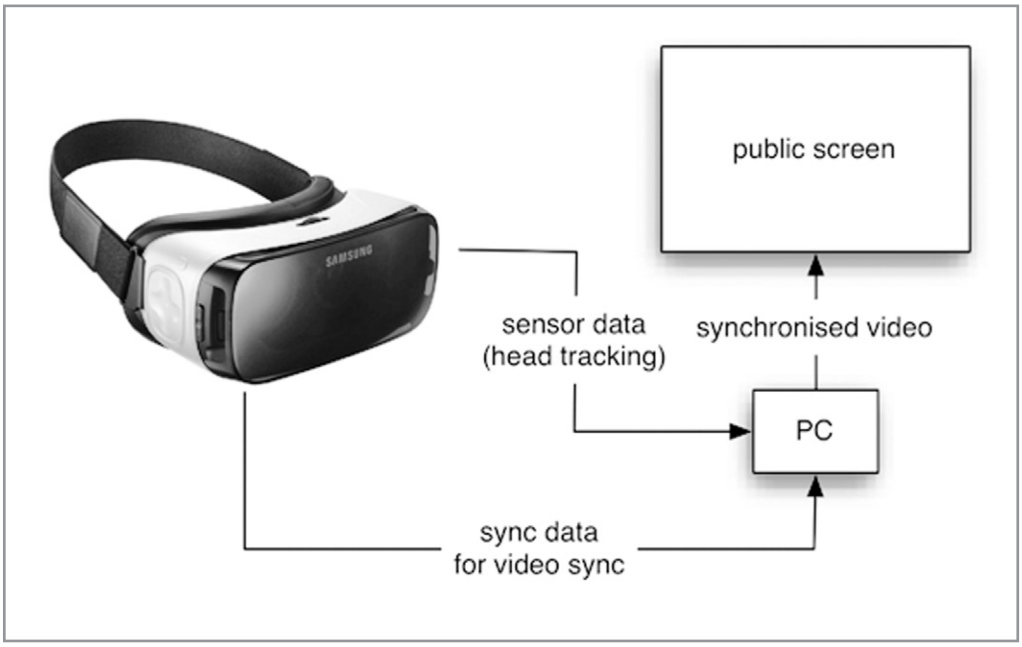

Fig. 5. Overview of Architecture of the Application

the pronunciation of the respective user.To make matters worse, that ambient noise can distort the detection greatly.

The use of the presented alternative methods of interaction is partly subject to other restrictions. To draw the gestures in the air, the required space for this process must be ensured. Especially through the use of HMD and the lack of view of the environment it must be ruled out that furnishings and other visitors are not affected by the use of gestures. Also the social acceptance plays an important role. The social acceptance refers to how a user feels while performing certain interactions and how this interaction is taken of around standing people [4]. If an interaction in the method of execution unpleasant or even painful, the user will not perform this. The same applies to the voice control. When around standing people are disturbed by the voice commands or the user has the feeling to disturb, the interaction is not used [4].

	Gestures (Symbols)				
	circle O	checkmark	left arrow <	right arrow >	letter S
correctly recog-nized	96%	100%	92%	88%	80%

Tab. 1. Recognition results of usability test with Smartphone-Motion-Controller

WEBPAGE

In order to present the project to the public and visitors who are interested in getting an impression of the virtual concert, a complementing webpage was developed and linked to the Konzerthaus homepage[11]. The responsive single page website is divided in sections and gives an overview of the purpose and usage of the VR-application.

Following a short introduction to the project, four selected themes of the application's expert mode „360° Musik plus“ are explained by their visual and acoustical representation. Each animation visualises a different theme of the Jupiter symphony („Das Motto“, „Das Fanal“, „Das Tänzerische“, „Lyrisch“) by using corresponding graphical symbols, which were synchronized with the equivalent theme's sound file. Thus, and by a displayed short textual definition, an improved insight into the structure of the composition is provided.

In the section “Impressions” there are two types of videos implemented to illustrate the functionality of the VR-application. The first video allows to look in every direction of the 360° Video (3d-scene) and the user is able to view the groups of musicians or the conductor, who are performing the concert. The second video guides through the 3d-scene in a scripted sequence and is specially produced for the website. The line of sight is focused on the relevant area and is supported by the visualised theme symbols.

For the implementation of the 360° videos on the stationary website a plugin (KRPano panorama viewer[12]) was used. Due to some difficulties playing the video on mobile devices, the final implementation of the 360° video is made with the provided Youtube[13] plugin.

[11] http://demo.inka.f4.htw-berlin.de/~konzerthaus/

[12] http://krpano.com

[13] http://www.youtube.de

The section „Making Of“ contains a slideshow, which illustrates the work process of the 360° video recording and software implementation as well as the physical installation in the Konzerthaus vestibule.

PHYSICAL INSTALLATION

In addition to the application on the GearVR a physical installation was developed and hosts the whole application in the foyer of the Konzerthaus Berlin. This installation was built for several reasons. The most important reason was to be a kind of platform for the developed application, so that this construction attracted attention at the Konzerthaus.

In addition a physical installation was necessary to give the user a fix and secure position in the foyer and protect the user in case of cyber sickness or also called motion sickness. I.e. many users had feeling to fall. One reason is, if a user wears the HMD, the user can not see its own legs or body. Also the selected position of the camera (3 meters above the floor) contributes to this feeling. The most important part of the physical installation is a handrail. The user can hold and fix his position. The user tests show that the installation gives to the users a feeling of safety.

In order to charge the VR-device in an elegant manner, an induction charger was installed in the physical installation. The GearVR needs only to be placed on a dedicated and marked place to charge the battery of the device wireless.

For more details and results of the project and study please refer to [5] and [6].

ACKNOWLEDGEMENTS

This paper describes the work undertaken in the context of the projects SIGNAL and IKAROS hosted by the research group Information and Communication Systems INKA that is generously funded by the European Regional Development Fund (ERDF).

Fig. 6. Visualisation of different themes

Fig. 7. Induction charger with applied Gear VR

REFERENCES

1. O. Bimber. 2006. Multi-projector techniques for real-time visualizations in everyday environments. In ACM SIGGRAPH 2006 Courses (SIGGRAPH '06). ACM, New York, NY, USA, , Article 4 . DOI=http://dx.doi.org/10.1145/1185657.1185799

2. K. Tan, H. Hua and N. Ahuja. 2004. Multiview panoramic cameras using mirror pyramids, in IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 26, no. 7, pp. 941-946, July 2004. doi: 10.1109/TPAMI.2004.33

3. Ivan E. Sutherland. 1968. A head-mounted three dimensional display. In Proceedings of the December 9-11, 1968, fall joint computer conference, part I (AFIPS '68 (Fall, part I)). ACM, New York, NY, USA, 757-764. DOI=http://dx.doi.org/10.1145/1476589.1476686, URL: http://design.osu.edu/carlson/history/PDFs/p757-sutherland.pdf

4. C. S. Montero, J. Alexander, M. T. Marshall, S.Subramanian. 2010. Would you do that?:understanding social acceptance of gestural interfaces. In Proceedings of the 12th international conference on Human computer interaction with mobile devices and services (MobileHCI '10). ACM, New York, NY, USA, 275-278. DOI=http://dx.doi.org/10.1145/1851600.1851647

5. F. Pfeiffer, J.Reinhardt, K.Remes, S. Schöbinger, J. Sieck, M. Thiele-Mass. Combining Virtual and Augmented Reality Approaches for a Project with the Konzerthaus Berlin.In: Proceedings of Culture an Computer Science: Augmented Reality, Berlin, 2016, vwhVerlag, 2016, ISBN: N/A

6. T. Wienrich, J. Reinhardt. Motion- and Speech-based Interactions for Virtual Reality Applications realised with Head-Mounted Displays. In: Proceedings of Culture an Computer Science: Augmented Reality, Berlin, 2016, vwhVerlag, 2016, ISBN: N/A

RESPONSIVE WEB INTERFACES: PROBLEMS AND SOLUTIONS

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Abstract

One of essential aspects of modern web development is the analysis of a spectrum of up-to-date hardware and, as a consequence, of user's perception and problems of appropriate display of web resources on various platforms. Issues of creation of responsive web-interfaces are considered with the focus on technological pre-requisites and implementation opportunities.

INTRODUCTION

Web-design may rightfully be considered as an interdisciplinary sphere of web development where technological opportunities, art stylistics, and user's perception are inextricably connected.

The development of hardware, standards of formal description of the structure and external display of web documents and software not only makes the process of web development more effective but also makes it possible to propose new functional capabilities and services to the user, which requires new interface solutions from the developers. It should be mentioned that many current modern interface elements are products of rethinking of early ones that are practically forgotten now.

It may be ascertained that certain trends have formed in web-design recently, which may be identified in the course of analysis of newly created resources and of old web-sites subjected to complete functional and visual re-work.

It seems quite useful not only to define those trends but also to trace the sources of modern interface solutions and point out the technological aspects which have promoted their implementation. The article presents issues related to the concept of responsive design.

RESPONSIVE WEB-DESIGN

The concept of "responsive web-design" [1] was proposed in 2010 as a concept of web-interface development aimed at adequate display of a web-sites on all devices and all platforms. Afterwards the idea was developed, with focus made on the necessity of integrated consideration of platforms and browsers in the whole variety of their versions. In this vein, the term adaptive web-design is used in a number of English sources for extended interpretation.

In a way, the uniquely fast distribution of mobile devices was a prerequisite for the success of the responsive design concept among developers and its support in implementation of web-resources. The audience appraised the new opportunities of access to resources practically immediately, which made the developers look for new solutions.

The necessity of serious re-think of previous standard approaches to web-interface design undoubtedly was motivated by the desire to ensure comfortable and effective execution of user tasks. No matter how resource holders formulate their tasks, their ultimate target is to attract and keep users. Commercial web-sites are aimed at profit earning, non-commercial ones (nonprofit organizations, professional associations, pilot projects, etc.) are interested in provision of information and solicitation of cooperation. Anyway, accessibility of a resource for any platforms and convenience of use thereof under standard conditions becomes an important task for the developer.

Considering the concept of responsive web-design in a broad sense, one should mention the necessity of the development of cross-platform and cross-browser approaches to a wide range of issues which do not have final solutions yet. These are the problems related to display of video and audio content by using browser facili-

Fig. 1. Fragments of interfaces of the web-sites of the State Hermitage Museum and the Louvre Museum. 2000

ties, problems of presentation of interactive 3D objects and scenes, etc. Analysis of those issues typical for resources with complicated media content is beyond the scope of this article and will be published later.

Essential aspects of web-interface development relevant to any modern resources will be considered below.

Problems of adaptation of web-page layout to the display area

The problem of adequate display of a web-site on devices with different screen resolution was considered long before introduction of mobile devices. Many developers who worked in the middle and the second half of the 90s (at least in Russia) remember the effect of occurrence of new monitors: it was quite an event. At first, the process seemed to be evolutionary and quite controllable. Occurrence of new resolutions could be accompanied by respective designer's adjustments: at first 600x480, then 800x600, 1024x768…

Further increase in the resolution of monitors forced the developers to limit the width of the main content block to keep the composite equilibrium and ensure comfortable perception of text. Generally by 2000, the width was around 700-800 px, later (and up to now) – 960-1200 px.

The following examples are fragment of interfaces of the largest two museum resources of 2000 (data from the archive http://web.archive.org) obtained at 100% scale of browser on a typical laptop computer with horizontal resolution of 1600 px. The fragments are cut from top to bottom, but the frame allows to assess the ineffective use of space and, what is most important, the inconvenience of perception. Surely, modern browsers allow to perform page zooming, but the image quality decreases, the composition is disturbed, and the text becomes excessively large when the page is zoomed in.

The following rapid improvement of monitors and increase in the resolution made the developers look for solutions which allow to use the space effectively, without disturbing the composition integrity.

Due to the wide spread of mobile devices, the problem became paramount, because very low resolutions (so law that a lot of popular resources duplicated their content in order to create "mobile web-versions" which were mirror copies in content but designed in a conceptually different way) became important again. Currently a trend is observed for an increase not only in physical dimensions, but also in resolution of screens of smartphones and similar devices.

The following table (taken from the statistics resource http://ru.screenresolution.org) gives an idea of the current range of resolution.

Thus, the range of current resolution makes one think of implementation of dynamic adjustment of the web-page layout to match the current screen resolution and, moreover, the size of the display area (since the user can decrease the size of the browser window on a large monitor).

The dynamic adjustment of the web-page layout to match the display area involves a whole spectrum of solutions: the size of blocks and their relative positions may be changed, separate elements may be hidden or displayed, font parameters may be changed, etc.

No.	Screen resolution	%
1	1366x768 HD	18.44%
2	1920x1080 16:9 HD 1080	16.53%
3	1280x1024 5:4 SXGA	7.41%
4	1024x768 4:3 XVGA	5.56%
5	1600x900 16:9 HD+ 900p	5.39%
6	360x640	4.93%
...		
15	320x568	1.26%
...		
2895	21120x3240	0.001%
2896	60300x10800	0.001%

Tab. 1. Extract from the screen resolution statistics table (2016)

Basically, implementation of a responsive layout may be performed by using the JavaScript software scenario (the respective solutions were proposed in the first decade of 2000s on the basis of the resize event processing), however this approach seems to be quite awkward and ineffective.

New opportunities were open for the developers thanks to the long-awaited support of basic capabilities of the CSS 3 standard, especially @media rules, by most of browsers.

Prerequisites of responsive solutions

The capability of flexible sizing of web-page elements has become a serious step on the way to responsive design.

Basically, a lot of problems of implementation of designers' ideas resulted from setting of a fixed width for the main content block (CSS property width). Indeed, it is impossible to propose an "ideal" width for a wide range of resolutions in such a case. An empty space on wide monitors, when appropriately styled, does not affect the impression and does not cause discomfort when the resource is used. On small monitors, however, horizontal scrolling appears! This situation is absolutely inadmissible, as it sharply reduces the utilization efficiency.

It is noteworthy that properties which make possible to set not only fixed values of width and height, but also maximum/minimum values, i.e. the value range, were defined as early as in CSS 2 (1998). The property max-width (maximum width) proved to be the most useful one.

Setting of the maximum container width limit prevents the content from occupying the whole free space and thereby ensures appropriate compositional solution. When viewed on devices with low resolution (or when the size of the browser window is decreased), the content covers 100% of the window width, which at least ensures comfortable viewing.

Generally the percentage setting of the width of enclosed blocks is used jointly with the max-width property. For example, 50% ensures arrangement of two blocks in a row, 25% - four blocks in a row. By changing the window size, one can observe quite "responsive" behavior of the inner structure elements in absolute majority of modern resources.

One should separately mention the "responsive" images and image sliders which are currently of immediate interest. For such elements, it is sufficient to set the width 100% of the container width (width: 100%) and define the height automatically (height: auto). When the container size is changed within a preset range, the width of the image will change respectively, and the proportions will remain the same.

Pitifully, so natural and effective solutions only gained widespread 10 years after the CSS 2 standard had been presented. Presumably it was in the period from 2006 (issue of MS Internet Explorer 7) till 2009 (MS IE 8).

Practically all versions of MS IE browsers give rise to rightful unfavorable criticism from developers, however support of adequate display of a web-site, if only for relatively new versions, is mandatory. The user audience of MS IE is quite wide; therefore the issue of versions to support the next capabilities of HTML and CSS shall be a signal for developers.

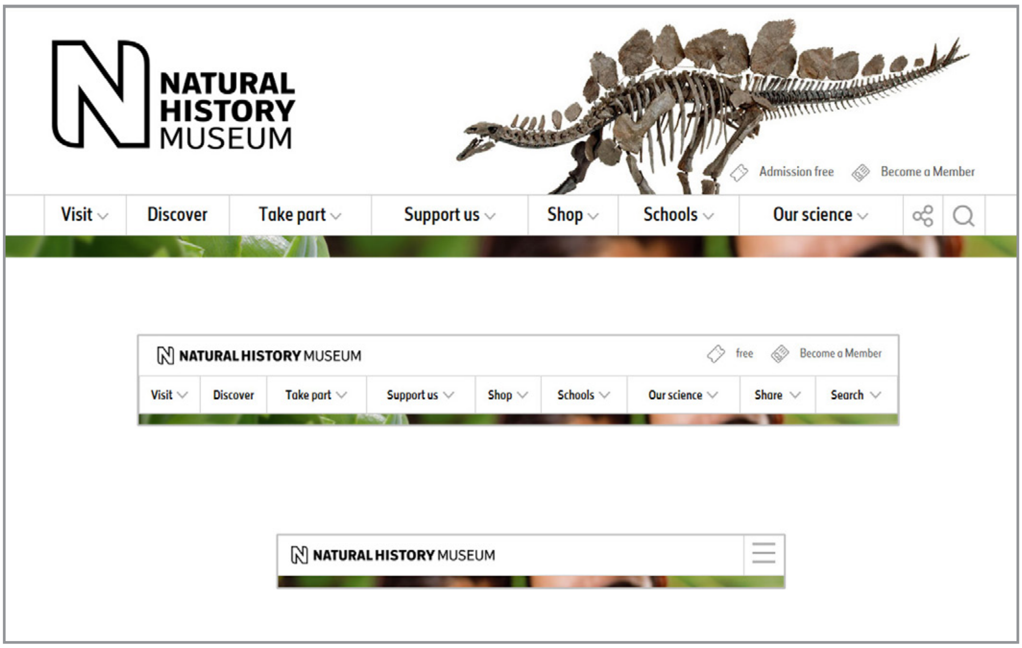

Fig. 2. Header of the web-site of the London Natural History Museum
at different widths of the display area

Use of CSS 3 @media rules

The @media rules were introduced in CSS 2 and ensured the capability of variable setting of parameters of display of individual web-page elements on devices of different types (screen, printer, speech synthesizer, etc.). These capabilities are still important, e.g. for setting of printout parameters. Indeed, in such a case it hardly makes sense to print out decorative elements, navigation, ad blocks, etc. They are hidden by the respective formal CSS declarations.

The CSS 3 extras which make it possible to define dozens of output characteristics [2] became a real breakthrough in the sphere of responsive design implementation. These are the width, the height, and proportions of both the device screen and the display area; screen resolution; color parameters; orientation (important for mobile devices); etc.

Any, even a most sophisticated, design drawing is implemented on the basis of CSS descriptions which set the color, size, relative position, margins, visibility or invisibility, particular positioning, etc., for elements of a document. The capability of changing those parameters depending on characteristics of the viewing device by using the facilities of the same CSS produces a desirable effect.

Let us give an example of the rule which ensures responsiveness of interface for the following hypothetical situation. Imagine a horizontal main menu which should vanish in case of narrow width of the display area (say, 720 px), making room for the typical icon – “hamburger” the activation of which results in appearance of a differently designed menu.

The HTML code may look as follows:

```
<nav id=”menu”> … </div>          <!—horizontal main menu -->
<nav id=”menu-mini”> … </div>     <!-- icon -->
```

Possible CSS code with the @media rule:

```
menu-mini { display: none; }          /* icon is hidden by default */
…
@media all and (max-width: 720px) {
    menu { display: none; }           /* main menu is hidden */
    menu-mini { display: block; }     /* icon is shown */
}
```

Of course, in nontrivial cases CSS declarations are substantially larger, as the particularities of display of a wide range of elements have to be taken into account. Below please find an example of a seemingly simplest interface of the header on the web-site of the State Hermitage Museum (https://www.hermitagemuseum.org). However, several elements are used here, which change their visibility and position.

We would dare say that commencement of active application of @media rules for implementation of responsive layouts can be dated back to 2011, where MS Internet Explorer 9 was issued.

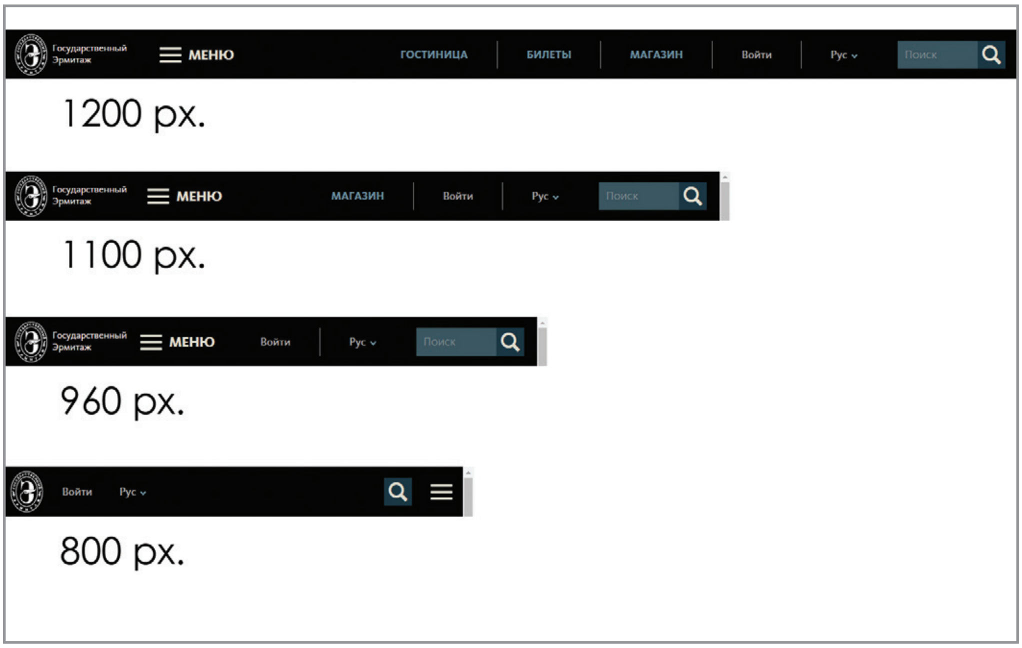

Fig. 3. Header of the web-site of the State Hermitage Museum at different widths of the display area

Adaptation of elements at web-page scrolling

The response of web-interface elements to a change in the scrolling position is beyond the scope of responsive design tasks, and this seems to be unfair.

First, a large part of effects have not decorative, but strictly functional purpose. An elaborated strategy of processing of a scrolling position may substantially improve the user's perception, increase the work speed and draw attention to active elements of a web document. Of course, improvement in efficiency will be noticeable for pages with extensional content.

Second, from the point of view of software scenario, adjustment of the page look due to a change in the size of the display area and modification at scrolling belongs to the same class. Namely, they are processers of two global events of the browser: resize (change of the window size) and scroll.

Standard solutions at software processing of a scrolling position: hiding of secondary elements; appearance of elements promoting effective navigation; fixation of essential elements with respect to the window borders.

It is assumed that the user initiates scrolling when he or she is reading the content attentively (then the secondary elements should be hidden) or, on the contrary, trying to find a way around on the page (in this case, additional navigation element may help). For example, when scrolling down, it is appropriate to hide decorative and low-priority elements of the header. The main navigation or a search query input field may be fixed close to the upper border of the window. An alternative solution may be to hide the extensive navigation block at scrolling down and fading-in thereof at scrolling back.

Additional navigation elements which give a signal on the current section and allow moving either to another selected section or to the beginning of the page are quite effective for long pages with complicated structure.

EXPERIMENT: BRIEF ANALYSIS OF MUSEUM WEB-SITES

To illustrate the advantages of responsive design, I would like to give a number of positive examples of web-resources from the sphere of culture and arts. It was decided to make a small selection of sites of the most famous museums. To the author's surprise, half of them have no signs of responsiveness. Moreover, formal descriptions of external display of page elements use a fixed value of container width. As noted previously, such a basic approach prevents from provision of further flexible solutions. Problems were also found in responsive web-sites: incorrect display in MS Internet Explorer 9. Undoubtedly, this is an obsolete and disappointing version, but all typical solutions may be implemented for it.

Having added the web-site of the London National History Museum which is technologically well designed, though it does not fall into the original category "culture and arts", we obtain the following result.

Web-sites without responsive elements:

- the Russian Museum (http://rusmuseum.ru);
- the Capitol museums (http://www.museicapitolini.org);
- Pompeii (http://www.pompeiisites.org);
- the Tretyakov Gallery (http://www.tretyakovgallery.ru);
- Musée d'Orsay (http://www.musee-orsay.fr);
- the Louvre Museum (http://www.louvre.fr).

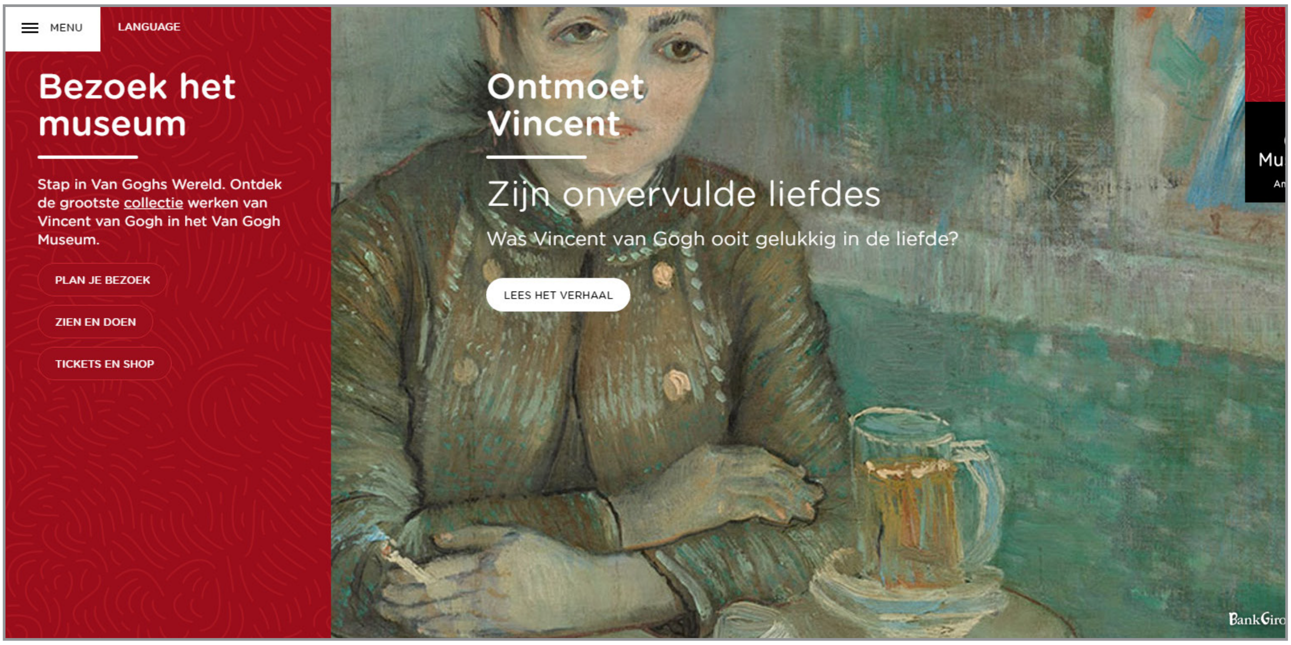

Fig. 4. The Van Gogh Museum site: view in Google Chrome, Mozilla, Opera, Safari, Yandex browsers

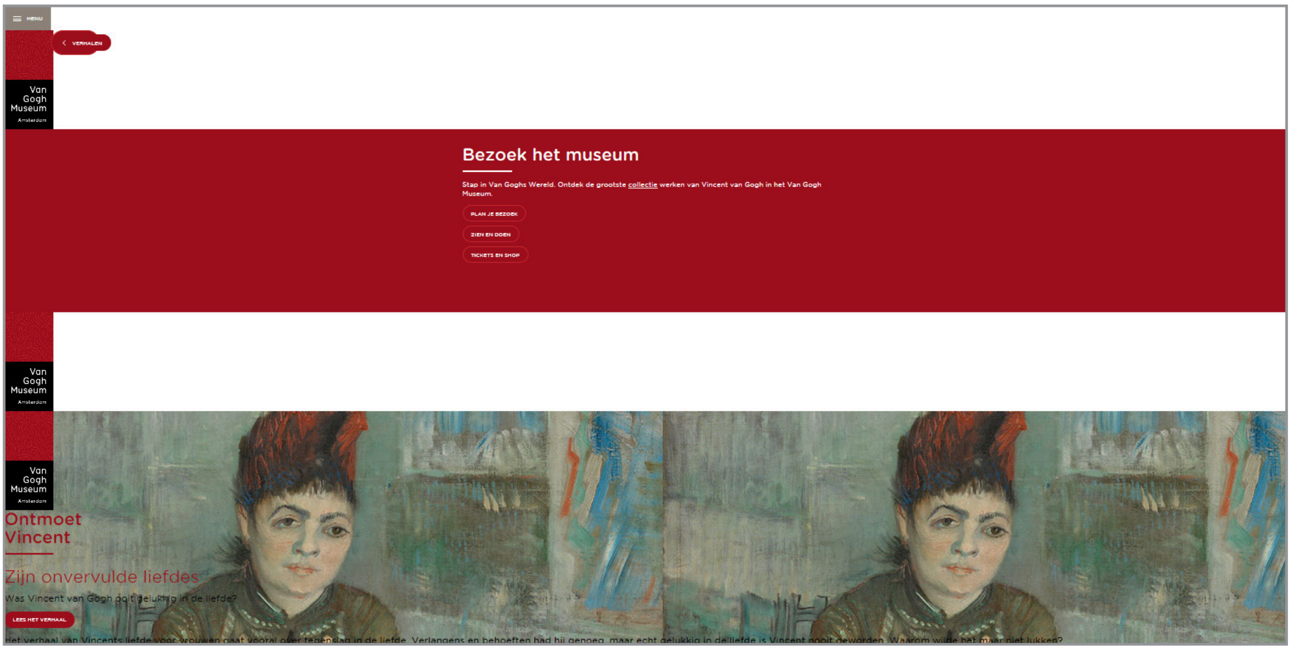

Fig. 5. The Van Gogh Museum site: view in MS Internet Explorer 9

Responsive web-sites incorrectly displayed in MS IE 9:

• the Metropolitan Museum of Art (http://www.metmuseum.org);

• the Van Gogh Museum (http://www.vangoghmuseum.nl/en);

• State museums of Berlin (http://www.smb.museum).

Responsive web-sites supporting MS IE 9:

• Tate Britain (http://www.tate.org.uk);

• the State Hermitage Museum (http://hermitage.ru);

• the London Natural History Museum (http://www.nhm.ac.uk)

It is difficult to understand the cause of out-of-date technological solutions. Most of web-sites considered were subjected to re-design a mere several years ago. The possible reason is that museums have mobile application in addition to web-resources. Indeed, users of mobile devices often prefer to download a special application. However, unlike the previous "mobile web-versions", mobile applications are not a "mirror image" of the main web-site and present incomplete content.

Hopefully, further positive actions will be taken for comfortable display on a wide range of devices.

CONCLUSION

Implementation of effective interfaces remains one of the key objectives of web development. The development of hardware and complication of functionality proposed by web-servers is a serious motivation for statement of new tasks. Improvement of formal languages and facilities of web development often runs ahead of hardware progress.

The main challenge for developers is the delay in support of new standards by a number of platforms and browsers. Successful and solicited solutions often remain at the concept level for years. Nevertheless, the process of creation of responsive web-interfaces has got out of crisis and has good future prospects.

REFERENCES

1. Ethan Marcotte. Responsive Web Design. (May 25, 2010) URL: http://alistapart.com/article/responsive-web-design (accessed date: 12.05.2016).

2. CSS3 @media Rule. URL: http://www.w3schools.com/cssref/css3_pr_mediaquery.asp (accessed date: 12.05.2016).

VIDEO 360: WHEN THE THEATRE COMES. THE EDGE BETWEEN ART AND TECHNOLOGY

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Abstract

Alexandrinsky theatre has been closely collaborating with IFMO University since the New Stage had been built and represented to the city in 2013. These two institutions had a number of joint projects. Most of them were implemented during the New Stage opening, in particular, virtual stream, software support and IT elaborations.

The New Stage of Alexandrinsky Theatre forms part of the modern theater complex. It is the best technically equipped theatrical venue in Russia. The New Stage disposes modern machineria and provided with the multimedia equipment. The venue placed in the former workshops in the very heart of St. Petersburg, within a walking distance from the Theatre's historical building. Main purpose for extension of the oldest national stage in Russia was to create new, technologically advanced platform for development of the experimental, creative research directions. High-tech transformer stage, professional media center, rehearsal rooms, all these make the New Stage the most attractive venue for filmmakers, musicians, researchers of the innovative technologies in the field of contemporary theater.

While the repertoire of the main stage is dedicated mainly to the classical drama in interpretation by the Russian and foreign directors, the four venues of the New Stage are opened to the innovative development of contemporary theater, dance, music and literature. New formats of theatrical performances suggest a challenge for their representation in media and demands to find new ways for their archiving.

In so-called "classical" theatre we used to deal with the front oriented mise-en scene, where the audience and the actors separated by the means of stage limits and "forth wall".

Fig. 1. The New Stage. View from the outside

Fig. 2. The New Stage. View from the inside

Of course, this standard model does not work exactly so, even in traditional drama theatre. (There are plenty examples when the spectators placed right on the stage or actors comes to the audience). The provocative repertoire of the New Stage all the more counters this convention. Here we deal with the extremely complex situation when there is no spatial division between doers and watchers. The most representative case of such position is the performance "Telluria" after the Vladimir Sorokin's homonymous novel staged by Marat Gatsalov in 2015.

In "Telluria" audience is surrounded with the stage set and the actors play among the rows. The stage set has a panoramic structure, where the simultaneous action permanently happens all the performance long.

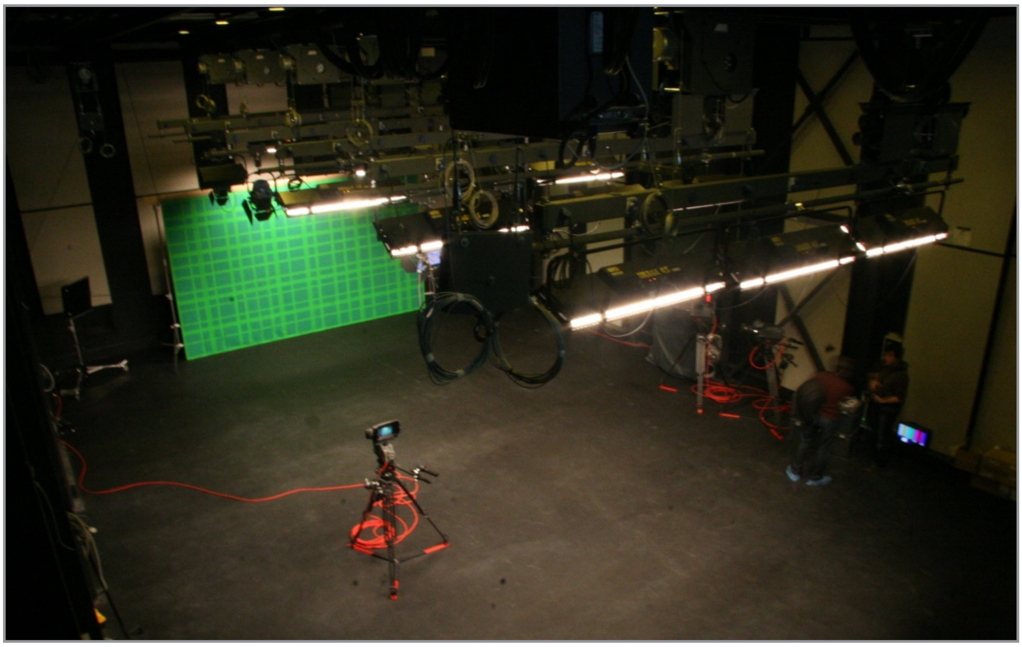

Fig. 3. Multimedia studio of the New Stage

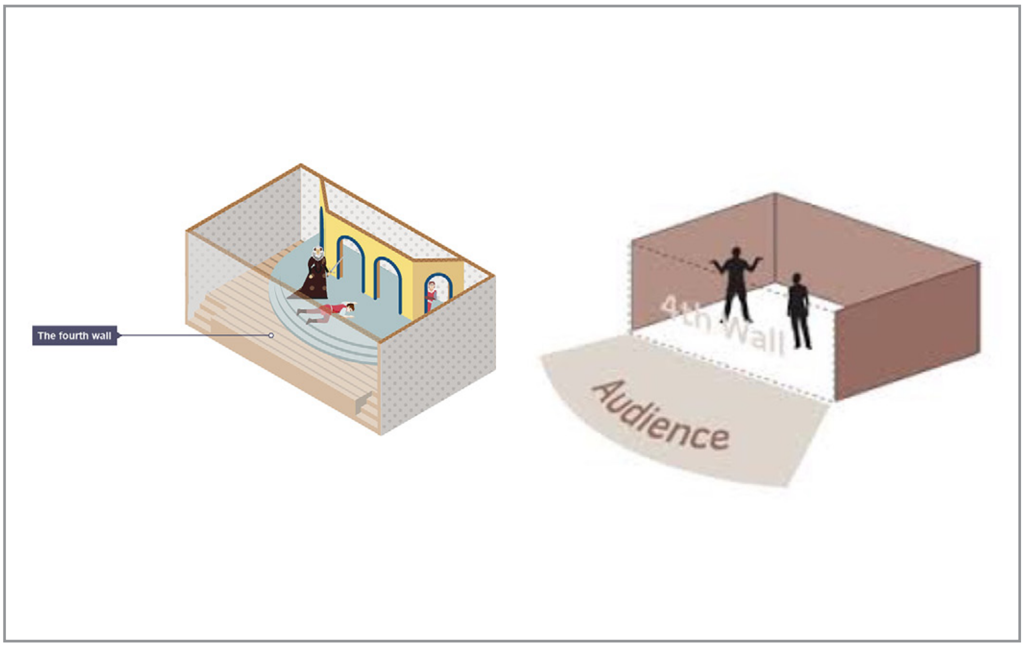

Fig. 4. The forth wall

Spatial nature of the performance suggested the idea to test the new elaboration in video technology – immersive video 360 degree.

Video 360 became more or less familiar multimedia technology for the wimps during the last couple of years. Nevertheless, it mostly associated with the game industry. People learn about video 360 as a part of augmented reality media presented as a sort of entertainment by pushing recreational companies.

The New Stage of Alexandrinsky theatre together with the IFMO University decided to think bigger and initiated the project “Theatre 360” which was supported by the Ministry of Culture. The thing is that the most part of repertoire of the New Stage is dedicated only for the particular venue. Therefore, there is no opportunity to perform their somewhere else. The goal was to elaborate new ways of representation modern theatrical art for a wider auditorium, using the latest multimedia technologies.

Fig. 5. “Telluria” by Marat Gatsalov

Fig. 6. “Telluria” by Marat Gatsalov. A screen from the video 360

The initial idea of the project was to film the whole performance “Telluria” by the means of 360 degree video technology. The creative group, leaded by Yuri Didevich from The New Stage and Denis Stolyarov from IFMO used a rig with the GoPro Cameras and placed them in a heart of the mise en scene.

As a result, the creative group successfully filmed the trial 360 video version of the performance. However, the crew faced with some difficulties during the process of filming. In particular, Yuri Didevich noted: “Performance record in video 360 format needs a plenty of preparation. For the successful realization of such projects a deep knowledge of the specifics of the technology is very important. You need to know its abilities and limitations. During the experiments we found that it is difficult to record contemporary performances using the technology 360 degree due to the fact that the camera set has an extremely low dynamical range”.

Fig. 7. “Telluria” by Marat Gatsalov. A screen from the video 360

The first attempt to make a full version of the performance in 360 brought creative group to several practical conclusions, which will be useful for further work in this field:

1. Filming video 360 needs a special light score. Not always original light score of the performance is appropriate;

2. It’s impossible to start filming before you write a precise plot for the future production. The low dynamical range of the rig sometimes require to change original mise en scenes;

3. The whole cycle of production for full version of performance in video 360 format approximately takes from 1 to 2 years;

4. Audience reception of innovation product produced in the edge of art and multimedia technology may be unpredictable. The audience should be prepared for reception.

Section 2.
Digital Cultural Heritage & Virtual Museums

INNOVATIVE APPROACHES TO PROMOTING OF TOURIST ROUTES THROUGH DIGITAL NARRATIVE

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Abstract

Digital storytelling is an up-to-date effective tool capable of presenting tourism products by innovative means. It offers series of exciting possibilities, which can capture the attention of potential tourists and influence the process of decision-making. The paper deals with various approaches to combination of the art of storytelling and interactive and immersive technologies for tourist routs promoting.

INTRODUCTION

People have been traveling from the earliest times, and, whatever their motives may be, they are, in some way or another, related to the exploration of the world in its dynamics and diversity, and to the acquisition of new experience. Therefore, narrative, as a so-called window to the individual human experience, as an instrument for interpreting or attaching the meaning to reality, is a powerful tool for new destinations and tourist routes promoting.

Over the last years, the capabilities of digital storytelling have been used more and more frequently in the sphere of tourism [1], which is logical, since “the travel and tourism industry has had to adjust much faster than other industries as digital, mobile and social has transformed consumer behavior and led to the emergence of the ‘always-connected’ traveler” [2].

Digital storytelling, that, according to the definition of Carolyn Handler Miller, uses “digital media platforms and interactivity for narrative purposes” [3], allows users (potential tourists) to interact actively with the content, even participate in its creation, which has a positive impact on the involvement, and fosters a long-term relationship between the ultimate consumer and the tourism services provider. Today the demand for this new form of storytelling is the highest among “digital natives”, who cannot imagine themselves without interactive forms, because people today interact with other people and with information by means of computer, the Internet and mobile systems, on a daily basis.

The purpose of this paper is to show how tourism industry can use the benefits of combining the art of storytelling with interactive and immersive technologies, such as web-based technologies, VR and Augmented Reality, mobile devices, etc., in order to draw the audience's attention to tourist routes. In this paper we also thoroughly analyze two graduation projects for the sphere of tourism, which have being created by the students of the Graphic Design Institute of SPGUPTiD (Russia, Saint-Petersburg) under the guidance of the author of this article.

NEW POSSIBILITIES FOR TOURISM PROMOTION

Among different tourism promotion means the Internet is the most effective one. Websites, blogs, Internet-ads, social media, information resources, etc. – these are the tools for convincing the clients to choose this or that tourist route. The competition that exists in the World Wide Web stimulates the search for and use of new methods of promoting tourism products, as well as new marketing vehicles. Digital narrative that combines the art of storytelling with interactive and immersive technologies can be one of the innovative methods which allows tourist routes advertising in a new form. `

Web-based narratives arrange video, audio, rich infographics, texts, and photos into stories which the majority of interactive media is based on. The interaction between user and multimedia content is the central focus of web-based project experience. This interaction implies not only control over the navigation, but also the user's participation in content creation. The user content is an important factor which should be considered as a mean of digital storytelling. The content may be of various nature: video or pictures, audio or texts, and it can be easily implemented into stories through social media platforms (Vkontakte, Facebook, Twitter, Instagram, etc.).

Immersive storytelling and virtual tourism

Immersive technologies in the digital storytelling can operate differently. The easiest way to give users the feeling of presence is to use in the digital narrative spherical 3D panoramas (or 360-degree photographic panoramas), where various elements, such as video, photos, 3D models, text, music and interactive maps, are integrated. Digital narrative project can be built entirely on the basis of immersive panoramas, linked together by interactive surface and transitions.

The world of traveling and tourism is becoming more and more "occupied" with virtual reality technologies which are becoming more and more sophisticated and available. By now, virtual reality technologies have finally caught up with the users' expectations. Due to the recent emergence of innovative VR platforms, devices, and mobile solutions (for example, Oculus Rift, HTC / Valve Vive, Sony Playstation VR, Google Cardboard, and Microsoft Hololens) virtual reality can provide a better sense and impression of what the customer is buying. With VR apps and 360 video it has become possible to involve the audience and encourage it to interact with your tourist route.

Virtual environments, integrated in the cultural context, which are often called "virtual heritage", offer potential tourists an opportunity to gain the experience of interacting with virtually reconstructed historical places (in 3D format). In its turn, 360 video also provide immersive possibilities for virtual tours undertaking in a wide range of environments. The combination of computer graphics and 3D modeling enriches the narrative, created with the use of spherical camera, by illustrating the objects which are hidden not only physically, but also due to the passage of time. Many reconstructions of cultural heritage objects are accompanied by stories about events and people related to a given place.

VR technologies contribute to the development of virtual tourism which will become one of the directions of tourism industry. Even today there are projects under development, such as Christian Wolf's web series, "which would use high-definition 3D cameras and binaural microphones to capture the way humans hear and see the world, and then guide viewers on virtual tours" [4]. Moreover, the tourism sector is growing in the virtual online world "Second Life", which is one of the most famous virtual worlds. In order to organize tours in Second Life, residents are offering tours, opening virtual travel agencies and publishing guidebooks to help new users find their way around [5].

"The Melbourne Remote Control Tourist": innovative solution

One of the outstanding innovative solutions based on virtual tool strategy, which is worth mentioning, is "The Melbourne Remote Control Tourist", an interactive web campaign, organized by Tourism Victoria in Australia in 2013, that allows the potential visitors to explore and experience Melbourne virtually with the help of the eyes and ears of four real-world tourists, who have been fully connected to the world via helmet-mounted cameras, microphones, GPS and some clever mobile live streaming technology [6]. This virtual experience was orchestrated by Clemenger BBDO, Tool director Jason Zada and Exit Films. Visitors were able to watch the five-day live event via Livestream, controlling their every move through multiple social platforms. According to Jason Zada, Melbourne's RCT represents "a bit of a game, a bit of a travel show and a lot of exploring" [7]. "Everything is centered around the idea of 'Go before you go.' You can experience any part of the city, instantly, from anywhere in the world. You can virtually 'try out' Melbourne before booking a trip," Zada said.

For five days in October the virtual tourists of Melbourne's RCT explored the city, building their routes based on suggestions from Twitter and Facebook users. The video footage streamed live 8 hours a day and the users could follow the urban explorers via their Instagram feeds, Google maps integration or FourSquare, at the same time offering directions, giving advice and suggestions on what to do and see in the city.

"The Melbourne Remote Control Tourist" did not use 3D cameras and binaural microphones to capture the way humans hear and see the world. However, there is no doubt that it is only a matter of time that such technologies will be possible in the context of the objectives facing such interactive projects as "The Melbourne Remote Control Tourist".

Today, virtual tours in the tourism industry serve mainly as a promotional and advertising tool. If you take a person who is planning a trip, it is only logical that he or she is curious about what sights and landmarks they are about to see. Nevertheless, virtual trips can also replace real ones due to certain reasons (lack of free time or money, or health problems).

Digital real-time experiences at a physical location

Augmented reality (AR) is one of the most successful applications of interactive digital narrative in the real world. AR technologies allow involving the audience in an entertaining story-based performance which can take place in any pavilion, shopping mall, at any exhibition, as well as on the screen of a mobile platform.

In search of new ways of attracting clients and stimulating employees, and in order to create the culture of "playfullness", many companies use games as a part of their marketing strategy [8].

Location-based games and Location-based storytelling are media formats that are closely tied to real world locations. They use mobile digital devices (tablets, smartphones), GPS data and maps to guide through the experience while interacting with the user and his/her position. Mobile games provide new opportunities "to immerse tourists on-site throughout exciting storytelling and role-playing, challenges and social interaction with other players" [9]. Location-based Augmented Reality Games take visitors on individual and interactive walks through the places being visited and "enhance the tourist experience in a fun and enjoyable, but more importantly memorable and unique way" [9].

The above mentioned methods of tourism product promoting with the help of digital storytelling do not include all possibilities. Sometimes, the most unexpected solutions can lead to the most effective results.

STUDENTS' PROJECTS IN THE SPHERE OF TOURISM

For several years already, we have been paying much attention to the issues of cultural heritage, education and tourism when we train future digital media industry professionals [10 – 12].

Among digital storytelling prototypes, created by Master Program students of Saint-Petersburg State University of Industrial Technologies and Design (major: graphic design in multimedia) in 2016, 2 projects were aimed at promoting of tourism products in the Internet. These experimental projects realized in the form of web-based narratives tend to use the possibilities of digital storytelling to introduce potential tourists to the route in a pleasant, entertaining form: to involve them in the project, inform about the most important aspects of the route and encourage them to make the decision.

Interactive music video "To the Base of Belukha Mountain"

The project by Kristina Yolkina tells about a journey along the most beautiful and popular route of the Altai – to the base of Belukha – the holy mountain of the Altai. The mountain was called Belukha (from the word "belyi" – "white") because of the mantle of snow that covers its three peaks and slopes all year round. For many centuries, Belukha has attracted travelers and tourists like a magnet. We are using this tourist route as an example because it is a high-profile brand offering various options for tourists, which makes it particularly attractive for different tourist categories. The project is made in the form of interactive music video with high level of narrativity and a branching structure, and allows the user to choose a route from a number of possibilities, eliminating the strict one-directional basis of a traditional film. The project uses 2D animation, interactive infographics and the potentials of web 2.0 technologies.

The story is focused around three young girls, friends, who have different level of trekking training. The girls pass along the route, overcoming all difficulties which are an inevitable part of such travels. The use of cartoon-based interactive video helps to show the peculiarities of this route in a simple, entertaining form. Approximately every 20 seconds the user is faced with a choice which determines further development of events. The interactive music video "To the Base of Belukha Mountain" provides visual indicators at fixed points during the video, prompting the viewer to make a decision on what he or she would like to see next.

However, the user is not only capable of controlling the actions of the characters and choosing among the options of the route passing, but he or she can also collect photos with the most magnificent views.

Due to interactivity, the viewer/user can influence what he or she sees during this journey. However, no matter what choice he or she makes, the viewer/user will be able to "have a walk" along the grassland meadows, see real mountains, the mirror-like surface of lakes, the "birth" of mountain rivers, to wake up to birds singing and sun shining through the tent.

Today, interactive music video is a field for various experiments and innovations. The project "To the Base of Belukha Mountain" also offers new, original solutions.

Each alternative route through the interactive video is finished by interactive infographics, which visualize the data according to the chosen route, and help to deliver complex information to the viewer/user quickly and in simple terms. The last part of the non-linear video is presented in the form of interactive infographics, which reflect the peculiarities of the passed route, contain photos with the best views of the route, "collected" by the user, as well as the tourism agency logo and a direct link to its website. Interactive infographics can vary depending on the chosen route, and help to briefly describe the most important elements of the tourism product. The project "To the Base of Belukha Mountain" also uses UGC elements, urging Instagram users to share images that represent for them the most memorable moments of their travel along different routes to the base of Belukha with the hashtag # beluharoute. These images will populate a portion of the online experience. Through the final infographics, one can visit tourist resources, escape the project or go back to the beginning of the interactive music video to see what will happen if he chooses other options at various points.

This project, being an example of undercover marketing, represents a prospective way of promoting tourist route by means of creating of a digital narrative in the form of interactive music video (IMV) for various platforms. Involving users in the process of narration can be very effective. For example, by creating a series of web-videos, travellers can participate, share, vote and comment on the ideas for future episodes. Since all episodes are based on the users' decisions and feedback, the level of customers' involvement and the total number of views will be high.

Web-documentary project "Vasilievsky Island. The Era of Peter the Great»

The project by Stoyana Khristoskova, where a wide range of potentials of web-documentary is used, is dedicated to Vasilievsky Island in the Era of Peter the Great.

We know that web-platform-based multimedia documentary narrative can be a powerful tool for transferring knowledge in an entertaining form. This web-documentary project invites user to the era of Peter the Great and tells the story of Vasilievsky Island, its history, legends and myths, as well as gives information about the large scale model of St. Petersburg of 18th century "Peter the Great Aquatory". Vasilievsky Island is the heart and soul of the Capital of the North.

Combining live-action video (documentary footage), text, audio and animation, the interactive web experience gives the user the opportunity to navigate through the various stories about Vasilievsky Island during the reign of Peter the Great. Hypertext narration structure, presence of hyperlinks, typical for the Internet, and multimedia nature of the web-project being created, contribute to the additional background and depth of the story. A lot of attention is paid to the visual design, which shapes the aesthetics of the project, as well as to the experience of the audience-content interaction.

Interactive animation tells existing legends about the name "Vasilievsky Island"- the myth of the origin of its name, as well as the interesting facts and legends concerning certain buildings. Interactive data visualization helps the audience to study facts and maps on their own; interactivity links complex information (data) together and contributes to a deeper understanding of any story.

ACKNOWLEDGEMENTS

Today, tourism industry can draw customers' attention to tourist routes not only by using traditional narratives (movies, sound advertising, printed materials, etc), but also by means of wide variety of digital narratives, including web-based narratives, immersive narratives for VR and beyond, location-based games and location-based narratives, and others.

The combination of digital storytelling with interactive and immersive technologies opens up new possibilities for tourism promotion: it enables the potential tourists to get a better sense and impression about the forthcoming route; to create new experiences which are fun and engaging for customers and employees likewise.

Current best practices, as well as experimental projects developed by the students of SPGUPTiD, demonstrate, how the capabilities of digital platforms can be used to get acquainted with the tourist route in a pleasant, entertaining way.

REFERENCES

1. Barbara Dierickx (PACKED vzw), Julien Brouillard and Claire Loucopoulos (Dédale), "Report on existing tools and devices related to narrative approaches and requirement functionalities D5.2", 2013. – URL http:// www.athenaplus.eu/getFile.php?id=178 (accessed: 10.05.2016).

2. "Travel Brand Content Marketing: Engaging Social Consumers", March 18, 2015. – URL: http://thinkdigital.travel/all-insights/developing-content-perspectives-for-travel/ (accessed: 10.05.2016).

3. Carolyn Handler Miller, "Digital Storytelling: A Creator's Guide to Interactive Entertainment", Routledge, 3rd edition, xviii, 2014.

4. "A Wolf Abroad - A Virtual Travel Show Experience". – URL: https://www.kickstarter.com/projects/680193102/a-wolf-abroad-a-virtual-travel-show-experience (accessed: 11.05.2016).

5. USA TODAY, "'Second Life' courts virtual world travelers", May 15, 2007. – URL: http://usatoday30.usatoday.com/travel/news/2007-05-11-second-life-world-tours_N.htm (accessed: 12.05.2016).

6. "The Melbourne Remote Control Tourist", – URL: https://www.thinkwithgoogle.com/campaigns/the-melbourne-remote-control-tourist.html (accessed: 12.05.2016).

7. Duncan Macleod, "Melbourne Remote Control Tourist", October 11, 2013. – URL: http://theinspirationroom.com/daily/2013/melbourne-remote-control-tourist/ (accessed: 15.05.2016).

8. Jessika Weber, "Gaming and Gamification in Tourism", 2014. – URL: https://thinkdigital.travel/wp-content/uploads/2014/05/Gamification-in-Tourism-Best-Practice.pdf (accessed: 10.05.2016).

9. Barbara Neuhofer, "Content, context, co-creation and other eTourism predictions for the next 20 years", March 14, 2013. – URL: http://blogs.bournemouth.ac.uk/etourismlab/tag/augmented-reality/#sthash.cxWlBKRP.dpuf (accessed: 10.05.2016).

10. N. Dvorko, "Digital Storytelling for Cultural Heritage Presenting". EVA 2015 Saint Petersburg. Electronic Imaging & the Visual Arts International Conference, St. Petersburg, June 24th-25th, 2015, Conference Proceedings. – SPb ITMO University, pp. 68-70, 2015.

11. N. Dvorko, "Digital Storytelling Landscape". In Moenandar, Sjoerd-Jeroen / Miller, Nicole Kavner (eds) Not Ever Absent: Storytelling in Arts, Culture and Identity Formation. Oxford: Inter-Disciplinary Press (ebook), pp. 239–247. 2015.

12. N. Dvorko, "The Potential of Web Documentary for Education"// INTED2016 Proceedings. 10th International Technology, Education and Development Conference. Valencia, Spain, pp. 3925-3932,7-9 March, 2016.

GOOD PRACTISES FOR POPULATING A CDVS DATABASE FOR ARCHAEOLOGICAL SITES AND MUSEUMS

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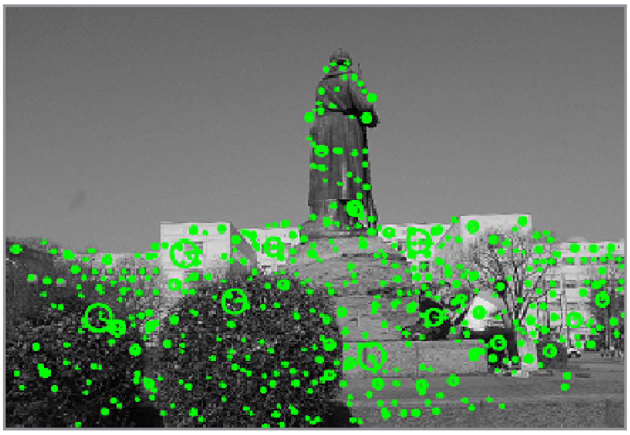
Abstract

In this work we suggest some good practices aimed at populating a CDVS database meant to enhance the experience of a user during a sightseeing tour. The key benefit of the proposed approach is to give some hints on the minimum number of pictures, captured from different angulations, which can extensively describe a monument, so that the CDVS algorithm can properly match an image taken by a tourist and the appropriate record in the database.

INTRODUCTION

Nowadays, tourists can benefit from a significant number of services delivered to their mobile phones in order to enhance their city tours, and their experiences in an archaeological site or within a museum. There are plenty of applications providing updated maps of the touristic sites and fresh news on them: such applications are at hand, just by surfing the web on mobile devices. Furthermore, thanks to the social attitude of the web, reliable reviews about places worth visiting are always available. Additional information about a square, a building or a site can be retrieved right-on-time as far as the application is aware of the user's position. Location-based services are a now reality due to the large availability of on-board GPS and WiFi receivers; however, when a more precise localization is required, new approaches need to be thought. Traditional GPS cannot be adopted to accurately determine what a tourist is looking at in high-density archaeological sites or museums. In fact, in this case, many significant objects may be close to him. Then, it would not be possible to enhance his experience by feeding a mobile application with dedicated information on that object. Image-based solutions can then be of a great benefit. The required step in this case is that the tourist has to take a picture of the object which he wants to know more about. Applications like Amazon Flow [4] and Layar [5] have been thought with such an objective in mind and they can dramatically help in providing additional content associated to an object of interest. To the best of our knowledge, the drawback of these approaches is that they require quite a significant amount of processing resources to elaborate the image or, if the processing is remotely performed, they require bandwidth to upload the image corresponding to the scanned object – this may be an issues especially in crowded locations. Then, methods to reduce the amount of information to be transmitted and/or to ease the processing can be dramatically beneficial.

The recent MPEG Compact Descriptors for Visual Search (CDVS) standard [1, 3] provides the capability to detect, encode and compress significant key-points of an image, thus enabling an efficient retrieval from a database of millions of reference images. This standard exploits ALP – a SIFT-like algorithm – to locate invariant key-points in an image and describes them in terms of SIFT



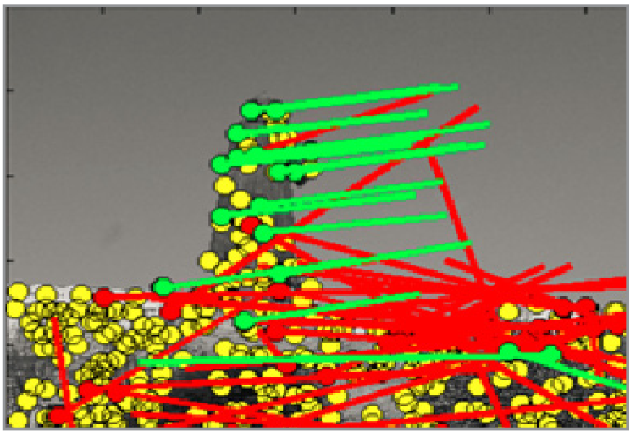


Fig. 1. (Left) example of extracted key-points; (right) example of key-point matching

descriptors. The latter are then compared with descriptors extracted from other images to assess, for example, if two images contain the same object. The main point of strength of such approach consists in a significant reduction of the amount data, either stored or transmitted, thanks to the key-points filtering and descriptors quantization and encoding.

The objective of this paperwork is to describe how the MPEG CDVS standard can improve the tourist experience by allowing content enrichment in archaeological sites and museums. By populating with a sufficient number of pictures a database, an application may adopt the CDVS paradigm to understand which object is currently being watched by a tourist: this will enable the augmentation service by providing relevant information. As an intuitive requirement, the database should contain as many different objects as possible (so to widen the service coverage) with the minimum number of different angulations (as a trade-off between the accuracy in retrieval and the database size).

The rest of the paper is organized as follows. We first describe the proposed approach highlighting the main novelties of the framework. We then describe the data acquisition setup together with the obtained experimental results. Some considerations and future work conclude the paper.

PROPOSED APPROACH

Here the CDVS architecture is briefly recalled. The interested reader may refer to [3] for a detailed explanation of the algorithmic blocks. The CDVS standard foresees the following normative blocks: the Interest Point Detection block receives as input a grayscale image and processes it with a low-degree polynomial (ALP) detector extracting a list of key-point candidates. The points are then filtered by the Local Feature Selection block based on a relevance metric, so to reduce the cardinality of the list to a fixed size. In the next stage, for each of the retained key-points the SIFT descriptor is extracted.

The key-point locations and descriptors are compressed: the formers by adopting a lossy coding scheme, the latters by a low-complexity transform to derive uncorrelated components followed by a Bag-of-Words quantization stage [7].

The list of compressed key-point locations and descriptors is the local descriptor of the image. CDVS standard also computes a global descriptor through a Local Feature Aggregation algorithm. Local and global descriptors result in the fixed size CDVS image descriptor.

Here is the point: two images can be compared through their CDVS descriptors. A preliminary match is computed between the global descriptors, resulting in boolean assessment: if it is positive, also the local descriptors are compared. To do so the compressed descriptor of each key-point from the first image is matched with all key-point descriptor from the second one. Appropriate distance measure is used to compute a matching score ranging from 1 (identical descriptors) to 0 (no match). Then a geometry consistency check is performed [6]: the set of key-point matches which have obtained a relevant score is filtered with RANSAC algorithm; this permits to identify the largest subset of matches supporting the same perspective transform between the two images and, at the same time, leads to identifying and rejecting the outliers. The output is threefold: the number of retained matches, the sum of their scores being the total image comparison score, and the matrix that allow warping the first image onto the second one.

In [2] we proved the feasibility of effectively implementing MPEG CDVS in today's smartphones to guide a tourist through an urban photo tour. Here we propose to adopt this standard to allow content enrichment in archaeological sites and museums by providing useful guidelines on how to populate the database used for comparison. The objective is to let the tourists take a single photo of a portion of the site (or, conversely, an object in

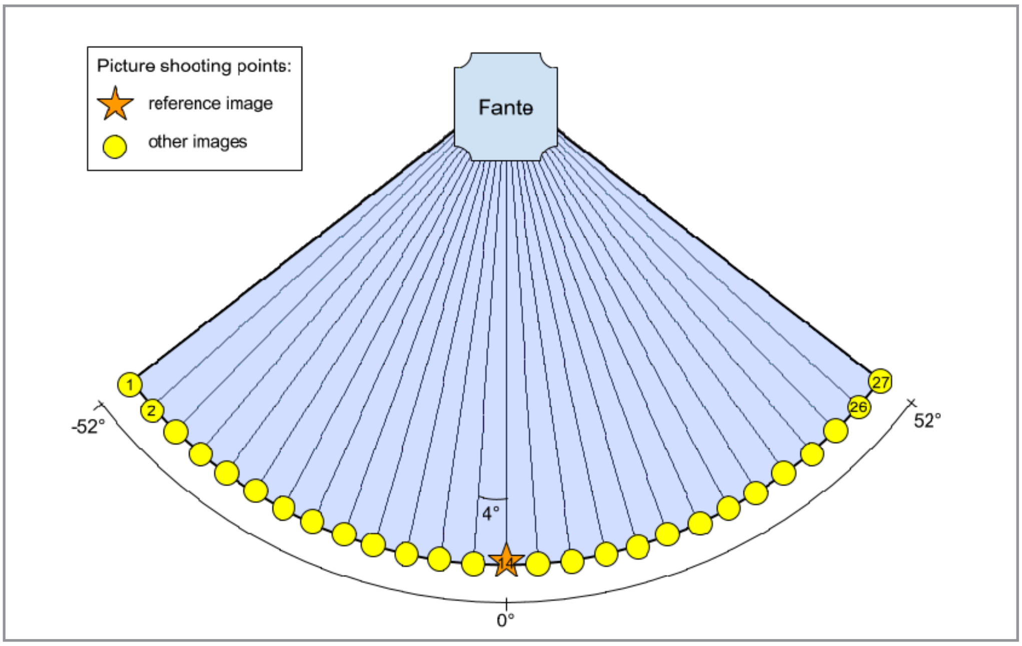


Fig. 2. Acquisition setup for testing

a museum from an arbitrary point of view), and provide him with additional information of the framed object. We focus on the database optimization by answering a crucial question: what is the minimum number of pictures of an interest object the database should contain to ensure a high probability of recognition? And, consequently, are there any important guidelines to follow when populating the database?

Figure 1 (left) shows an example of the key-points automatically extracted by the CDVS algorithm. The different sizes of the green circles refer to the scale and blur level at which they were extracted. Figure 1 (right) shows the match between a picture taken by a user and a picture stored in the database. Green circles indicate that a correct matching between descriptors was found (the lines connect the two matched descriptors) while yellow and red circles respectively indicate points without matches and matches discarded from the geometric consistency check. Here, the number of correct (green) descriptors is sufficient to univocally match the taken picture to the monument (although the database does not contain exactly that image but only the one on the left).

DATA ACQUISITION AND EXPERIMENTAL RESULTS

In the following we report the setup and the experimental results obtained for the "Fante d'Italia" monument in Turin, Italy. A CMOS Bayer sensor manufactured by FujiFilm has been adopted, alongside an aspherical lens from the same producer for the whole acquisition process: both for train and test images. This allowed us to exclude the variability of ambient light and the effects of heterogeneous optical, geometric and electronic characteristics of the camera from the processing steps. Moreover, acquisition consistency has been assured alongside all the acquisition process.

Figure 2 shows a top view representation of the acquisition area. The distance from the base of the monument is set to 8.70 m and pictures are taken at a level of 1.80 m from the ground. The shooting points on the circumference are equally spaced with an angle of 4° from -52° to +52° wrt to the front position taken as reference. The number of photographs is therefore 104° / 4° + 1 = 27. The shooting axes are as reported in Figure 2 so that in each image the monument is always in the center, the angle being the only varying parameter. The distance between two adjacent shooting points is approximately 60 cm.

When comparing images, we considered three different metrics:

1. S: the total score of the match, defined as the sum the scores of relevant matches after the geometric consistency check;
2. N: the number of relevant key-point matches after the geometric consistency check;
3. L: the average score of at key point level. L = S / N.

S is the most complete indicator of the quality of the correspondence between a couple of images. The other two somehow contribute to the first one: N refers to the number of the matches, while L refers to their strength. In the following S and N have been expressed as percentages with respect to their theoretical maximum (which is the number of key-points of the reference image).

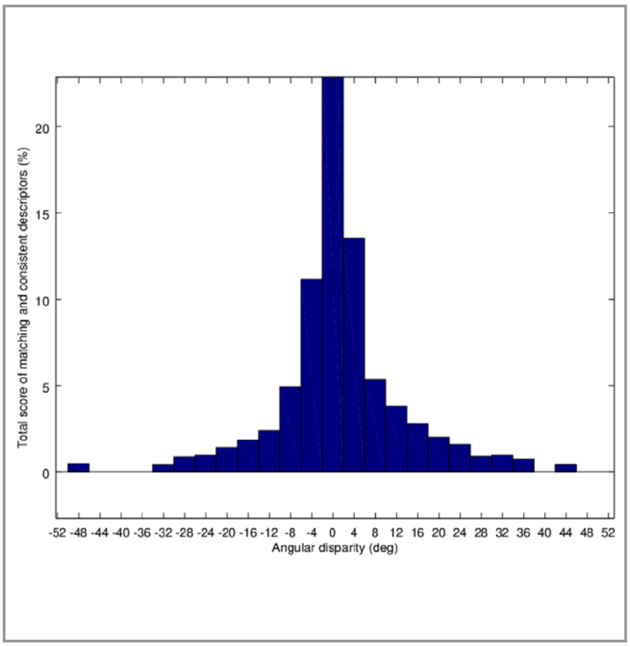


Fig. 3. S - total score of matching and consistent descriptors (in percentage) with respect to the angular disparity (in degrees)

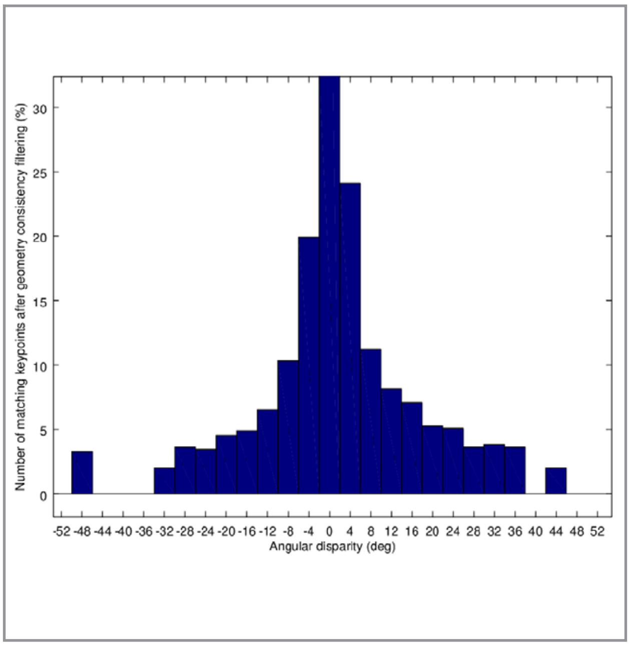


Fig. 4. N - number of matching key-points after the geometry consistency filtering (in percentage) vs the angular disparity (in degrees)

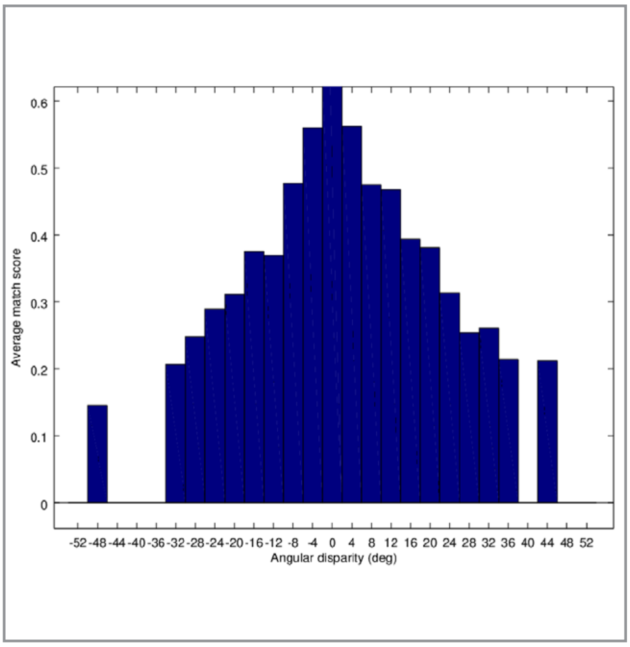


Fig. 5. L - average match score vs the angular disparity (in degrees)

Three sets of comparisons have been performed. We report here the comparison between the reference picture and:

1. A set of pictures in which the monument is not present in order to define the noise level in image matching;
2. The pictures taken from different angles to understand how the shooting position may affect the CDVS algorithm performance;
3. A panoramic picture of the area, including the monument itself, in order to check whether a match can be found.

As a first step, in order to define the noise level in the matching processes, 5 additional pictures have been taken in the same locations of images 1, 6, 14, 22 and 27, but pointing in the opposite directions. This way, even with similar backgrounds, the pictures do not contain the monument.

The comparison of the two data set leads to 27 × 5 = 135 pairwise image matching. On average, the score S is 0.004%, with the majority of the image pairs totalizing 0% - no match at all - and only some of them leading to a maximum of 0.1%. Being the standard deviation 0.018%, the valid noise threshold for the subsequent steps has been estimated as:

$$SNOISE = avg(S) + 3 \times std\_dev(S) = 0.058\%$$

The second set of tests reports the comparison between the reference picture and the pictures taken from different angles of view, so to understand how the impact of the shooting position on the performance of the CDVS algorithm. Figure 3 reports the total score S in respect with the angle. An angle of 0° means that the picture has been compared with itself (hopefully with a 100% match). As the angular distance increases the total score rapidly decreases. With an angular distance of 4° (which refers to the first two pictures at the left and right of the reference image), the matching is about 14%; between 8° to 30° the metric drops in the range between 2% to 5%.

Figure 4 depicts the parameter N: the number of matching key-points after the geometry consistency filtering. The 100% matching can be found for the reference

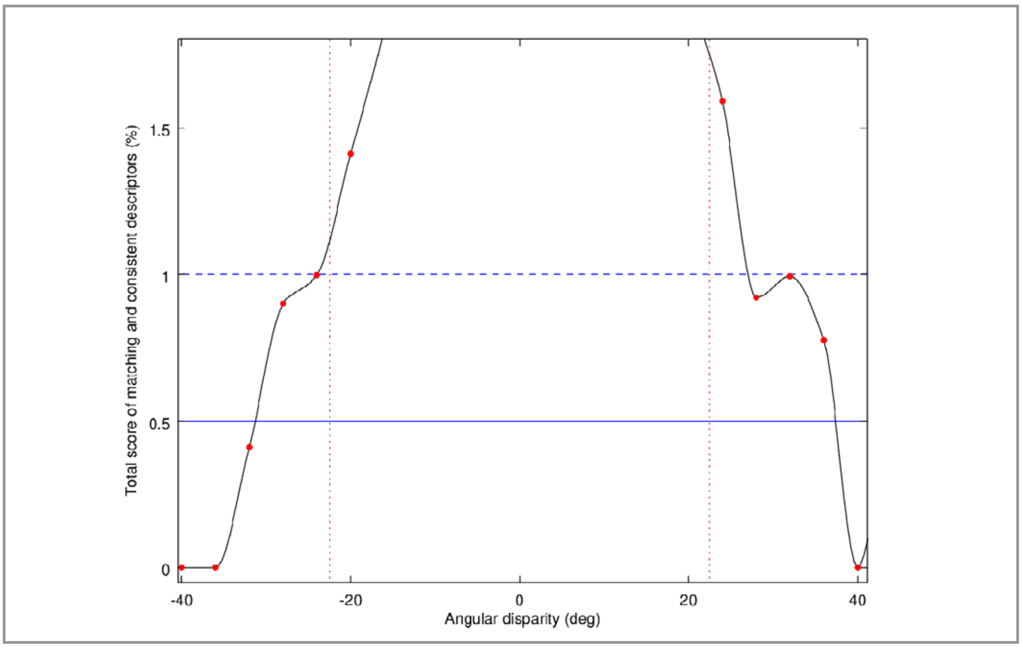


Fig. 6. S – zoom on total score of matching and consistent descriptors

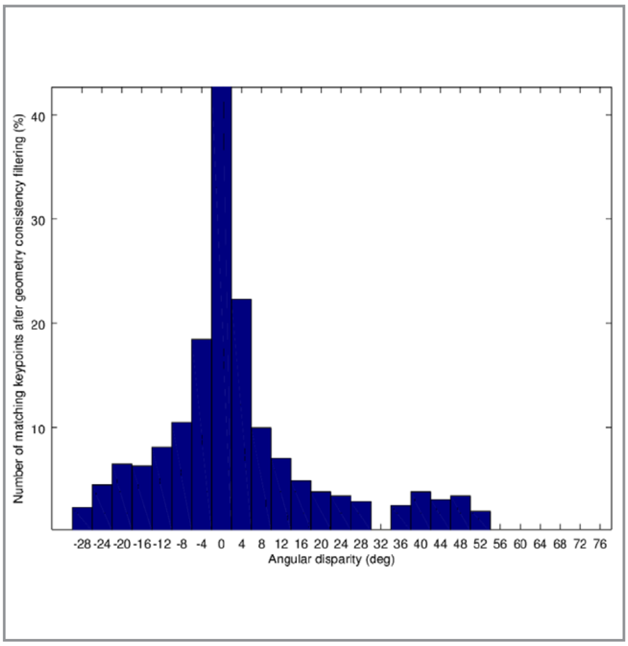


Fig.7. N - number of matching key-points after the geometry consistency filtering (in percentage) versus the angular disparity (in degrees) for a different reference picture

picture while a steep behavior can be observed from ±4° to ±24°. This is substantially similar to the trend of S, even if less sharp.

In Figure 5 we show the behavior of L (the average match score per key-point pair), still depending on the angle. As depicted, the behavior of this score is less pronounced than the one of N. Excluding the 0° angle - where L=1, the average score decreases almost linearly from ±4° to ±32° - with values between 0.55 and 0.22.

Comparing the three metrics, S looks the most comprehensive and discriminative one, featuring both a steep decay and the most monotonic trend. So we decided to use this metric to set the threshold T on angular disparity that trades off between having few pictures and ensuring correct image match.

In choosing T it must be considered that the behavior of S for high disparity value is not consistent: monotonic property is lost and even the value falls to zero but sparsely raises again. Than T should allow for a sufficient safety margin to filter out this inconsistent tail trend. We identified T = 22.5° to be a consistent and convenient choice. Indeed this value allows for S to stay over 1%, as can be seen in Figure 6, more than an order of magnitude higher than SNOISE thus ensuring a proper discrimination between matching and not matching images. At the same time keeping disparity in the interval [-T, T] allows shooting pictures with an angular displacement up to 45° that is quite easy to put into practice.

From the Figures 3 to 5, it is worth noting that a symmetric behavior of the histograms can be found for all the reported metrics. This can be seen as a positive property of the proposed approach as it implies that shooting a particular side of this object does not affect performance. A further proof of this can be derived from Figure 7 in which the reference picture (i.e. the one shoot by the user) is not the same as in the previous cases. As can be seen, the symmetry still holds.

From all the results described above we can state that it can be sufficient to populate a database with pictures taken approximately with an angular displacement of 45° each to guarantee that, regardless of the shooting point of view, the object will be effectively recognized by the CDVS approach.

Test image	S (%)	N (%)	L
PANO1	4,31	9,60	0,45
PANO2	2,15	5,43	0,40
PANO3	2,14	5,43	0,39

Tab. 1. Experimental results for panoramic pictures

The last set of experimental tests has been carried out to provide some guidelines on the type of pictures which should populate a CDVS database. In particular, we analyze whether it is possible to store a single panoramic picture instead of a set of multiple pictures (e.g. when dealing with an urban square or an amphitheater). Three different panoramic pictures of the previously considered area have been tested. As can be seen from Table 1, when the algorithm tries to match a reference picture to a panoramic image which includes the picture itself the total score S ranges from 2% to 4%, that is 35 to 70 times than SNOISE then allowing for effective retrieval.

CONCLUSIONS AND FUTURE WORK

In this work we proposed some guidelines on how to populate a CDVS database in order to face storage limitations while guaranteeing that the object can be still successfully retrieved. Results show that in order to completely describe a monument regardless of the specific shooting point, 8 pictures taken at 22.5° × 2 = 45° each are sufficient to allow the CDVS algorithm to recognize the object. Preliminary results also show that in the case of a panoramic picture of an area, MPEG CDVS perform well thus allowing recognizing an object from such a particular shooting mode.

Future work will include comprehensive testing on a heterogeneous set of mobile devices in order to validate how the algorithm performs when using different lens and optics. A bigger set of locations and objects to detect is also part of the ongoing work.

References

1. S. Paschalakis, G. Francini, G. Cordara, M. Bober, L. Duan, K. Iwamoto, and V. Chandrasekhar, “Compact descriptors for visual search,” in Text of ISO/IEC DIS 15938-13. ISO/IEC JTC1/SC29/WG11 MPEG2014/N14392, 2014.

2. G. Ballocca, A. Fiandrotti, M. Gavelli, M. Mattelliano, M. Morello, A. Mosca and P. Vergori, “Demonstrating the new compact descriptors for visual search (CDVS) standard for image retrieval on mobile devices”, 2014 IEEE International Conference on Image Processing (ICIP), Paris, 2014, pp. 3411-3413

3. L. Duan, V. Chandrasekhar, J. Chen, J. Lin, Z. Wang, T. Huang, B. Girod, W. Gao, “Overview of the MPEG-CDVS standard”, IEEE Transactions on Image Processing, vol. 25, no. 1, Jan 2016

4. Amazon Flow. [Online]. Available: http://www.a9.com/whatwedo/visual-search/

5. Layar. [Online]. Available: http://www.layar.com

6. S. S. Tsai, D. Chen, G. Takacs, V. Chandrasekhar, R. Vedantham, R. Grzeszczuk, B Girod, “Fast geometric re-ranking for image-based retrieval,” in Proc. IEEE Int. Conf. Image Process. (ICIP), Hong Kong, Sep. 2010, pp. 1029–1032.

7. S. Paschalakis et al., CDVS CE2: Local Descriptor Compression, document ISO/IEC JTC1/SC29/WG11/M28179, Jan. 2013.

PRESENTATION OF THE CULTURAL HERITAGE IN THE MODERN EDUCATIONAL FIELD

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Abstract

This article covers some aspects of preservation of cultural heritage in Yaroslavl. This paper characterizes the activity of heritage organizations working in the city, as well as different ways of collaboration between local authorities, commercial sector, cultural and archaeological institutions. Also the article describes educational program for students of the Yaroslavl State University.

INTRODUCTION

The protection, maintenance and promotion of cultural heritage, including what is sometimes called the "historic environment", is an undertaking in which different government funded agencies and institutions combine efforts with non-governmental organizations and local communities. Nowadays cultural heritage is implicated in many fields of activity, including economic and regional regeneration, tourism, education, and the enhancement of social identity. It is necessary to draw the attention of young people to the theme of heritage preservation. Yaroslavl is the historic city that has preserved unique buildings in its central part. It is growing and developing city, as a result, there is a need to integrate monuments in a modern urban environment. That's why we should learn previous experience of the preservation of architectural heritage. An analysis of the sources and the literature let us to conclude that questions related to general trends in urban planning and reconstruction of historical cities should be more studied.

OUR CAPABILITIES OF SUPPORTING PRESERVATION OF THE HERITAGE

Today our government supports movement for the safeguarding of Russian cultural and natural heritage. There are some non-governmental organizations which are working for the preservation of cultural and architectural heritage. VOOPIK, founded in Moscow in 1965, is a national organization for monuments preservation. Nowadays this organization has offices almost nationwide. In this study, we consider the work of regional offices.

Yaroslavl office of VOOPIK always pays attention to the monuments and sites of the city. Our database is intended to present images and tell about monuments and important parts of the Yaroslavl and other cities of Upper Volga [1, 2]. The researching of the heritage, the understanding of the importance and awareness of responsibility will help people not to lose it, and turn to the benefit of the city.

The basis of the project is a set of e-learning materials for the "Protection of Cultural and Natural Heritage" course for master degree (post-graduate) students. We created a database called "VOOPIK Division of the Upper Volga region in 1966-1985 years"[5]. This database has FIPS Certificate on State registration. Fragments of database are shown on figures 1 and 2. It includes materials for students self-training, lists of basic training and additional literature, a collection of electronic information resources, recommendations for their use. This database presented archival materials, texts of the most important documents, plans, glossary, and supplies a guidance for the study material, quizzes on the basis of

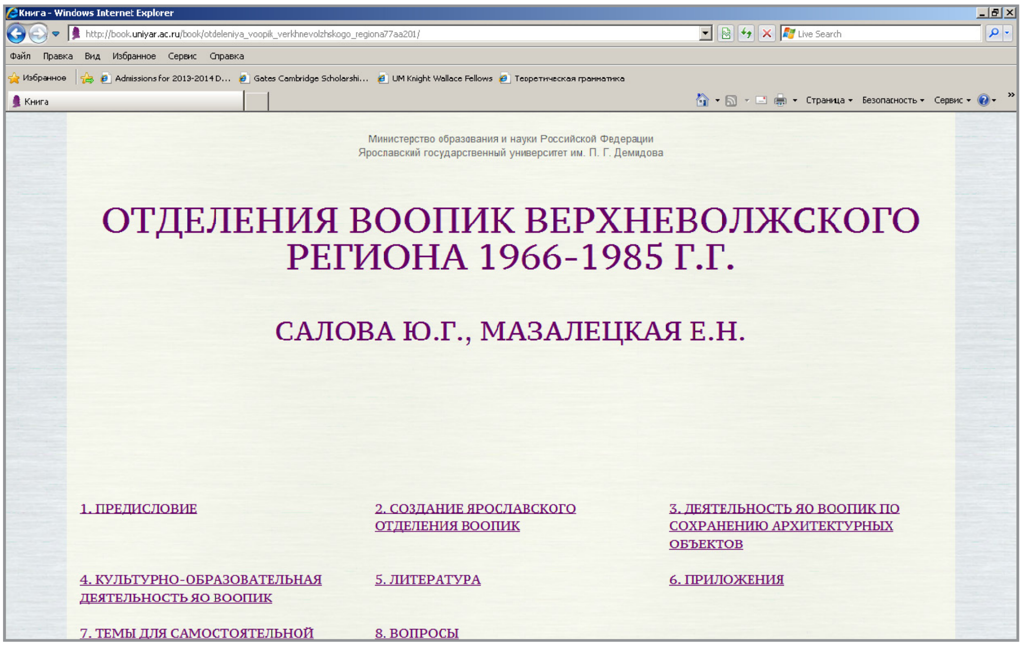

Fig.1. Title of database

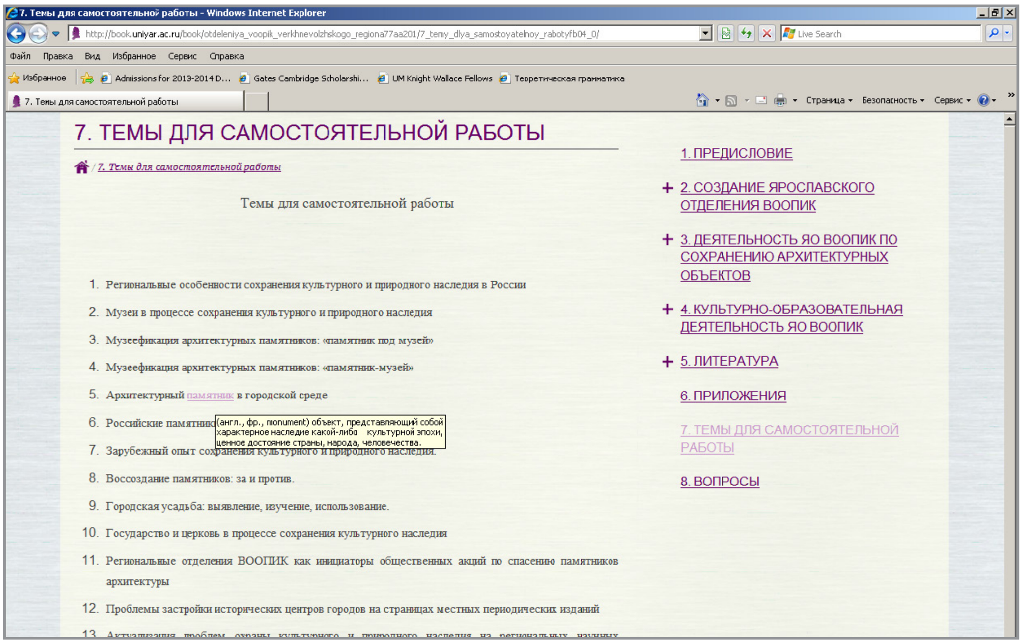

Fig. 2. Fragment of database

the development of the discipline (see fig. 2), additional information materials to study the course. It also contains comparative tables which were made up of archival material, demonstrating increase of members of VOOPIK, financial income, changes in structure. On the basis of this background we can evaluate the work of organization. Students are offered to master professional skills in a convenient form.

Based on past experience, this database allows the developing of solutions for the integration of architectural heritage in modern urban environment, to create new excursion routes on the basis of the material presented in the manual. It clearly shows changes in the urban environment of Yaroslavl. This database can be used in educational programs of other educational institutions for both higher and secondary vocational

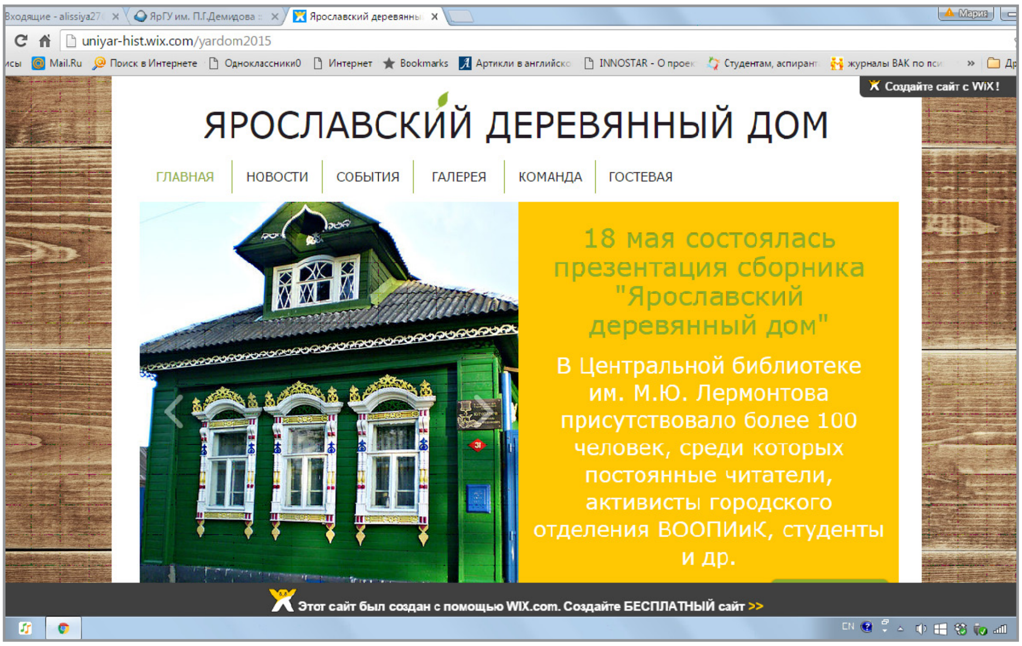

Fig. 3. Home page of Wooden Yaroslavl

education [5]. Materials for this database were collected in archives and libraries of the Yaroslavl region. We plan to expand the database. There will be some new sections. Now we are working on the selection of the material for other cities of the Upper Volga region such as Rybinsk, Kostroma and Vladimir.

In our region there are some other interesting initiatives to promote the protection of monuments and the transformation (renewal) of urban environment. Recently, a presentation of the project called «Yaroslavl wooden house» [7,8] was held, it was organized by VOOPIK. These efforts were supported by Mayor's Office of Yaroslavl, Yaroslavl State University, Pedagogical State University, museums and other organizations. The main goal of this project is to study the history of the city of Yaroslavl wooden buildings, lost and surviving monuments. Also the website of this project is an interactive digital portal for sharing and gaining of the information concerning events and stories related to wooden houses of Yaroslavl. [8] As a part of this act a book «Yaroslavl wooden house» has been published; it shows the history of the city of Yaroslavl wooden buildings lost and preserved monuments. It is intended for anyone interested in the history of Yaroslavl, wooden architecture and the conservation of monuments. The book has been published with the support of the Mayor's Office of Yaroslavl and Yaroslavl regional branch of the Russian Geographical Organization. Cooperation between heritage organizations, government and society is the key to prosperity of our cities.

CONCLUSION

We believe that development of projects in the field of the protection of monuments in modern Yaroslavl, as well as the creation of projects in collaboration with various organizations involved in the popularization of monuments and upgrading of the urban environment, will help to preserve, develop and promote historical cities. Research activities of the Verkhnevolzhskiye offices of the VOOPIK will reveal different aspects of their work, forms of interaction with the scientific community in the region, analyze the experience of attracting people to the protection of cultural objects [3, 4]. Today there are some modern capabilities of preservation heritage like databases, websites, digital portals etc. But, only the collaboration between modern and traditional elements will give significant results. With past experience studying, it is possible to develop a strategy for successful urban redevelopment and to shape public opinion basis of the today's media capabilities. The introduction of regional components in the programs of educational institutions' can promote the rising of a more open educational field in the region and it will also increase the level of knowledge about history and cultural heritage [6].

REFERENCES:

1. Филиал ГКУ ЯО «Государственный архив Ярославской области» — Центр документации новейшей истории (далее - ЦДНИ ГАЯО). Ф.973. Оп. 1. Д. 31. Документы о работе Ярославского районного отделения общества.

2. ЦДНИ ГАЯО. Ф.973. Оп.1 Д. 140. Справки о лекционной работе общества. Тематика лекций.

3. ЦДНИ ГАЯО. Ф. Р-973. Оп.1 Д. 54. Документы о работе секции архитектурных памятников 1970-1973 годы.

4. ЦДНИ ГАЯО.Ф.973 Оп.1. Д.3 Т.1 Секция по вопросам памятников архитектуры, изобразительного и прикладного искусства. 1966-1968, 1968-1969.

5. Отделения ВООПИК Верхне-Волжского региона 1966-1985гг.: Электронное учебное пособие http://book.uniyar.ac.ru/book/otdeleniya_voopik_verkhne_volzhskogo_reg89802012/

6. Рафикова К.В. Виртуализация сферы культурного наследия России / С.В. Соловьева, В.И. Ионесова // Модернизация культуры: идеи и парадигмы культурных изменений. Материалы Междунар. науч.-практ. конф. - Самара.: Самар. гос. акад. культуры и искусств, 2013. – Ч. I. – С. 178-184.

7. ЯрГУ им. П.Г. Демидова. http://www.uniyar.ac.ru/events/science/prezentatsiya-proekta-i-knigi-yaroslavskiy-derevyannyy-dom

8. Ярославский деревянный дом. http://uniyar-hist.wix.com/yardom2015#!blank-7/kuxqb

VISUAL IMAGE OF VIRTUAL MUSEUM

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Abstract

Virtual museum is one of the ways to present museum collections in Internet. Up-to-date technologies in this field make it possible to show exhibits to a high degree of accuracy and at the same time in a vivid manner.

The paper's subject is creation and perception of visual image of a virtual museum.

The highest value of exhibits in tangible museums is their physical genuineness. On the contrary, virtual exhibits do not contain as much information as real objects, therefore, they do not arouse feelings and emotions which appear when people contact with authentic tangible objects. As a consequence, presentation manner of intangible objects in virtual space becomes especially important.

Visual impression of a virtual museum gets imprinted in memory of gross audience after having acquainted with information content of the museum that is why visual image is a very essential quality of any virtual museum.

Correspondence of actual emotional impact received by the audience with the impact expected by the museum designers directly depends on visual image of virtual museum.

Speaking about museum audience, design target of both tangible and virtual museums is to create a visual image which would produce impressions.

Subject of computer designing studied in the paper is a web-site of virtual museum. The author analyses methods and principles of designing aimed to get a final product –visual image. The author also describes artistic techniques which help to make a certain effect on perceiving audience.

INTRODUCTION

Using of information technologies has become a common practice in museum business. Social informatization and computerization led to fast development of new methods in museum collections' compilation and in relations building with museum audience.

Multimedia tools (such as interactive panels, projections, audio and video materials, etc.) help to present exhibition theme and to emphasize key points in exposition scenario. Computer technologies are successfully used for creation of up-to-date museum space – they help to present museum objects in detail and produce bright eye-catching visual image [1].

Online catalogue which includes digital copies of museum exhibits is one of the forms of collection rep-

Distinctive features of the virtual museum:	
as a museum project:	as a design project (website):
• structured virtual environment in which virtual exhibits are placed; • expositional focus; • expositional scenario; • plotlines: • scientific and research focus; • social focus; • etc.	• emotional immersion into virtual environment; • universal access; • facilitation of public access; • formalized structure; • multilayer informational structure; • quick search; • the absence of risk factors associated with exhibits storage conditions; • unlimited exhibition space; • etc.

Tab. 1. Distinctive features of the virtual museum

resentation on the web. The main target of such practice is to introduce collection to wide audience and to attract social interest to it, and by this means to enlarge audience and promote museum. This is the way to enhance social and communicative functions of the museum.

Further development of museum on the web has led to phenomenon of virtual museum. But it is followed by a considerable confusion in terminology due to missing definition and formulated specific features of virtual museum.

Museum websites representing tangible museum usually offer digital version of its collection or a part of it in the format of digital album. Such approach is widely spread, for example: on-line collections of Guggenheim Museum, Louvre, State Hermitage, State Russian Museum, etc.

Although such product delivers introductory, popularization and advertising functions, but it is still not a virtual museum, because in fact it does not have full range of museum features and functions.

Although there is no common understanding of the virtual museum phenomenon, many researchers insist that only those websites which are created in accordance with the rules of museum establishing (museum designing) can be called virtual museums [2], [3], [4]. Such an approach means certain method of creation of virtual exposition, when scientific and art concepts interconnected by expositional scenario have to be properly developed prior to project implementation stage.

In general, virtual museum is a complex product: as a website it performs as a design project, but at the same time obtains features and functions of museum project.

Following this approach, we can try to formulate main features of virtual museum (tab. 1).

PERCEPTION OF VIRTUAL EXPOSITION

Functioning of tangible museum is closely connected with handling of museum objects. Information is received by audience through perception of exhibits. Language of traditional museum communication bases on physical objects instead of words [5].

Museum object has a very high information potential. It delivers information concerning its creation and being, its functions in past years, process and aesthetic features as well as other unique features [6].

Physical/material authenticity is the highest priority for tangible museum collection. It is the most important criteria in selection of exhibits. Museum object helps to get in touch with past events; it brings feelings and emotions arisen from perception of true authentic artifacts.

Additional expositional tools (tools of functional and decorative arrangement [6]) fulfill communicative potential of museum object. In tangible museum a wide range of additional expositional tools includes: exhibition equipment (stands, cases, lighting, audio and visual equipment, etc.), additional illustrative materials (maps, diagrams, sketches, tables, miniatures, etc.), texts, labels, navigation signs and many others. All these tools are aimed to implement informational potential of museum object.

Synergy of museum objects and functional and decorative arrangement tools results in visual image of the exposition. The phenomenon of visual image is related to its semiotic nature. Visual image is reflection of original empirical reality [7].

Creation of art imagery of a museum composition is the task for artists and designers. Artist is always searching for design solutions and devices that would bring expected impression, narrate exposition plot and develop main idea and concept. As a sign, museum object can lose its initial denotation and obtain new quality of a symbol or metaphor which transfer concept of the exhibition.

Additional expositional tools aim to facilitate imagery impression of the collection, to deliver the idea of the objects' composition. These tools are the key to understand encoded visual image.

Museum information can be perceived in different ways. Perception and interpretation of visual images depends on such phenomena as sight and vision. Vision and differentiating ability is based on knowledge and experience imparted and inculcated from early childhood [7].

Object and event description is always associated with environmental conditions. Perception means allocation of the object in the system: position, color and brightness, distance to it and other characteristics. In other words every act of perception is a visual assessment [8]. Intellectual activity that forms a certain opinion of the object is the next stage which follows visual assessment.

In virtual environment a museum object loses its key feature- material authenticity. This fact questions traditional museum communication in virtual environment. It causes discrepancy in definition of virtual museum, because virtual museums do not contain authentic material objects. In virtual museums communicative function is fulfilled by objects which are supplementary and exercise additional expositional role in tangible museums.

Most of exhibits in virtual museums are digital copies of tangible museum objects or computer reconstructions of lost or even nonexistent objects. This fact makes virtual presentation very important. Digital copy loses documentary evidence and physical properties – it does not give the audience feelings and emotions that arise from perception of authentic object in tangible museum.

Design concept influences on virtual exhibition even more significantly than artistic concept influences on tangible one. Digital copies inevitably go through several stages of processing with graphic software and their visual presentation might notably vary from original physical objects., Even if reconstruction is based on scientific evidence and results of thorough scientific research, virtually reconstructed objects are mainly results of artists and designers' creative work.

Visual image of virtual museum is the result of author's perception. This image is a design product created by artist or designer in cooperation with museum specialist. But principle of information perception of the exhibit is the same as in tangible museum: it is still visually assessed from the point of emotional and aesthetic impression on the audience.

Visual image of virtual exposition is incredibly important, because it stands out in memory and remains memorable long after the audience becomes familiar with information content of this exposition. Fidelity of perceived information and correspondence of actual emotional impact with the author's conception directly depend on quality of visual image of a virtual museum.

Computer modeling and animation technologies should be applied very carefully and in a correct manner so that unity and composition of virtual exposition would remain stable and solid, so that game aspect and playing with audience would not extrude scientific approach to museum designing and establishing. It is essential to make clear border lines between authentic objects and events and reconstructed reality.

Museum interiors, their solemnity together with authentic material objects presented with the use of additional expositional tools make experience of museum visiting a great deal more exciting than indirect perception of digital copies displayed in PC monitor or tablet screen.

Despite all limitations related to virtual nature of online museum, potential of virtual exhibition environment is still far not exhausted [9]. Virtual museum has certain unquestionable advantages, in particular, possibility to display large environmental objects including lost or significantly modified ones. Virtually reconstructed copies cannot substitute originals, but emotions they excite and impressions they produce are much stronger than what we get from common descriptions and illustrations.

Architectural and landscape objects, large monuments can be easily and clearly perceived from the monitor. Virtual technologies help to get complex view of the object, to study it from different angles and in section drawings, to deconstruct it and analyze it in detail.

Digital copies of lost monuments obtain additional value due to impossibility or inexpediency of their physical reconstruction. Visual image of such virtual exhibits usually produces bright emotional impression on mass audience.

Development prospect of virtual museums is closely connected with new efficient creation methods of their visual image and technologies of perception modeling.

VISUAL IMAGE OF VIRTUAL MUSEUM AS AN IMAGE OF DESIGN PRODUCT

Creation of visual exhibition image has much in common with image creation of of any piece of tangible art: architecture, painting or sculpture. It demands creative and innovative approach.

Professional computer skills are not the key point in design process. Results of virtual museum project depend mostly on the designer's mentality and ability to handle the entire project as a whole. Virtual exhibits' creation demands a synthesis of scientific research, innovative approach, logic and creativeness of the author. Virtual museum object as a design product is not a fantasy of the designer. Any object should correspond with the targets of the whole exhibition and general concept of the museum. Designers traditionally use artistic devices and tools which help to produce certain emotional effect during visual perception of the objects.

Goal of design communication is impression which substance is a visual image. Therefore the object of a special attention is the image with encoded semantic potential, capable to impress [10].

In terms of communication, design process and process of museum designing are both aimed at creation of visual image that would produce the right emotional impression.

Compliance with general principles of website design helps to secure the right perception by users. These principles include ergonomics aspects, correspondence between aesthetics and thematic focuses, representation accuracy, effectiveness of applied technology.

Ergonomic interface is oriented on users' demands. It is used for solving certain tasks, consists of clear operating and control elements and has logical navigation. In many ways aesthetics characteristics of final multimedia product depend on fulfilled principles of ergonomics.

Today there are not many examples of full-blown virtual museums: Google Cultural Institute (www.google.com/culturalinstitute/home), Virtual museums of things Thngs.co, Europeana project (www.europeana.eu/portal). Among Russian projects: World Digital Library (www.wdl.org/ru), Virtual museum of Russian primitive (www.museum.ru/primitiv/). The examples mentioned above are selected from the point of their art imagery and vividness of produced impression.

Nowadays, when information technologies are developing so fast and many cultural institutions aim to enhance their presence on the web by partial publishing of their collections, we can see certain stagnation in creation of virtual museums. It might happen due to numerous difficulties in implementation of virtual museum projects.–. Virtual museum project is a job for a big team of specialists, it requires time and considerable investments. However, it is doubtless that properly developed virtual exhibition or museum is much more efficient way to display the exhibits than occasional publishing of digital copies. Virtual museums have better prospects in theory and practice of preservation of architectural monuments and art heritage in general.

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REFERENCES

1. L. P. Barutkina, Multimedia in contemporary museum exposition. Vestnik SPb GUKI. 4/2011.
2. Museum and New Technologies // On the Way to Museum of XXI Century / N.A.Nikishin. 1999.
3. A.V. Lebedev. Virtualization of Museum or New Thingness? Museum Design, 2009.
4. Y.A. Petrova. Virtual Museum as an Effective Implement for Cultural Heritage Conservation and Museum Development. Vestnik SPb GU, s.6, v.3, 2012.
5. A.V. Lebedev. To the Nature of Museum Design // Museum Design, 2009.
6. T.P. Poliakov. How to Make Museum, 1997
7. A.A. Nikonova. Visual technologies and preservation of cultural heritage in Russia, VestnikSPbGUKI. 1(18)/2014.
8. Art and Visual Perception. A Psychology of the Creative Eye. The New Version. Berkeley and Los Angeles: University of California Press, 1974
9. A.S. Drikker. Virtual Museum: From Informational Technologies to New Quality of Art Project, 2006.
10. G.N. Lola. Communicative Resource of Design: Methodological Aspect. Vestnik SPb GUKI. 11/2010.

TYPOLOGY OF VIRTUAL MUSEUMS AND THEIR POTENTIAL FOR PROVIDING INFORMATION FOR HISTORICAL SCIENCES

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Abstract

The article deals with the examination of virtual museums and their typology, the evaluation of their potential for historical researches. The author determines possible ways of rising their potential in order to use the sources presented in virtual museums more widely; gives the definition of a virtual museum; marks out their types; shows the meaning of virtual museum resources for broadening of scientific themes; singles out the existing problems and restrictions, connected with the usage of online collections and virtual museum sources; suggests ways for raising the information value of virtual museums and broadening their possibilities to use them in researches.

INTRODUCTION

Virtual museums present a great variety of sources and variable educational environment able to solve important social problems. Virtual museums have high cultural value and they can become the important basis for scientific historical and classical researches. However, it is often rather difficult to usevirtual museum resources and they cannot be fully used by the researchers and be involved in the scientific revolution.

The purpose of this article is to present the virtual museum typology, to reveal their potential for providing information for historical science and to provide ways of their effective usage in scientific researches.

VIRTUAL MUSEUM – WHAT IS IT?

Several main directions can be highlighted in the virtual museum research. They are: the study of virtual museum as a cultural phenomenon; the usage of virtual museums and their possibilities in the sphere of education; the questions of virtual museum creation and design; the comparison of real and virtual museums, etc. But researchers do not often pay attention to the term "virtual museum" and it is used as a matter of course. Moreover, the researchers, users and developers of virtual museums usually interpret this term in different ways.

In the usage of term "virtual museum" we can categorize the following main approaches to its content: the concept of "virtual museum" is treated as

1. a model of an invented museum created with the help of computer technologies, which exists only in virtual space [1];
2. a digital object that has the characteristics of a museum, in order to complement, enhance or expand the experience of a real museum through personalization, interactivity and content enrichment [2];
3. a synonym for a virtual tour of the museum;
4. an understanding of the site of a real museum as a"virtual museum" (as a representative of the museum on the Internet);
5. a collection of digitally recorded images, sound files, text documents, and other data of historical, scientific, or cultural interest that are accessed through electronic media [3];

6. a real museum exhibition, including the virtual methods and techniques of representation of exhibits (multimedia audio-visual effects, holograms, computer installations, etc.) [4];

7. the online Museum of Computer Art.

We understand the term “virtual museum” as an information system, which contains common online collection or several collections of items with metadata, has museum characteristics and allows to carry out the scientific, educational, exhibition and excursion work in virtual space [5].

TYPOLOGY

According to the definition of “virtual museum”, not all informational resources appear to be virtual museums and, just on the contrary, many resources appear to be virtual museums but they are not called so.

The first ground for typology is the main way of source representation. According to this criterion we can single out the following types of virtual museums:

1. informational recourses, which transfer real museum environment to virtual space and organize it as a virtual museum tour. Developers of such resources try to create the feeling of real presence in a real museum. These virtual tours can be completed by separate images of pieces for approximate examination, or can ignore this necessity;

2. virtual museums, which contain online collections of items. Online collection is a collection of online copies of items, united according to some criteria (to the theme, storage fund, author, style, etc.);

3. virtual museums, which represent online collections of items together with museum background, information organizing and directing informative, educational and scientific work on the basis of available historical material.

So, if we can estimate the information potential of all these types, it turns out that the third type allows to use all the resources in History as much as possible.

The second ground for typology of virtual museums is the relationship to the institution of storage of real items of cultural heritage. So, virtual museums are created by different teams:

1. by real museums and other storage institutions;

2. by a joint effort of storage institutions and research institutes (including universities and academic institutes);

3. by various organizations;

4. by private persons and entrepreneurs;

5. by creative teamwork.

Any information resource, which contains digitized data of historical sources, must include the information about their origin. That’s why, the relationship to the sources and their belonging to the official storing place plays a very important role. The usage of sources for scientific purposes suggests the criticism of the source, which is impossible without their understanding and authenticity and the possibility of checking the equivalence of the authentic resource content and its digital copy from the virtual museum.

The next ground for the typology is the aim and the purpose of virtual museums. The purpose defines the possibilities of virtual museum usage for scientific research. For example, a virtual museum created for educational purposes for children contains data oriented to exact category of users and the level of sources representing should meet the demands. On the other hand, the sources, the purposes of which are maximally wide, have the greatest possibilities in scientific usage. It is connected with the fact that virtual museums are seldom created for scientific community because historical sources are of interest for wide range of audience.

Thus, virtual museums, that have online collections and are created on the basis of materials of storage institutions, have the greatest potential for information support.

CASE ON THE HISTORY OF PARLIAMENTARISM

The History of parliamentarism probably is not very good for demonstration of necessity and importance of the use of virtual resources of museums in historical research. But we shall clearly show how the virtual museum recourses enrich the researches with information and promote the appearance of new research practices.

Thus, virtual museum sources represent historical and cultural environment of appearance, development and work of representative bodies in various countries. The variety of historical sources from the collections of virtual museums allows us to enrich the given theme, to use not only official documents but a wide range of other sources – graphic (e.g. pictures of parliamentary events, deputies’ portraits, different photographs of events and meetings), material (e.g. furniture of parliaments, their cultural environment, personal thingsof deputies, valuable things, connected with traditions of parliaments from different countries), audio and video sources (they reflect not only official meetings but their daily routine, give the possibility to estimate deputies’ manner of speaking and their behavior during public speeches, their oratorical abilities, charisma, etc.) [6].

Sources presented in virtual museums let us see the informal life of parliamentarians, their daily routine, habits, traditions and many other things.

Virtual museum materials suggest sources for research of cultural environment of parliaments, offer great opportunities for comparative studies of cultural environment of representative bodies from different countries and regions, their traditions and peculiarities of parliamentary work.

Virtual museum sources on this topic present various points of views, show relationships of different groups of people to the parliamentary questions. The introduced sources allow us to trace the relationship to the history of parliament. It is very important to analyze such resources and to analyze how they alter and gain symbolic significance.

We do not ignore many information resources, devoted to the History of Parliaments. There are rather many of such resources – digital libraries, archives and others – and they contain many digital collections of documents concerning the History of representative bodies, including reports of meetings and other sources [7]. We would like to pay attention to the cultural meaning, the history of daily routine. Virtual museums in their majority exactly present these sources for acquaintance and study. The sources from the virtual museums and their information space reveal the value of relationship of didactic level, which can be the subject of research.

Thus, we can see considerable potential of usage of virtual museum sources for full and detailed study.

PROBLEMS OF VIRTUAL MUSEUM USAGE

Virtual museums represent a wide variety of sources and have considerable potential for providing information for historical science. But there is a whole set of problems, which prevent us from using the resources more effectively.

A critical look at the creation of virtual museums, the analysis of problems and difficulties of the usage allow to offer recommendations to improve the quality of created information resources, to broaden the possibilities of their effective usage.

We can sort out several main blocks of problems of existing virtual museums, which appear to be obstacles for their effective usage.

Problems connected with the sources and their organization:

- problems of meta description (and ist absence) and the variability of used standards;
- problems of the origin and authenticity of the source and the possibilities of its verification;
- quality of digital copies;
- organization of sources;
- different formats of sources' representation.
- Problems connected with the information support (legends):
- not all information resources pay attention to the questions of conditions and origin of sources.
- Problems of the organization of information in the VM space:
- lack of research and complexity of ist functionality;
- attentionis not paid to the possibilities and methods of hosted resources using;
- the absence of classification, subject distribution or other types of material categorization.

One of such problems is that there are too many formats of representation of sources. The collections of virtual museums are represented with various sources – written, graphic (including 3D) and audio and video sources. The majority of virtual museums demonstrate original images of text sources but they do not present the machine-readable format. Such approach considerably narrows search possibilities of information systems of virtual museums (the source can hardly be found by the system). Similar problems appear with audio and video sources, because they do not have their description or too little of it, in spite of the apparent value in the research.

Overcoming of these challenges will improve the quality of the generated resources, will increase their information returns, will increase the use of CH in classical research and education.

GROWTH OF VIRTUAL MUSEUM CAPACITY IN THE INFORMATION SUPPORT OF HISTORICAL SCIENCE

The growth of virtual museum quality is connected with the realization of professional approach to the creation and development of these resources and ways of their digitization. Part of the problems mentioned above can be solved with to the usage of extended standard of meta descriptions, including not only the description of the subject as a piece (property of the institute and collection, code number, physical state and safety, size, etc.), but subject description (e.g. key-words, subject, periodization, authorship and other extra parameters). The analysis of existing virtual museums shows that there can be a great number of additional description categories. For instance, virtual museum of Gulag contains online collections, including description of each unit and all digital collection of pieces. Virtual collections of Gulag contain different online documents, materials and other evidences devoted to the theme of political terror and repressions. Each piece has a detailed standard description, e.g. property of the museum, authenticity, delivery date, date and place of manufacture, size, materials, short description, the safety degree, detailed legend, persons (as the writer and all personalities, connected with the piece and its storage), connection with pointer necropolis (additional resource, which contains data about burial places of repressed people), and suggested subject groups. Broadened description of subjects and collections exist in other virtual museums. The importance of additional description of online versions of historical sources appears to be in the fact that structural and diverse descriptions allow to carry out more exact user's search and give the audience a greater understanding of the exhibits.

The realization of multiformat representation of sources promotes the expansion of possibilities of resource usage (including the possibility of computerized text analysis in the presence of full-text sources).

Text sources can be introduced in double (or triple) format – picture, text under the picture of page and text. We suppose that recognition, test and transcription of text sources allow us to develop substantially the collections of virtual museums, and to give the possibilities for scientific research usage of the sources.

Representation of audio and video sources must also be multiformat, including transcription for broadening of the possibilities (for providing historical researches).

Information system of virtual museum should possess the possibilities of flexible subject distribution of sources with the possibility of various representations of sources. Methods for electronic collections forming may be as follows: the museum funds, subject collections, chronological principle, affiliation to the authorship of the collection (according to the name of the collector and founder of the collection), etc. Moreover, cross-collector connections improve the quality of information resources (items of different collections are related to each other thematically, chronologically, or another type, must have the possibility of mutual visualization while searching). Thanks to this fact, the completeness of the information, while searching for it, can be extended. It is also possible to intellectualize search engines of the system.

Virtual museums should be equipped with comfortable and, at the same time, easy navigation based on electronic collections, they should include the possibility to limit search by section, topic, periodization and other parameters for more accurate delivery of information.

The creators of virtual museums can diversify the information environment through the implementation of multi-tasking resource utilization. This approach can be achieved through the establishment of additional blocks of information that could help to realize more fully the objectives set for the museum. So, educational and cognitive tasks can be realized by forming of special sections, which can have some possibilities of using of sources and the related information.

Growth of use of virtual museums in research fiel dis-related to their introduction to the space of research professionals. In the Laboratory of historical and political informatics of Perm National Research University a specialized catalog of historical-oriented information systems has been created [8]. The catalog includes also historically oriented virtual museums. It is very easy to use this system because it has wide possibilities for search both in the form of text search, and search on request in accordance with the field of knowledge, chapter of history, geography, period, types of sources and other parameters. The development of this catalog and its expansion are able to broaden the use of virtual museum resources in historical research.

CONCLUSION

Thus, the growth of the information capacity of virtual museums and the capacity of utilization of their resources in historical research can be done by improving the quality of virtual museums (including the quality of the digital collections) and by creating of conditions, when the resources can be used by professionals. It is possible thanks to the development of special catalog of historically-oriented information resources.

There is an important component in the development of the information environment of virtual museums – it is the study of information resources themselves and their theoretical reflection. In spite of the fact that there is a great number of research papers devoted to virtual museums, the scientific direction of the virtual or digital museology is still developing. We believe that the theoretical study of virtual museums and their functions in the virtual space can become the basis for updating of the museum information environment, improve the quality of created virtual resources, and it enables virtual museums to become more important due to their social, cognitive, educational and research opportunities.

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REFERENCES

1. Kaulen ME, Sundieva AA (2009) Slovar aktualnih museynikh terminov. Musey J. 5:48.

2. V-must, Virtual Museum Transnational Network. Virtual Museums. URL: http://www.v-must.net/virtual-museums/what-virtual-museum

3. Virtual museum. Encyclopedia Britannica. URL: http://global.britannica.com/topic/virtual-museum

4. Interv'yu doktora iskusstvovedeniya, glavnogo nauchnogo sotrudnika Laboratorii muzeynogo proektirovaniya AlekseyaValentinivicha Lebedeva (2006) Mir museya J. 11. URL: http://www.future.museum.ru/lmp/mission/interview.htm

5. Povroznik N.G. Virtual'nyjmuzej: sohranenie i reprezentacija istoriko-kul'turnogo nasledija (2015) Vestnik Permskogo universiteta. Serija Istorija. 3 (30). P. 213-222.

6. Museum of Australian Democracy. Old Parliament House. URL: http://moadoph.gov.au; Portraits: Parliamentary Museum and Archives. Parliament of India. Lok Sabha. House ofthe People. URL: http://164.100.47.192/loksabha/PhotoGal/ViewAllPhotoCategory.aspx; The HistoryofParliament. URL: http://www.histparl.ac.uk; Art in Parliament. URL: http://www.parliament.uk/about/art-in-parliament; Library, Museum andDocument Center of Iran Parliament. URL: http://www.ical.ir/en; Parliament Museum New Delhi, India. URL: http://www.parliamentmuseum.org/indextry.html; Parlamentarium. URL: http://www.europarl.europa.eu/visiting/en/visits/parlamentarium.html; The Barbados Parliament Museum. URL: http://www.barbadosparliament.com/gallery_museum/show_gallery;Thai Parliament Museum. URL: http://library2.parliament.go.th/museum/know.html; First women in Parliament. National Museum of Australia. URL: http://www.nma.gov.au/online_features/defining_moments/featured/women_in_parliament; Google Cultural Institute. URL: https://www.google.com/culturalinstitute and etc.

7. Parlamentskaja istorija pozdneimperskoj Rossii: nauchno-obrazovatel'nyj portal. URL: http://helios.psu.ru/pls/dum_test/frames.html; EPPI: Enhanced British Par-

liamentary Papers on Ireland, 1801-1922. URL: http://www.dippam.ac.uk/eppi; Πρακτικά Συνεδριάσεων. URL: http://www.hellenicparliament.gr/Vouli-ton-Ellinon/I-Bibliothiki/Koinovouleftiki-Syllogi/Praktika-Synedriaseonand etc.

8. Historical-oriented Information Systems.URL: http://digitalhistory.ru

CONCEPTUAL FOUNDATIONS OF DIGITAL LIBRARIES: A REVIEW OF INTERNATIONAL AND NATIONAL LEGISLATION

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Abstract

The article presents the results of a study, dealing with the conceptual foundations of digital libraries, carried out by analysis of foreign and national legislation. It is emphasized that considering the advances in information technology, and ubiquitous distribution and access to the Internet, digitization of books, journals and other documents, making them in digital format straight away has led to the emergence of digital libraries, which has raised the degree of accumulation of digital cultural heritage. The author outlines the urgent problems related to the lack of common terminology, legal recognition of electronic libraries as objects of digital cultural heritage.

1. INTRODUCTION

«Libri amici, libri magislri»

The state is a leader and the guarantor of the functions and tasks of cultural policy formation, preservation, accessibility and security of cultural heritage. One of the most important media is printed edition, as the distributor of knowledge, scientific research, also the distributor of cultural heritage and participant in its preservation. The accumulation of material by libraries has deep roots, as the collection and transmission of memory from one generation to another is the basis of human society. Security of books is provided for in the UNESCO Constitution (1945) [2].

2. THE CONCEPT OF THE RESEARCH

With advances in information technology, ubiquitous access to the Internet, the digitization of books, journals, and other documents, creating them directly in digital form has led to the emergence of electronic libraries and revolutionized the emergence of digital cultural heritage. Modern humanity is moving towards a society [27], in which digital information can replace a lot of printed information, and supplement it [26, p. 53-56].

The existence of libraries per se is not dependent on physical form of documents – their mission is to link past and present, to help shape the future while retaining the heritage culture, as well as the integration of new information technologies in professional activity. This mission is unlikely to change in the near future.

The concept of digital libraries as the idea of “libraries of the future”, available to all and at any time of the day, began to develop in the late 1980s. For the first time the use of the term, based on ideas of W. Bush (Bush,V. As we may think. Atlantic Monthly. 1945, July), associated with the report, delivered to the Corporation for national research initiatives, 1988. [36].

First, investments in digital libraries were only from the Federal budget [32], but then in the interests of the whole society funding from Federal agencies, foundations, and other organizations were raised to conduct basic research in organizational and program-technical problems related to Internet and digital library creation. This resulted in innovative ideas for the acceleration of the processes [34].

The importance of digital libraries in the preservation of world cultural heritage is understood all over the world. In December 2000, the United States Congress passed a law (Public Law 10B 554) [14] on the recognition of the importance of preserving materials in digital format for future generations [29].

In one of the largest libraries in the world – the Library of Congress – from 75 to 200 documents are scanned daily. According to experts, to digitize all of its fund (142 million) will take more than a decade. Primarily in electronic form were translated documents dating from before 1923, since they had no copyrights. In 2008 pan-European digital library Europeana started to operate. By the beginning of the project it contained 2 million different digitised objects of cultural heritage of Europe. The national library of France has digitized the most demanded funds in Europe and posted them on the Internet at http://gallica.bnf.fr.

The integration of digital libraries into the global system of libraries is exceptionally important to form the world's digital cultural heritage. Electronic libraries as the subjects will be able to implement and unify the standards for the formation, preservation, access and security to digital cultural heritage.

For today the result of this integration (with the joint effort of the Library of Congress, UNESCO, and more than 120 participating agencies in the world) is the creation of the world digital library (web site www.wdl.org) [39], which contains about 13 thousand objects from almost two hundred countries, providing free access to primary cultural heritage materials.

World digital library is constantly updated, has great potential and is used by people all over the world. World digital library function is not limited to providing only digital books, journals and articles, it is increasing the number of types of publications, including prints, photographs, archival materials, films, audio recordings, thus taking over some functions of the virtual Museum and archive. A prerequisite for the integration of the huge information resources in a library is the access to materials via the Internet global network with the correct support of diversity [5] and multilingualism.

Special attention is given to cultural and linguistic diversity in the Manifesto IFLA, according to it the libraries should serve all members of society without discrimination on cultural or linguistic principle; provide information in appropriate languages or in a comfortable writing systems; to provide access to a wide range of materials and services that are tailored to the needs of all societies [13].

The processes of globalization and informatization have affected Russian culture, including library activities. With the financial support and management of the state the foundation of the new objects of information environment, which are electronic (digital) libraries, started.

Libraries work in accordance with the principles of the foundations of legislation on culture, implementing activities for the conservation, creation, dissemination and assimilation of cultural values, creating a "legal guarantees for free cultural activities of associations of citizens, peoples and other ethnic communities of the Russian Federation" [17].

The creation of electronic libraries and the emergence of digital collections in Russia began in the second half of 1990-s, with the joint efforts of the Institute of world literature of the Russian Academy of Sciences named after A. M. Gorky and the Scientific-technical center "Informregistr" of the Ministry of information technologies and communications of the Russian Federation. It was the beginning of the realization of one of the largest projects in scientific terms - the creation of "Russian Literature and Folklore" Fundamental Electronic Library (ESF).

In 2005 at the initiative of the Russian state library, Library for natural Sciences of RAS and other organizations established the Russian Association of electronic libraries, which was registered as a non-profit partnership "Electronic libraries". Charter of the partnership, approved by the Constituent conference of February 11, 2005, is the main document defining the legal status, goals, objectives and activities of the partnership governing the rights and obligations included in the partnership's membership, approving the composition of the management bodies, the funding of these institutions and the process of reporting [30].

The Electronic library "Scientific heritage of Russia" opened in 2007; according to the program of the RAS Presidium it's goal is to safeguard and provide public access to the scientific works of famous Russian and foreign scientists and researchers working in Russia. The Presidential library named after Boris Yeltsin, whose mission is to provide electronic materials on the history of Russia, was opened in St. Petersburg in 2009.

Today the largest electronic libraries of Russia have vast electronic resources from the following institutions: the institutes of the SB RAS, Russian Academy of Sciences, digital library of the RSL, the library, Russian national library (E-library "Domosfera", Research electronic library (eLibrary), etc.

So one can conclude that in the era of globalization of the information society [9] it is necessary to rethink the library functions. Electronic libraries exist as specialized information libraries, as local and global information systems and repositories of digital resources, and play a huge role in the formation, preservation and accessibility of digital cultural heritage [26, p. 53-56].

In the Millennium Declaration (2010) and the Hangzhou Declaration (2013) it is stressed that the cultural aspect and the development of international cooperation in the field of culture is essential [11, p. 9], and "the time has come to fully integrate culture" [12]. This is stated in the state program of the Russian Federation "Information society (2011-2020)", approved by RF Government decree of April 15, 2014 No. 313 [18], where target is the high degree of integration of the Russian Federation in the global information society, in accordance with the need to respect international law.

Currently, however, there are problems of legal regulation of public relations in the performance of digital libraries. Information resources, such as electronic libraries, can act as an independent object of services, which allows us to distinguish these relations into a separate subject area. Research features of public relations in the field of library activities, identifying gaps and contradictions of their legal regulation is needed to improve law-making and for activities enforcement in the future.

At the legislative level the creation of a regulatory harmonization of information library processes is required, addressing issues of copyright for digital heritage, the rights of access to the resources of electronic libraries, information security, safeguarding and other specific to the virtual space (the Internet) software, technical and organizational regulations.

One of the current, to date, remains the problem of legal definitions. In scientific publications since the 1980s, there are several dozens of definitions of this type of libraries “electronic library”, “digital library” “virtual library,” etc. (twelve definitions are discussed in the work of K. V. Vigursky, and E. A. Mountain only) [22; 23, pp. 158-188; 24, p. 116-119].

Many of mostly foreign researchers believe that the most correct definition is “digital library” because all the materials in these libraries are digitized, i.e. get a digital, discrete nature. Digital nature presentation of information in digital (electronic) library determines both its potential opportunities and forms of work.

The correctness of such a definition is substantiated by the following features: a library is a collection of digitized materials available via computer, global computer network or the Internet; relies on a system and concept of formation, which determines which resources it includes and how they are organized; useful for finding information in its collections, the stability and reliability of access to them through information technology [35, p. 33-46].

In other words, the digital library is a library in which collections are stored in digital formats (as opposed to print, micro form, or other media) and accessible by means of computational tools. The content can be stored locally or remotely [36].

The Digital library Federation defines digital libraries as organizations that provide resources, involving specialized services; ...ensuring distribution, maintaining the integrity over time of collections of digital works, and free access to use a certain community or society as a whole [33, p. 579-591; 37, pp. 198-202]. This is the definition used by the Association of research libraries (Association of Research Libraries (ARL)), which includes the 124 libraries in the United States and Canada. More common in domestic practice and scientific publications of Russian researchers following terms: “electronic library” (A. B. Antopolsky, Konstantin V. Vigursky, etc.); “digital library” [21, p. 10-12; 25, p. 12-22]; “virtual library” are less likely [28, p. 134-138; 31, p. 190-192].

In the Russian legislation “electronic library” in legal acts is already used, but not disclosed, there is no clear definition [20]. The definition of “electronic libraries” is missing in the following fundamental documents regulating library activity and library: the Law “On librarianship” (1994) [15]; the Law “On objects of cultural heritage monuments of history and culture of the peoples of the Russian Federation (2002) [16]; the decree of the President of the Russian Federation “On approving the Fundamentals of state cultural policy” (2014) [19]; resolution of the Government of the Russian Federation “About interdepartmental Council on the development of the national electronic library” (2012), as amended by 2015 [20].

It is time to consolidate new legal definitions of “digital library” under national legislation in accordance with the Constitution of the Russian Federation and norms of international law, (in a separate law or as an amendment to the existing Law “On librarianship”). Taking into account that such a concept is already applied in a number of legislative acts of the Russian Federation, it is necessary to leave its base.

3. CONCLUSIONS AND PROPOSALS

All the above allows to make the following conclusion. All historical [1] and legal prerequisites for the recognition of digital libraries as objects of digital cultural heritage already exist [38] in the framework of the international legal instruments adopted under the auspices of UNESCO [6]: Charter on the preservation of digital heritage (2003) [8], the international Convention for the safeguarding of the intangible cultural heritage (2003) [7], the Declaration of the UN Conference on sustainable development “the Future we want” [11], the Declaration of the International Congress of Hangzhou (2013) [12], the Resolution of the UN General Assembly “keeping the promise: the Association in achieving Millennium development goals in the Millennium Declaration (2010) [4], “towards global partnerships” (2011) [9], “Culture and development” (2011) [10], the Declaration of the International Congress of Hangzhou (2013) [12] and others [3], [13].

REFERENCES

1. The United Nations Charter on Education, Science, and Culture (London, 16 November 1945) 2016, Access from inform. legal portal “Guarantor”.

2. Bachilo, IL 2016, Information Law, Moscow, 437 p.

3. Kokoykina, ON 2014, ‘The development of the information society and issues of digital preservation’, Formation of regional cultural policy in the context of the modernization of education: Proceedings of the international scientific-practical Conf., Orel, p. 53-56.

4. Bush, V 1945, ‘As we may think’, Atlantic Monthly, July.

5. Trivedi, M 2010, ‘Digital Libraries: Functionality, Usability, and Accessibility’, Library Philosophy and Practice, retrieved 26 March 2016, <http://www.webpages.uidaho.edu/~Mbolin/trivedi-diglib.htm>.

6. The electronic (digital) library (based on the monograph MN Karpenko “distance learning”) 2016, retrieved 26 March 2016, <obr-nauka.muh.ru/content/doc/110721_io_05.doc>.

7. Lagoze, CJ 2010, Lost identity: The assimilation of digital libraries into the web, Ann Arbor, 385 p.

8. Public Law 106-554-DEC. 21, 2000 2000, retrieved 26 March 2016, <https://www.gpo.gov/fdsys/pkg/PLAW-106publ554/pdf/PLAW-106publ554.pdf>.

9. The largest digital library world. FAQ 2016, retrieved 26 March 2016, <http://ria.ru/society/20090527/172428361.html#ixzz3uGeTeTJM>.

10. World Digital Library 2016, retrieved 26 March 2016, <http://www.wdl.org/en/>.

11. The UNESCO Universal Declaration on Cultural Diversity (adopted on November 2, 2001) 2001, retrieved 26 March 2016, <http://www.un.org/ru/documents/decl_conv/declarations/pdf/decl_diversity.pdf >.

12. IFLA Multicultural Library Manifesto (app. In August 2008, the Board of IFLA) 2016, retrieved 26 March 2016, <http://www.ifla.org/files/assets/library-services-to-multicultural-populations/publications/multicultural_library_manifesto-ru.pdf>.

13. Fundamentals of the Russian Federation legislation on culture (app. Russian Armed Forces 09.101992 № 3612-1) (ed. From 11.28.2015) (rev. And ext., Joined. In force from 01.01.2016) 2016, Access from legal system “Consultant”.

14. Russian Association of Digital Libraries 2016, retrieved 26 March 2016, <http://www.aselibrary.ru/index.html>.

15. Towards global partnerships: the UN Declaration of December 7, 2011 A/66/447 2011, retrieved 26 March 2016, <https://doc-uments-dds-ny.un.org/doc/UNDOC/GEN/N11/626/50/PDF/N1162650.pdf?OpenElement>.

16. Kokoykina, ON 2014, ‘The development of the information society and issues of digital preservation’, Formation of regional cultural policy in the context of the modernization of education: Proceedings of the international scientific-practical Conf., Orel, p. 53-56.

17. The future we want: Declaration of Conf. UN Sustainable Development (Rio de Janeiro, June 2012) 2012, p. 9, retrieved 26 March 2016, <https://rio20.un.org/sites/rio20.un.org/files/a-conf.216-l-1_russian.pdf.pdf>.

18. Hangzhou Declaration “Ensure a central place of culture in sustainable development policies” (adopted in Hangzhou, Peo-ple’s Republic of China on May 17, 2013) 2013, retrieved 26 March 2016, <http://unesdoc.unesco.org/im-ages/0022/002212/221238m.pdf>.

19. On approval of the state program of the Russian Federation “Information Society (2011-2020)”: Resolution of the RF Gov-ernment dated 15 April 2014 no. 313 2014, Access from legal system “Consultant”.

20. Antopolskiy, AV & Vigurskiy, KV 1999, ‘The concept of digital libraries’, Digital Libraries, vol. 2, no. 2, retrieved 26 March 2016, <http://rd.feb-web.ru/vigursky-99.html>; Vigurskiy, KV & Gorniy, EA 2002, ‘Development of Digital Libraries: World and Russian experience, problems and prospects’, Internet and Russian society, Moscow, p. 158-188; Vigurskiy, KV 2006, ‘Dig-ital libraries: basic concepts’, Scientific book, no. 1, p. 116-119.

21. MacCall, SL, Cleveland, AD & Gibson, IE 1999, ‘Outline and preliminary evaluation of the classical digital library model’, 62nd Annual Meeting of the American-Society-for-Information-Science on Knowledge-Creation, Organization and Use, vol. 36, Washington D.C., p. 33-46.

22. Trivedi, M 2010, ‘Digital Libraries: Functionality, Usability, and Accessibility’, Library Philosophy and Practice, retrieved 26 March 2016, <http://www.webpages.uidaho.edu/~Mbolin/trivedi-diglib.htm>.

23. Arms, WY 2012, ‘The 1990s: the formative years of digital libraries’, Library hi tech, vol. 30, is. 4, p. 579-591; Shiri, A 2003, ‘Digital library research: Current developments and trends’, Library Review, vol. 52 (5), p. 198-202.

24. Alekseev, VN, Borodikhin, AY, Shabanov, AV & Dergacheva-Skop, EI 2008, ‘The digital library of ancient literary monuments of Siberia in SPSTL’, Modern Information Technologies and Written Heritage: From ancient texts to digital libraries. El’Man-uscript-08: Proceedings of Intern. scientific Conf., Kazan, p. 10-12; Erkimbaev, AO, Zitserman, VY, Kobzev, GA & Trahten-gerts, MS 2014, ‘Digital library instead of the traditional database for nanotechnology: the experience of using the ABCD system’, Scientific and technical information. Series 2: Information processes and systems, no. 6, p. 12-22.

25. Pchelintseva, SV & Prokhorova, DV 2014, ‘Peculiarities of the distance course “Artificial Intelligence Systems” in a joint virtual library based platform CLAROLINE’, Mathematical methods in engineering and technology, no. 4 (63), p. 134-138; Senich-kina, YA 2011, ‘Real and virtual library’, Actual problems of social communication: proceedings of the second International scientific-practical conference, N. Novgorod, p. 190-192.

26. Interagency Council on the development of the National Electronic Library (along with the “Regulations on the Interdepart-mental Council on the development of the National Electronic Library”): the order of the Russian Government dated 1 Sep-tember 2015 no. 918 2015, Access from legal system “Consultant Plus”.

27. On library: feder. Law of December 29, 1994 № 78-FZ (ed. of 8 June 2015) 2015, Access from legal system “Consultant”.

28. On the objects of cultural heritage (monuments of history and culture) of the peoples of the Russian Federation: feder. Law of June 25, 2002 № 73-FZ 2002, Access from legal system “Consultant”.

29. On approval of the Fundamentals of the state cultural policy: Presidential Decree of December 24, 2014 no. 808 2014, Access from legal system “Consultant”.

30. Interagency Council on the development of the National Electronic Library (along with the “Regulations

on the Interdepart-mental Council on the development of the National Electronic Library"): the order of the Russian Government dated 1 Sep-tember 2015 no. 918 2015, Access from legal system "Consultant Plus".

31. The Agreement on the Protection of Artistic and Scientific Institutions and Historic Monuments (Roerich Pact), signed at the White House members of the twenty-one American Republic, April 15, 1935, at 12 am: the resolution of the Seventh Inter-national Conference of American States on the Roerich Pact 2016, retrieved 26 March 2016, <http://etikavomne.agni-age.net/work/pact.htm#dogovor>.

32. The Scope of the Digital Library: draft prepared by B.M. Leiner for the DLib Working Group on Digital Library Metrics. January 16, 1998. Revised October 15, 1998 1998, retrieved 26 March 2016, <http://www.dlib.org/metrics/public/papers/dig-lib-scope.html>.

33. 'The Charter on the Preservation of the Digital Heritage' 2004, Library, no. 6, p. 40-43.

34. International Convention for the Safeguarding of the Intangible Cultural Heritage (Paris, 17 October 2003) 2003, retrieved 26 March 2016, <http://unesdoc.unesco.org/images/0013/001325/132540r.pdf>.

35. The future we want: Declaration of Conf. UN Sustainable Development (Rio de Janeiro, June 2012) 2012, p. 9, retrieved 26 March 2016, <https://rio20.un.org/sites/rio20.un.org/files/a-conf.216-l-1_russian.pdf.pdf>.

36. Hangzhou Declaration "Ensure a central place of culture in sustainable development policies" (adopted in Hangzhou, Peo-ple's Republic of China on May 17, 2013) 2013, retrieved 26 March 2016, <http://unesdoc.unesco.org/im-ages/0022/002212/221238m.pdf>.

37. Keeping the promise: united to achieve the Millennium Development Goals, the Millennium Development Goals: the resolu-tion of the UN General Assembly on September 22, 2010 2010, retrieved 26 March 2016, <http://daccess-dds-ny.un.org/doc/UNDOC/GEN/N10/512/62/PDF/N1051262.pdf?OpenElement>.

38. Towards global partnerships: the UN Declaration of December 7, 2011 A/66/447 2011, retrieved 26 March 2016, <https://doc-uments-dds-ny.un.org/doc/UNDOC/GEN/N11/626/50/PDF/N1162650.pdf?OpenElement>.

39. Culture and development: a draft UN resolution on December 22, 2011 2011, p. 10-14, retrieved 26 March 2016, <https://doc-uments-dds-ny.un.org/doc/UNDOC/GEN/N11/632/49/PDF/N1163249.pdf?OpenElement>.

DISCUSSION OF ACTUALITI OF THE INTERNATIONAL VIRTUAL MUSEUM OF IDUSTRIAL DESIGN CREATION. THE ROLE OF THE MUSEUM IN THE CULTURAL HERITAGE PRESERVATION AND DESIGN EDUCATION

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Abstract

The idea of creation of an International Virtual Museum of Industrial Design is discussed, and also actuality and possibility of such a project aimed on an introduction of history and development of design to the auditory of Internet users.

A brief overview of different virtual museums and real-life design museums is presented. A conception for International Virtual Museum creation is suggested in the report.

INTRODUCTION

When we discuss the best design objects as a part of material culture of humankind combining the achievements of science, technology and art, we clearly understand the value of these objects. But what are the criteria for announcing of a design object worth our attention and preservation? If we discuss this from one point of view, such as technical or esthetical, these criteria are not enough, as the functionality of the object is also essential. Designer's masterpieces differ from pieces of art which are unique and possess artistic value by nature; objects of design can exist in a numerous number of copies and their esthetic value depends upon morphogenesis trends in culture and changes under the influence of fashion. Design solutions lose their actuality when the new materials and technologies appear and also the needs of users change. Industrial design objects are created for users' needs satisfaction and while exploited they are deteriorating and finally they are utilized. More of it, the objects worth the places of honor in the best design collections can be exhibited in a technical museum, where their esthetical perfection is out of attention.

The history of Art museums is as long as a few centuries. Uffizi Gallery, for example, exists for more than four centuries. The son of Francesco Cosimo I de 'Medici exhibited antique sculptures and other valuable pieces of art on the first floor of the gallery east building in 1581 [1], and it became the start point for the World famous museum organization. The collections of industrial design products as the results of specific creative activities appear later, only in second half of XIX – early XX century, when the mass industrial production began. Thus, the creation of representative Museum of Design in the town of Hagen was an important point in the design history. The German

Fig. 1. Site designmuseum.org, the exhibits presentation

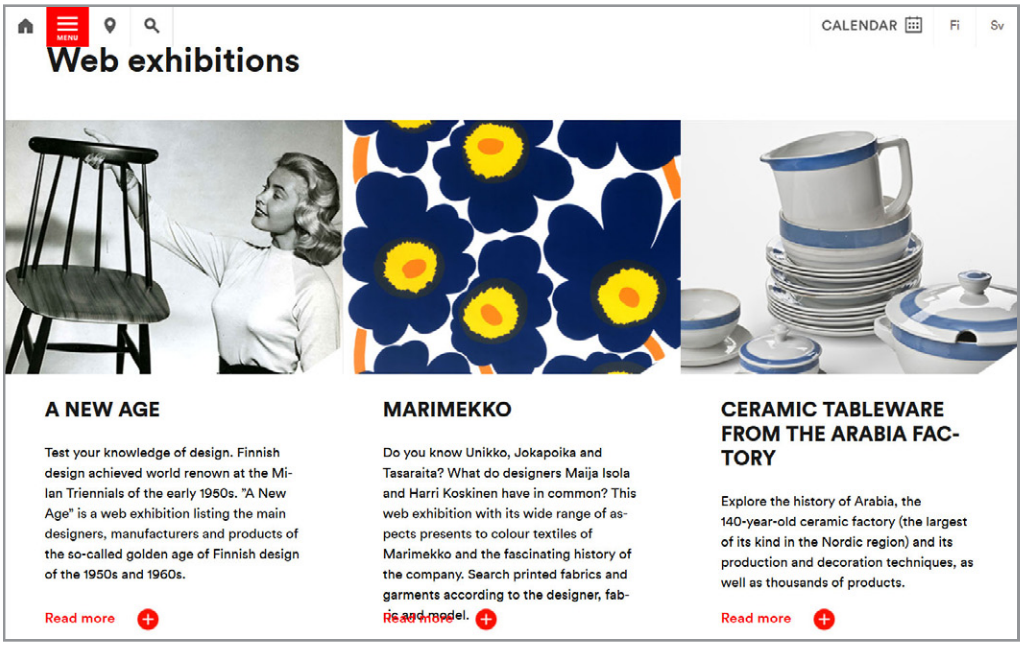

Fig. 2. A page from www.designmuseum.fi

Industrial Union (Deutscher Werkbund) and Karl Osthaus, manufacturer and collector, opened the “German Museum of Arts in Merchantry and Crafts” in 1909. The collection of the museum included “all commercial life objects”, including the printed materials [2].

Based on the foregoing, we can assume that the preservation of design masterpieces and design museums traditions have some features of their own when compared with the artistic and technical museums. These features are likely to be useful for the virtual museum of design. The virtual museum of design would allow us to preserve not only the best samples from famous designers of different countries and epochs, but also the serial production of unknown designers that accompany people in their everyday life and form the representation of material culture.

Fig. 3. A page from the www.triennale.org site

MUSEUMS OF DESIGN IN THE INTERNET

The expositions presenting the production of world-famous designers and national schools of design are opened in many countries now. They can be both included in the Art museums and as independent long-term exhibitions and specialized museums. Normally, these exhibitions are presented in the Internet with their own sites, which are an important source of information concerning the design history and new happenings in this sphere.

The London Museum of Design can be an example of such exhibition. Terence Conran opened the exhibition in the "Boilerhouse" pavilion on the base of the Victoria & Albert Museum in 1981, and in 1989 it was reorganized in the Design Museum. The Museum occupies a three-level loft on the Bank of Themes. This is a private museum and it exists with the help of a special fund and private donations. At the Museum site (designmuseum.org) we can find the catalogues and most interesting exhibits (fig.1) from the collection in the on-line regime [3].

The Helsinki Design Museum (fig.2), presented in the Internet with its own site (www.designmuseum.fi) with the WEB-exhibition can be discussed as a sample of national design museum.

The gallery view is accompanied with the following text: "The web exhibition is developed from the Memoron collection management program, in which the museum's collections have been catalogued. The copying of images is forbidden".

Triennale Design Museum (Milano) (fig. 3) uses the site www.triennale.org not only to announce exhibitions or photo's demonstration, but also provides additional materials, e.g. video. This helps the visitors to get a more detailed idea of the exhibition.

The brief review of the design museums web-resources allows us to conclude, that they are used as presentations of the museums and exhibitions. Normally, these pages inform briefly about the museums activities and supply the images of a few exhibits. This is a reasonable approach, as the museum site main tasks are the visitors' attraction and also the copyright on the images of exhibits preservation. But these features of the museum sites make the search of information concerning design more complicated for the people who have no possibility to visit different countries and cities. Probably, the International Industrial Design Museum, where the images copyright problem would be solved, could supply with the complete information everybody, who is interested in the design history, and, especially, the design schools students. At the same time, the existing museum sites use different principles of the information structure, presenting the exhibits chronologically, grouping according to the types of production (e.g. furniture, textiles, table ware, etc.), or based on personality. These principles could be used for the virtual museum, too.

SCIENTIFIC AND TECHNICAL MUSEUMS IN THE INTERNET

Means of transport, ships, airplanes and space ships were not only engineering achievements, but also the industrial design objects from the very beginning of their existence. Unfortunately, they are not presented in the design museums because of some circumstances. They are presented in technical and scientific museums normally, and demonstrated at the corresponding web-sites.

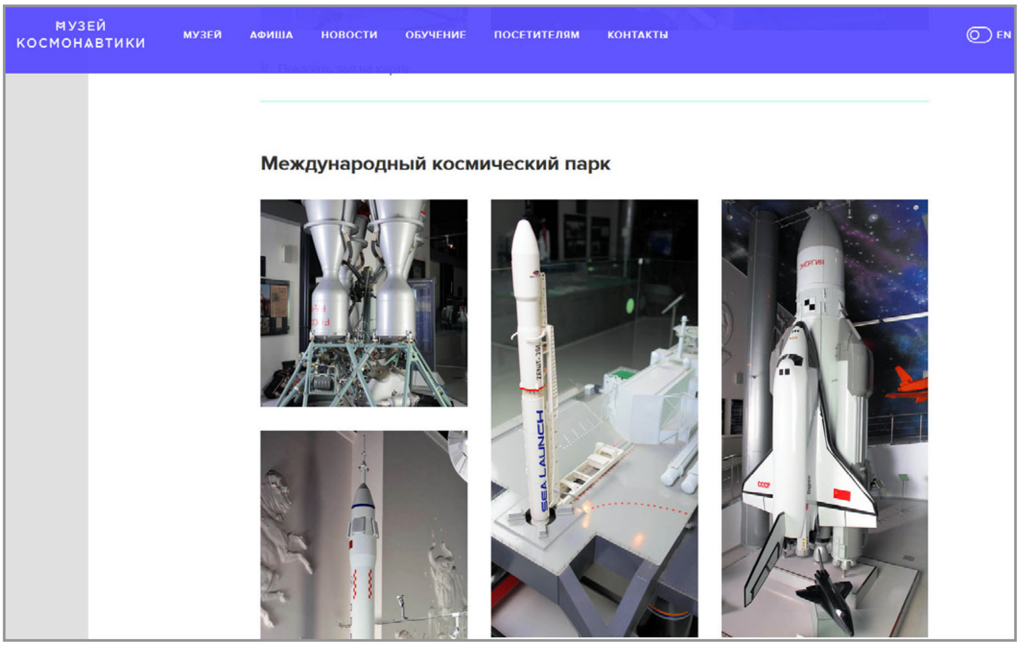

Fig. 4. A page from the Museum of Cosmonautics site

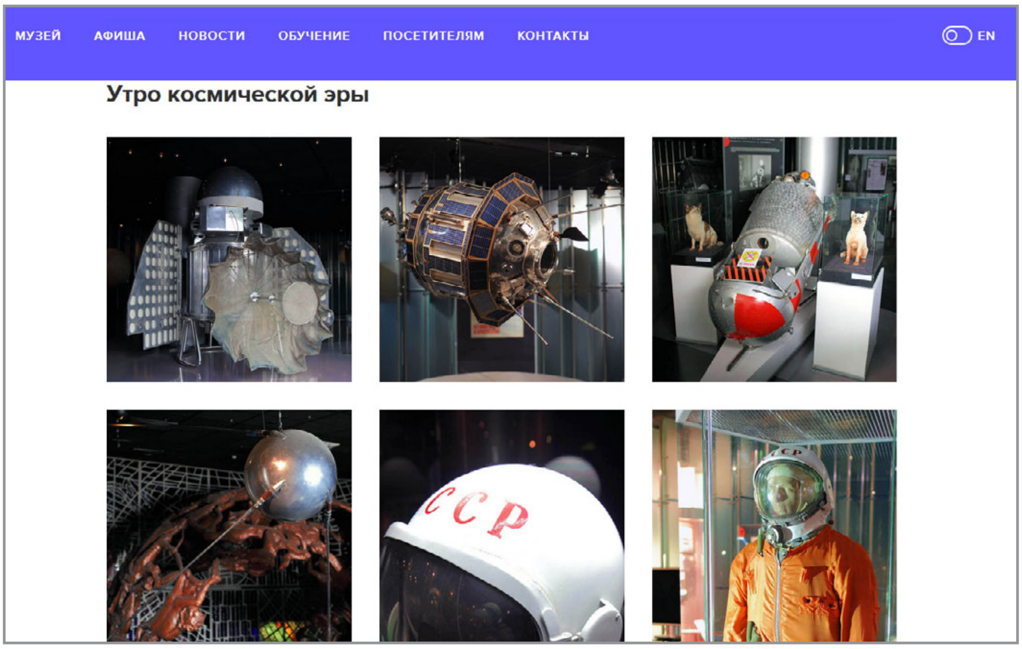

Fig. 5. A page from the Museum of Cosmonautics site

Still, many of such devices are important from the point of view of technical esthetics and ergonomics. They are interesting for designers, design historians, students. As a sample of a technical museum, presenting exhibits that are interesting from the point of view of design, we can discuss the site of the Museum of Cosmonautics (Moscow) (www.kosmo-museum.ru, figs. 4, 5), and of the National Railway Museum (York) (www.nrm.org.uk, fig. 6).

Unique exhibits often are presented at the technical museums sites; they are not models but original functional devices. But we can see normally only a few images and a brief description, sometimes accompanied with a video. For the virtual exhibition a 3D-model could be created, that would allow the visitors to see the object from all points of view, have a look inside, see how it works. The old technique is not

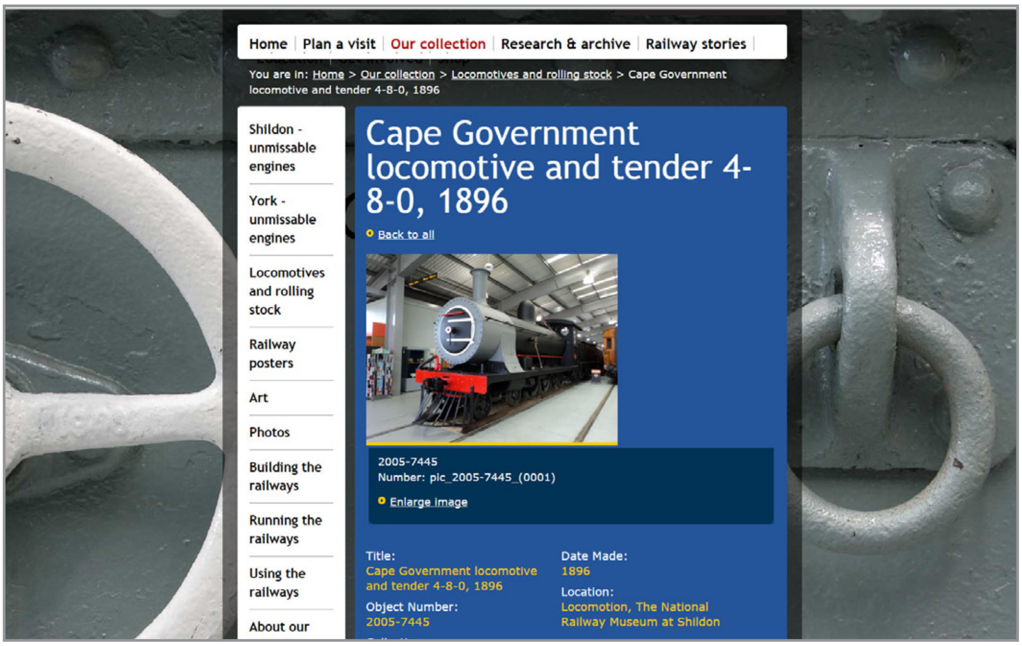

Fig. 6. The National Railway Museum site

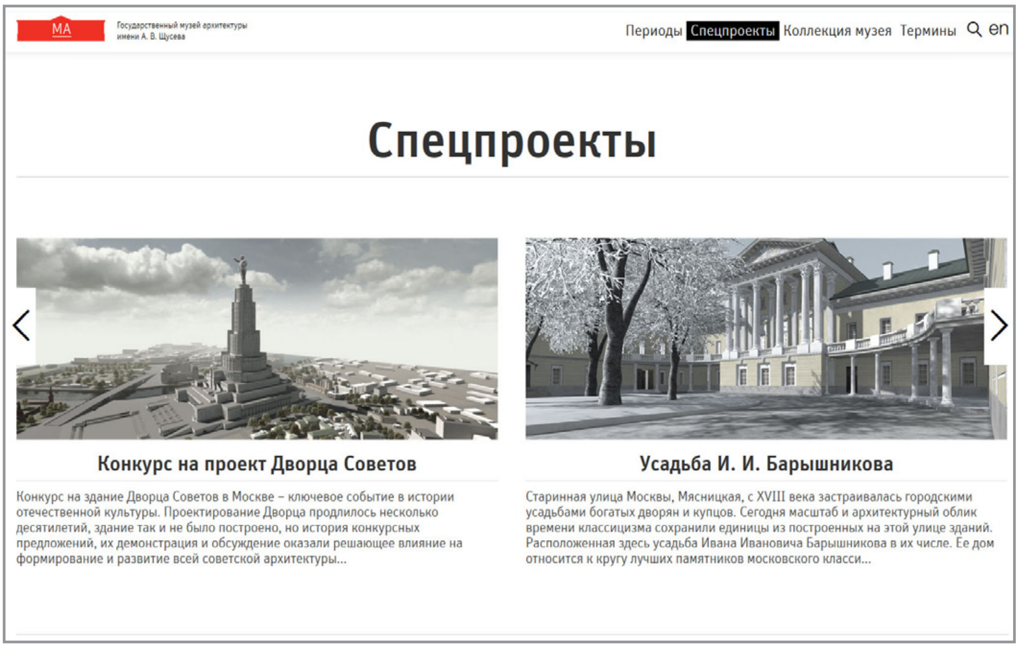

Fig. 7. Virtual Museum of Architecture on the Schusev State Museum of Architecture site

always suitable for reconstruction, as the process can be too complicated and expensive. More of it, the large objects need a lot of storage space, often the problem of keeping of a large collection becomes intractable. The virtual reconstruction methods based on the existing drawings that are successfully used for the architectural heritage reconstructions could be used also for the lost design objects.

VIRTUAL MUSEUM OF ARCHITECTURE

Virtual Museum of Architecture on the Schusev State Museum of Architecture site (vma.muar.ru) can serve as an example of such reconstructions. That's how the site describes the used technology facilities: "Except for the funds and the history of architecture study, the site also provides a unique possibility to have an excursion around the unrealized and lost monuments. In a special section the unique projects are presented – the results of joint efforts of the Museum and software specialists. The interactive 3D-models allow the site visitors to view the lost and projected constructions from all sides and in different regimes; walk and fly around the objects; receive the reference information" [4].

THE IDEA AND THE CONCEPTION

The idea of the International virtual museum of industrial design is based on three main points:

1. The globalization of the cultural processes and the understanding of the importance of the preservation of best samples of material culture;
2. The growth of interest to the history and development of design not only from specialists, but also from a wide auditory, including young people. The interest to the design as a cultural phenomenon;
3. The existence of computer technologies, allowing the developing of the project.

We could suggest some ideas concerning the conception of the museum:

1. Each participating country could be presented in a special "room", where the virtual exhibition of best national design achievements of global importance could be created. Thus, Russia could be presented by avant-garde and constructivism of the beginning of the XX century, as well as by the design projects and artifacts created for space exploration, starting from the second half of the XX century;
2. Personal "rooms" can be created also for the outstanding designers or the designers working in different countries, representatives of international style, for example, such as Henry Van de Velde, Walter Gropius, Le Corbusier, Charles, Zaha Hadid;
3. The exhibits could be presented with the help of photo images, video and 3D-models. The corresponding text could be suitable for printing, seen on-screen or reproduced in an audio-format. Probably the texts should be presented in the national language of the corresponding country and in English.

CONCLUSION

Probably the Virtual Museum of Design could be the main possibility for systematization and preservation of the important part of the global cultural heritage, as the industrial design masterpieces are a significant part of the material culture. Also the museum could be used for educational goals both for public and industrial design students.

A modern informational and communication technology allows organizing an international project. Each country can be presented in the virtual museum with original design pieces and as a part of general cultural-historical process, together they will form the general representation of the process of design development.

REFERENCES

1. http://www.uffizi.org/ru/ accessed 15.06.2016
2. Филл Ш., Филл П. История дизайна. – Москва: Колибри, 2015 (russian edition)
3. http://www.4living.ru/ accessed 15.06.2016
4. http://muar.ru/item/804-vma-na-intermuzee accessed 15.06.2016

Section 3.
3D-Reconstructions & Virtual Reality

DIGITALISATION OF A WHALING STATION IN THE KERGUELEN ISLANDS (SOUTHERN FRENCH AND ANTARCTIC LANDS)

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Fig. 1. Topography equipment on-site

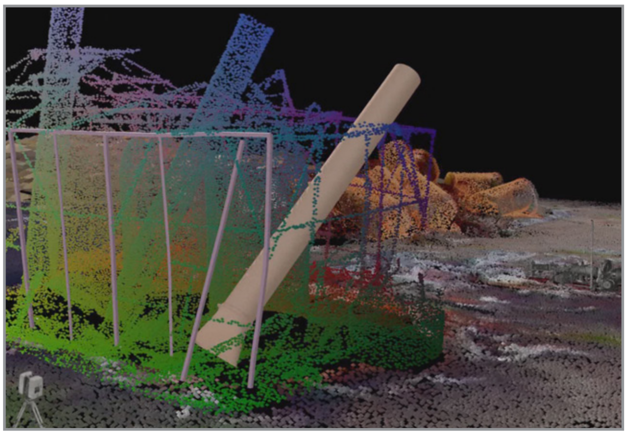


Fig. 2. Cloud and ground reconstruction

Abstract

The decision to make these far-away and barely-visited parts of the Southern French and Antarctic Lands more accessible has motivated the use of restoration technologies computerised from reality. The first mission for points acquisition completed in December 2010 now offers a variety of possible immersive and interactive visits which could be used in both tourism and scientific research.

INTRODUCTION

Virtual access to spaces offers an opportunity to discover and enhance potential places by promoting their attractiveness to potential tourists. Paradoxically, it is for that reason that through limiting access to touristic visits, The Southern French and Antarctic Lands have encouraged, with support from the Ministry of Culture, the use of a range of new technologies. The points initially acquired on the land in 2010 now give us a range of restoration means [1].

TOURISTIC ENHANCEMENT AND LIMITATIONS OF PHYSICALS VISITS

All 18th-century geographers agreed on the same thing: for the Earth to rotate almost perfectly on its axis, an equal amount of land exposure spread across the Southern hemisphere as in the Northern hemisphere was needed. Some even made progress by saying that an equal latitude in the Southern hemisphere corresponded with the same climate in the Northern hemisphere. This created hope for the discovery of a great Southern continent referred to geographically as “The Third World/Tertio mundi” that would guarantee the wealth and power of the country that conquered it. It included reproducing the consecutive economic and political plan made upon the discovery of the “New World” in America. Several maritime nations attempted to discover these promising lands by sending yachtsmen into Southern seas and some were able to complete geographical maps. Even French explorers such as Bougainville, La Pérouse, Crozet and Kerguelen discovered the lands that the Englishman, James Cook would visit some decades later. Travel narratives and accurate locations were able to generate economic temptations and even human stories have been combined with scientific or economic adventures.

There are still some remains of past activities. Their lack of maintenance sometimes leads to ruins that are incompatible with the desire to protect natural spaces. In other cases, their reconstruction enables touristic visits with vessels carrying thousands of tourists.

France, the country in control of the Antarctic and sovereign of certain territories under the authority of a territorial community (French Southern and Antarctic Lands – FSAL) has its only whale hunting site in the Kerguelen Islands (49° S), referred to as “Port Jeanne d’Arc”.

The station, built by Norwegians in 1908, operated for around 10 years [2]. Its operation model was similar to the one that the British used in South Georgia during the same time period. Whereas the establishment in the Kerguelen Islands was closed down, the British continued with, extended and modernised theirs. The Kerguelen site is therefore considered as a “fossil” representing the state of an industry in a given time period. Here, reconstruction offers an amazing opportunity for international cooperation and the study of a past industrial activity.

VIRTUAL REONSTRUCTIONS IN 3D/4D

A mission for points acquisition was carried out in December 2010 over 46 hours on a site across 6 hectares with the help of 3 laser scanners: 2 HDS 6000[1] and 1 C 10[2] by Leica® on a tripod. Topography equipment was

[1] Range of 60 metres
[2] Range of 120-150 metres

Fig. 3 and 4. Real life (left) and digitalised pigsty (right)

added to this[3] , allowing an adjustment of scanners with earbuds. Using the 209 viewpoints collected, a cloud of 4 billion points was generated. This information has been paired with circular helicopter flights over the site at different altitudes (50, 250 and 500 metres) with photographic coverage.

The points were assembled with Cyclone, a software dedicated to Leica ® material. As the clouds were correlated, the unnecessary points were removed and a ground reconstruction "skin" was started on. At the same time, the buildings were directly reconstructed through simulation in the cloud. This work was done "by hand" and represents an important time period. As the land and "objects" were rebuilt, the colour was obtained through the use of photos of veneer textures taken during the scanning process.

The result is a textured model; we have created shaders so that the coloured beaches look realistic with regards to the volumes (we therefore differentiate between "materials"; for the same colour we distinguish between wood and metal, for example). This stage allows us to obtain the database of the site at time T. The simulation of the site as a whole was carried out with Blender® [4], and we have obtained a result that is true to reality.

With Unity®, we can achieve real-time mobility at the cost of a slight decrease in realism, attributable to shorter calculations. At this point, we have our digital clone which lends itself to both leisure and scientific uses…

In addition to the development of a similar site visited in 2010 (3D reconstruction), from photographic archives we have created a 3D development of how it was a century ago, during the construction of the station (4D reconstruction). A sound knowledge of the anchorage points of the buildings in construction in 2010 and technology that allows the adjustment of the camera by correlation enables us to accurately know the position and angle of ancient camerawork. Through knowledge of camera angles, we can rediscover the height and characteristics of the building that has disappeared. We have reconstructed it to look just as it did at the time[5], using Blender®.

The overall time for the creation of a 3D digital clone (not including presentation to the public) is estimated to be around 700 hours, broken down as follows:

Time needed for the operation: 46 hours' worth of points acquisition;

Time needed for the use of Cyclone and the integration of the point clouds derived from photos: 50 hours;

Time estimated for the simulation of buildings: 600 hours;

Time estimated for the 4D reconstruction: 160 hours.

INTERACTIVE IMMERSION WITH HEAD MOUNTED DISPLAY OCULUS RIFT DK2

ITMO University team, in collaboration with Eurl Pérazio team, have designed a virtual interactive walk through a recreated site in Oculus Rift DK2 virtual reality helmet.

The solution used was Unity3D graphics engine with the option of exporting a 3D scene into head mounted displays.

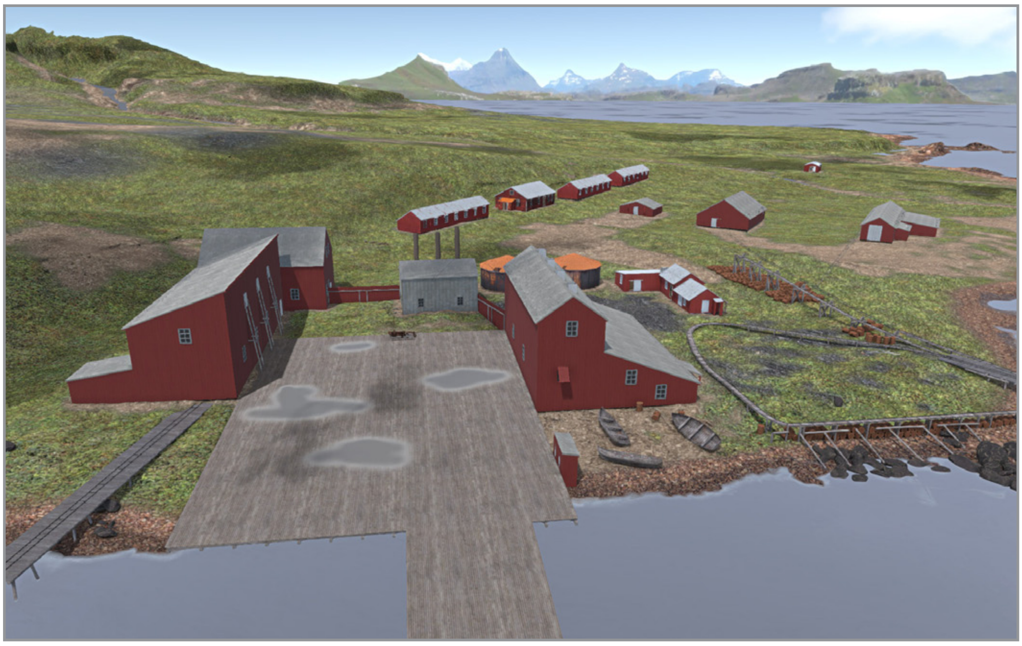
The experience of working with virtual reconstructions and head mounted displays has shown that the use of keyboard for navigating the virtual space with the helmet on is highly uncomfortable for an average user. Even the advanced users, with extensive computer games experience, experience certain problems with the controls.

Having considered a number of options, we settled on a version of 3D space navigation, similar to the navigation between panoramic pictures. In this case, the only control instrument the user requires is the head mounted display itself. To move from one object to another, you need to point a semi-transparent aiming symbol at a spe-

[3] TCRA 11103+

[4] Free software

[5] Depending on the quality of the original photos, the accuracy of the replacement can be a few centimetres out.



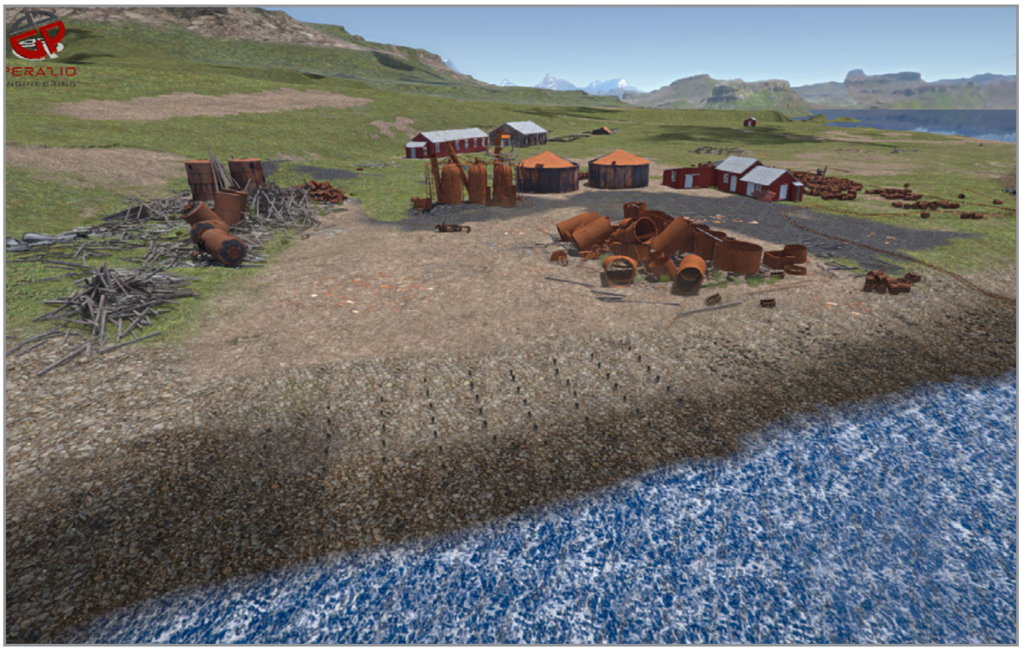


Fig. 5 and 6. 4D reconstruction of the site in 1910 using Blender (top) and its current situation in 3D (bottom)

cial marker, that, together with certain animation, initiates the action, i. e. the move to another location.

Apart from moving between locations on panoramic photo principle [3], hot points were created for the key locations of the 3D scene; they allow to obtain data on certain objects; this upgrades the 3D scene from just a passive walk through the grounds to an information- and education-oriented resource.

PERSPECTIVES

For the purpose of natural protection of these faraway lands, the FSAL tries to limit physical access by tourists on the sites themselves, while at the same time making the best virtual visits possible. The reconstruction process of “Port Jeanne d’Arc” is included in this policy and since its beginnings in December 2010, has led to several par-

Fig. 7. Backpack

tial or temporary reconstructions. The final result focuses on being "passively" shown to the public on-screen (computers, cinema screens etc), with the viewer watching the visit as if it were a film, and it can even be done "actively" thanks to interactivity.

Cooperation between French and Russian teams that was established in 2016 enhances the initial process of an immersive approach (oculus technology and recognition of the pupil's axis/eye tracking). Our approach is similar to that which is carried out in other sensitive and precious locations such as caves containing prehistoric art and is included in a process of dematerialised museography.

The use of such instruments in extreme climates poses a challenge when it comes to withstanding low temperatures. Likewise, strong winds can damage the accuracy of measurements. Therefore, we use a Leica backpack® in order to ensure future capture points in a dynamic way, which in principle is similar to the acquisition systems embedded in vehicles which can reach 70km/h.

CONCLUSION

The existence of two reconstructions that are "passive" and commented on, and "interactive" with other comments that give more details on what the "visitor" sees could be used together. Thus, this process will allow an interactive visit during which the visitor will move around the site and hear a general commentary. When they click on a certain point, they will be directed towards it and will receive specific information. Once this information has been provided, the general commentary will start again. We believe that this idea could offer numerous outlets in the tourism sector for a new form of visits that can be downloaded through reading applications by means of a marker.

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REFERENCES

1. MOUCHEL-BLAISOT R., REBIERE J., MOR-EIGNEAUX N., PERAL J., VALCKE S. (2008) : Pour une valorisation du patrimoine industriel des TAAF in « Conserver, étudier, protéger, valoriser le patrimoine en milieu isolé » Bastia-Lucciana, 9-12 octobre. ISBN 978-2-906375-10-9 / EAN 9782906375109. 13p.

2. GALTELAND O. (2012) : KERGUELEN LTD. 1908-1921. The optimism, the dreams – and the dull working day. Sandefjord, 51p.

3. Nikolay Borisov, Artem Smolin, Pavel Shcherbakov, Denis Stolyarov, Vasiliy Trushin, "The opportunities of applying the 360° Video Technology to the presentation of cultural events", ArtsIT 2016 - The 5th EAI International Conference on Arts and Technology, Interactivity & Game Creation, 118p.

DESIGN OF INTERACTIVE VIRTUAL ENVIRONMENTS. INTERACTIVE VIRTUAL 4D TOUR OF KORELA FORTRESS

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Abstract

The article explores the concept of virtual interactive environment through the case study of a prototype of a virtual interactive 4D tour of Korela Fortress. The team of ITMO University, together with the staff members of Korela Fortress Museum, create a virtual privately guided tour of the Fortress's premises, with the option of making a "leap in time" into the virtual 3D reconstruction of the Fortress of the late 17th – early 18th century.

INTRODUCTION

Virtual interactive environment can be defined as the immersion of the user into 3D virtual space, with the option of communicating with the 3D environment through various media (hot points, markers, virtual avatars etc.). The user must feel relocated into the space, integrating into it; this will trigger the desired emotional response.

The users can access these options via various head mounted displays that work both in the full immersion

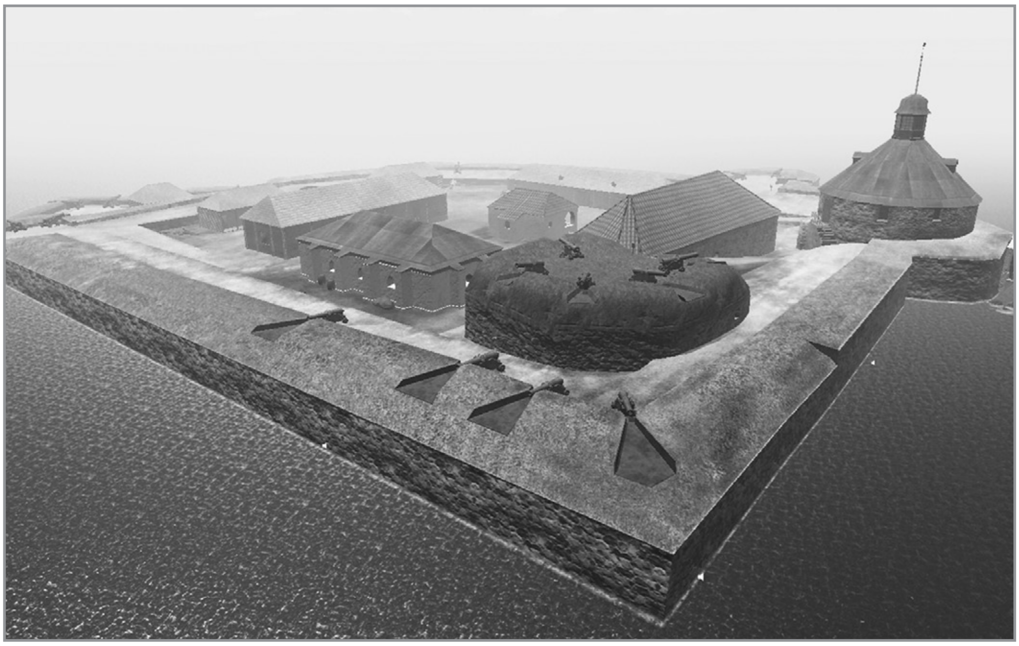

Fig. 1. Virtual reconstruction of Korela Fortress in late 17th – early 18th cents

into the virtual reality mode and in the augmented reality mode (communication with the objective reality) [1].

Virtual reality systems can be used in entertainment, education, in various interactive simulators for acquiring or improving certain special skills – speaking a foreign language, driving a car, managing the equipment of an oil processing factory. The simulators can be designed either as computer applications with standard configurations, or as entire software complexes that need advanced hardware and other types of specialized equipment [2].

A good example of interactive multimedia environment designed for cultural purposes is the project by the research group Information and Communication Systems INKA and HTW, Berlin University of Applied Sciences, in cooperation with Konzerthaus Berlin.

Using Video 360° technology, as well as the Samsung gear VR virtual reality helmet, an interactive application was designed that allows to watch a concert with interactive elements and, using special markers, obtain information on which musicians are currently performing this piece [3].

VIRTUAL INTERACTIVE 4D TOUR OF KORELA FORTRESS

Korela Fortress was selected as the venue for the virtual interactive tour; the Fortress's virtual 3D reconstruction for late 17th – early 16th century was created as a part of Ancient Fortresses of Russia's Northwest Multimedia Information System project.

Ancient Fortresses of Russia's Northwest Multimedia Information System is a research and educational resource designed by the team of the Center for Design and Multimedia of ITMO University; the project was backed up by the grant of Russian Humanitarian Research Fund (2012-2014) [4].

The virtual reconstruction of the Fortress was done to reflect a certain period, determined by the amount of data available (technical documents, photo records, illustrations etc.).

Autodesk graphic environments were used for making the virtual models of the fortresses; then the objects were exported into Unity3d graphic system.

The application was released in two versions.

The first version is the compiled file of the Fortress grounds, available at nwfortress.ifmo.ru. Once the respective page is downloaded, the user can "take a walk" through the grounds, view the reconstructed objects (canons, a cart etc.), and, with the help of the "HOT POINTS" system, obtain specific data on each structure located inside the fortress (Fig. 1) [4].

The second version of the virtual tour was specifically designed for the use together with the Oculus Rift virtual reality headset [4].

The project of 4D virtual reconstruction of Korela Fortress involved the combination of two technological challenges: a virtual 3D reconstruction of the Fortress and a tour in Video 360° format.

This particular fortress was selected, since its virtual historic reconstruction for the late 17th – early 18th century and its present-day exterior seemed to fit well together.

The goal was to design a virtual interactive privately guided tour of Korela Fortress, in 360° video format (the option of selecting the continuation of the tour at key points), with the option of moving from 360° video to 3D reconstruction format and back at all the key points [5].

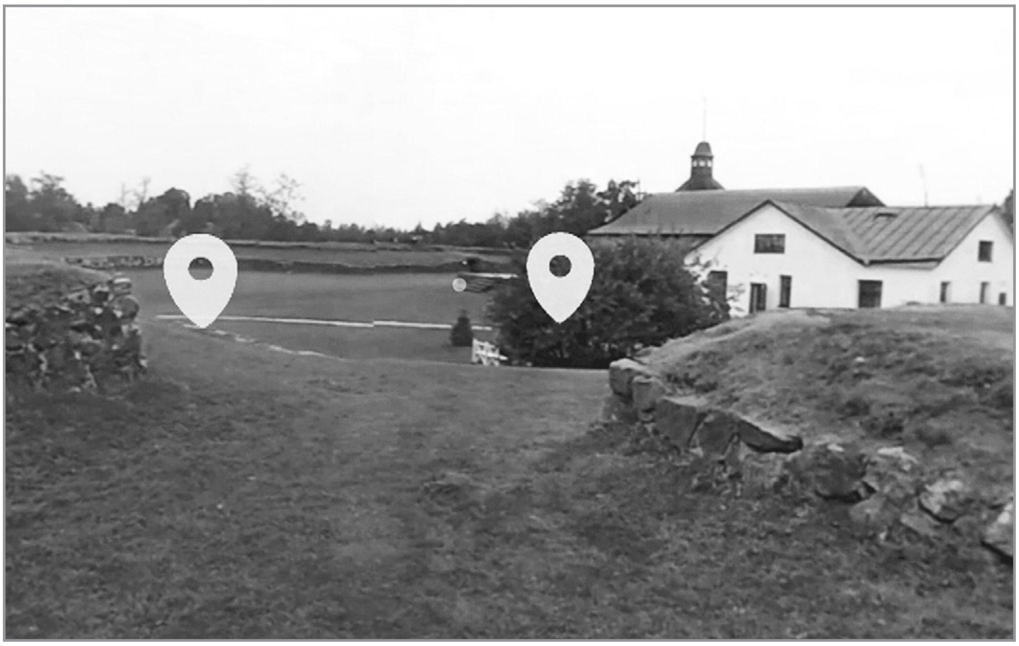

Fig. 2. Tour in Video 360° format with markers

The main challenge was to integrate a large number of fairly high resolution (4096x2048) video files into the Unity3d system, while ensuring their seamless switching and playback.

The first step was to analyze the potential of Unity3d standard instruments; the resulting decision was to use AVPro Windows Media RenderHeads plug-in. The plug-in ensures fluid playback of the video with the required resolution, and allows to superimpose the video over any surface. Since the materials filmed through video 360° production have equidistant scanning, a sphere with inverted normals was selected for the projection surface.

To combine two different locations, control points were selected on the grounds of Korela Fortress, non-identical to the non-preserved reconstructed virtual objects, and tour routs were chartered in between. The walks were filmed in both directions, to give the user the option of returning to the current point in the same walking mode.

The video files were divided into "walk" and "stationary" videos. The static "stationary" videos were 30-second loop files that would be repeated until the user selected the direction of his next move. After that, the walk video is activated; once this is done, the next static video is activated.

The name of the video file for the walk and the next point is determined by pointing the aiming symbol at a marker, designed in ITMO University corporate style (Fig. 2).

The choice is made by pointing the semi-transparent aiming symbol, located at the user's central focal point, at a special marker; this activates animation that shows after which time span the required action will take place. If the viewer "turns away" before the end of the animation, the marker returns fluidly to the initial position, and no transition takes place.

Since Unity3d cannot reproduce gif-animation, sprite animation technology was used. The video files was divided into stills, and converted into a special table that can be interpreted by Unity3d as a sequence of images that can easily be animated with the Unity3d inbuilt animation instrument.

Using this principle, the virtual tour of Korela Fortress in Video 360° format was assembled (Fig. 3). To facilitate the control in course of the tour, the following hotkeys were used:

1. Fast-forward of the current video file of the tour, with the move to the next control point;
2. Return to the beginning of the virtual tour in Video 360° format from any control point.

The next challenge was to design the transition from the virtual 3D tour in Video 360° format to the virtual 3D reconstruction.

The hotkey was programmed, that activates the move from any control point of the tour video to the same point of the virtual 3D reconstruction.

In the virtual 3D reconstruction, the space of the Fortress is navigated not with the help of special visual markers, but through the control keys that are used in most of the 3D computer games.

Return to the present-day video tour is performed through a special portal (Fig. 4), added to each control point. The user has to find the portal on the fortress grounds and step on it; after that he will be transferred to the same control point of the Video 360° format video tour.

We believe it is highly significant that the tour begins with the introductory roll with opening credits; after that the tour guide greets the user and invites him to visit the unique historical monument preserved until nowadays; this adds to the immersion into the virtual space.

Fig. 3. Virtual interactive guided tour of Korela Fortress in 360° video format

Fig. 4. Special portal designed in ITMO University corporate style

CONCLUSION

The format of the virtual interactive 4D tour of Korela Fortress is actually a prototype of a resource that can be used in tourism, education, entertainment and research. Besides, the use of head mounted display Oculus Rift DK2 ensures the required emotional immersion in the environment.

REFERENCES

1. 9 Spheres of Using Virtual Reality: Market Size and Perspectives: https://vc.ru/p/vr-use

2. Knyazeva G. Virtual Reality and Professional Technologies // Journal for the N. Tatishev Voljsky University, №15, 2010.

3. Reinhardt J., Schöbinger S., Sieck J., Thiele-Maas M., Remes K., Pfeiffer F. Combining Virtual and Augmented Reality Approaches for a Project with the Konzerthaus Berlin // Kultur und Informatik: Audgmented reality. 2016. pp. 29-40.

4. Borisov N., Smolin A., Stolyarov D. Multimedia 360° – new technology for arts and culture // EVA 2015 SAINT PETERSBURG. Electronic Imaging & the Visual Arts International conference, St. Petersburg, June 24th–25th, 2015 Conference Proceedings. – SPb ITMO University, 2015. – P. 18-31

5. Nikolay Borisov, Artem Smolin, Pavel Shcherbakov, Denis Stolyarov, Vasiliy Trushin, "The opportunities of applying the 360° Video Technology to the presentation of cultural events", ArtsIT 2016 - The 5th EAI International Conference on Arts and Technology, Interactivity & Game Creation, 118p.

3D RECONSTRUCTION OF A RUSSIAN PISTOL FROM THE SLAVA ROSSII

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Fig. 1. Discovery of the pistol during underwater excavations

Fig. 2. Russian pistol from the "Slava Rossii" shipwreck

Abstract

For the first time, an archaeological artefact containing metal has been restored using image processing and scanning techniques, and 3D printing. This method facilitates another practice for the conservation of archaeological heritage.

INTRODUCTION

An 18th Century pistol was found on a shipwreck of Russian origin, the "Slava Rossii" on the coast of Hyères (France)[1]. Aboard this war vessel were several weapons of

[1] http://www.wrecksite.eu/wreck.aspx?222721

Fig. 3

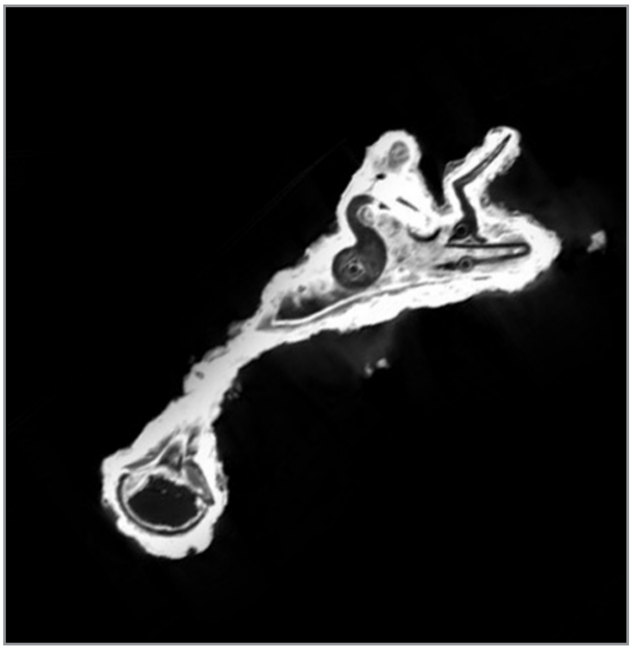

Fig. 4

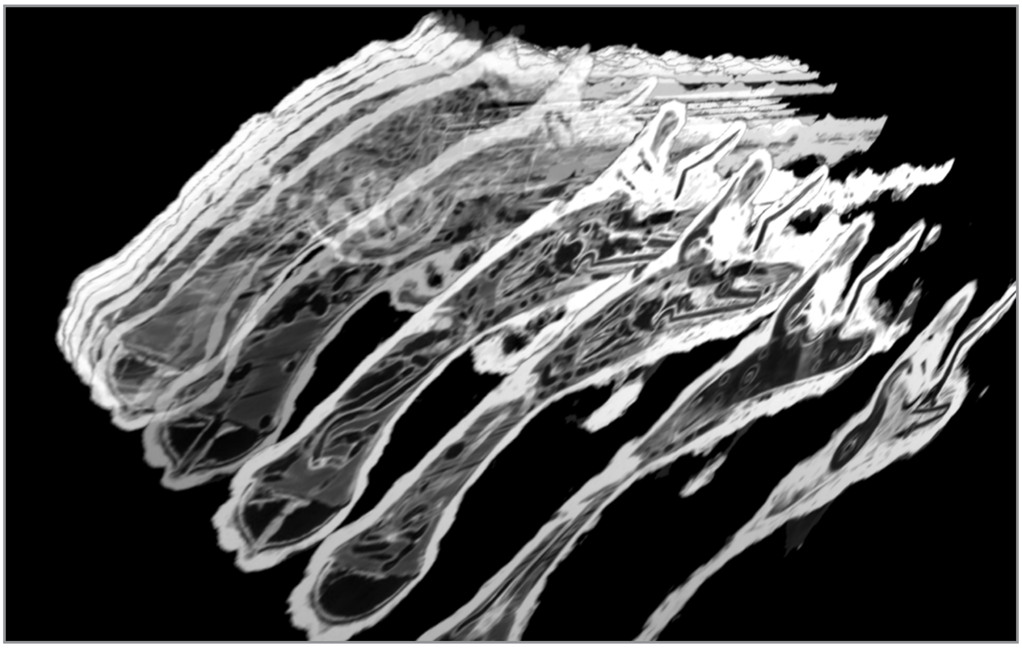

Fig. 5. Figures 3-5: X-ray images of the pistol (isolated images and reconstruction)

which the surface had become thicker, hence making the readability of the objects almost impossible[2] (Fig. 1 to 2).

The use of a medical scanner created geographically-mapped sections of the object which have allowed us to see the different parts of the pistol (Fig. 3 to 5). The outline of the visible sections has been traced and then shaped following the known spacing within the design.

The use of non-destructive control techniques reveals not only the outline of the object in its coating but also the operating mechanism. The same approach also concerned the interior of the object, usually concealed with platinum.

[2] http://www.culture.gouv.fr/fr/archeosm/archeosom/en/slava-s.htm

Fig. 6

Fig. 7

Once modelled, the different sections of the object were structured, based on different publications (Fig. 6 to 8).

The file was then used to digitally print the pistol. (Fig 9 to 10).

The time needed can be estimated at around 50 hours of work.

For the first time, this approach gives us the chance to read the surface and the internal mechanism of an object when the original has not yet been cleared. To date, it is certain that the time needed for restoration will not be less than the time taken to scan.

The fact that this work is equally based on documentation that aims to understand the operation of this

Fig. 8. Figures 6 to 8: Digital reconstruction of the pistol

Fig. 9

weapon, identifying the materials used (iron and copper alloys, flint and wood etc.) allows us to give the green light to a process that, in the future, will be translatable to other, less common objects.

In the present case, the approach applied is different from the one normally used in conservation-restoration due to the fact that small deformations of the object in its coating have been digitally corrected while an intervention on the original object would have investigated the object's historical traces, without correcting deformations.

Fig. 10. Figures 9 to 10: 3D printing of the pistol

CONCLUSION

Subject to a cohesion of the objects concerned which allows them to be manipulated, a sanitary condition which does not require stabilisation treatments or immediate interventions and a possibility of examining them through non-destructive inspections, the process proposed here widens the concept of "archaeological reserves", saves interventions for later, facilitates less-demanding museum exhibitions under climate control and also cuts insurance costs.

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ANTHROPOGENIC LANDSCAPES IN THE ABRAU PENINSULA IN ANCIENT TIMES

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Abstract

The main aspects of the development of 3D virtual reconstruction of the peninsula Abrau landscape in ancient times according to archaeological data are described. The available data allows to create a virtual model of a multi-level landscape of a region of the northern Black Sea on the basis of modern technologies used in archaeological research, such as photogrammetric technology, virtual panoramas, 3D modelling, 3D engine, etc. The project is supported by Russian Foundation of Humanitarian Research, № 16-01-12027.

The fates of monuments of historical and cultural heritage is unpredictable: profoundly, drastically changing its original appearance can be seen at present, others are known to us only due to more or less detailed descriptions, and the third ones are preserved frequently in the form of difficult to interpret complicated archaeological remains.

Reestablishment of the original image (reconstruction) of lost objects of historical and cultural heritage is undoubtedly an integral part of research process. However, full implementation of this task was always linked with enormous difficulties, as it required to employ very serious resources. The appearance of these reconstruc-

Fig. 1. Project Rome Reborn. Rome IV A.D.

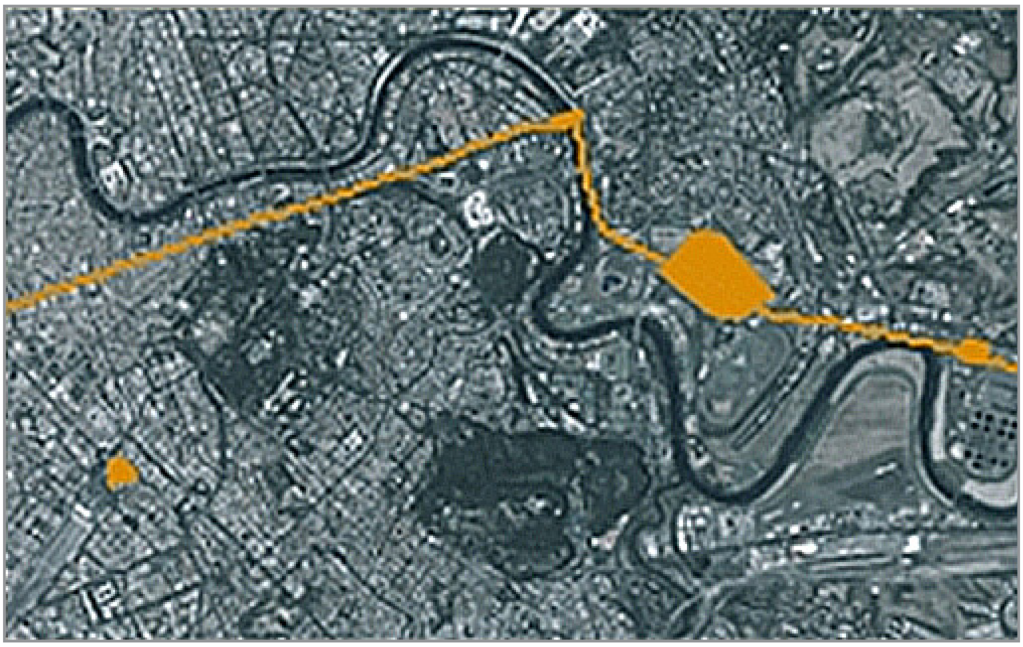

Fig. 2. Project Via Flaminia (Rome)

tions was in itself a great scientific event. Numerous non-professional reconstructions, as a rule, can be classified as scientific frauds. Revolution in the field of computer technology has led to the appearance of software-aided design CAD (Eng. Computer-Aided Design, Russian CABR), Information Modelling BIM (Eng. Building Information Modeling), photogrammetric processing, laser scanning devices, etc., significantly simplifying the technique of designing documentation. The research of the application of the methods of three-dimensional computer simulation in historical and archaeological research was initiated in the 1980s by foreign researchers B. Frisher, P. Reilly, M. Forte, D. Sanders and another. The first approaches to the synthesis of materials of archaeological research and historical documentation by using three-dimensional modeling software were formulated in 1980-1990 by

Fig. 3. The Bosporan state of the Bosporan Kingdom: the Peninsula of Crimea, Taman and Abrau (relief); the Cimmerian Bosporus (by Kondakov)

Fig. 4. The Novorossiysk archaeological expedition of Institute of archaeology of the Academy of Sciences conducts research since 1990

an archaeologist P. Reilly, who became the founder of a direction called "virtual archaeology" (Eng. Virtual Archaeology, Digital Archaeology).

These approaches have rendered a certain influence on the development of the applied field of "digital history" (Digital History).

Experience in implementation of projects of virtual reconstruction of historical objects abroad is significant. The greatest interest rightly arouse subjects related to the history of the Ancient world: Rome IV century A.D. (Rome Reborn), Carnuntum (lat. Carnuntum) — a Roman military camp at the crossing of the Amber route from the Danube and others.

In Russia the ancient period of history of the Ancient world (VI century BC – IV century A.D.) is associated with a state, its basic territories were located on two pen-

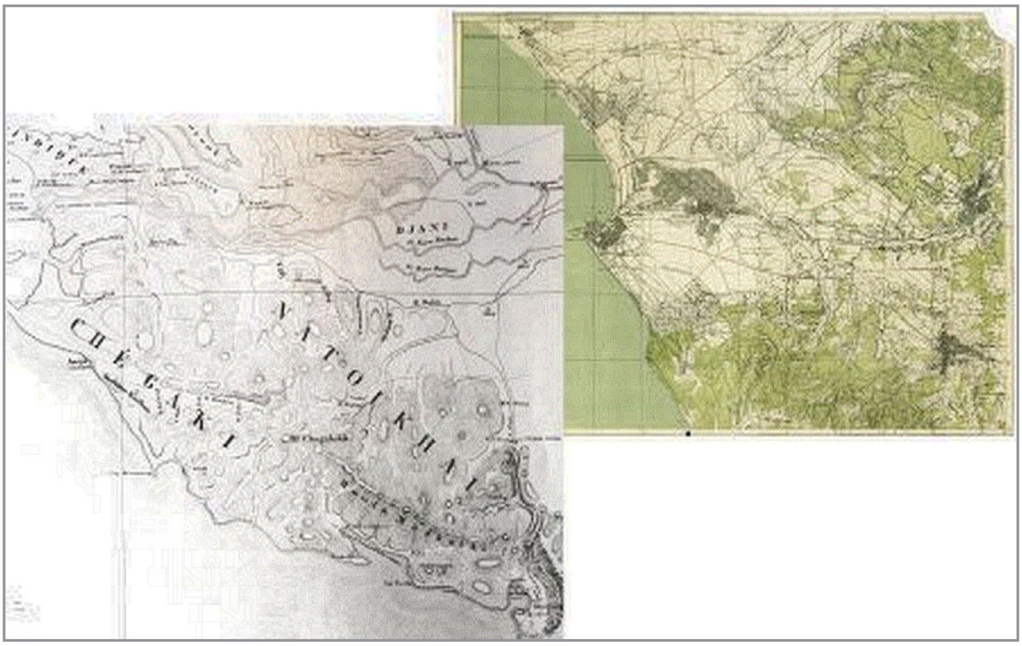

Fig. 5. River and roads on the Abrau Peninsula: XIX century (F.Dubois de Monpere), the beginning of the XX century (a halfverst map, 1926)

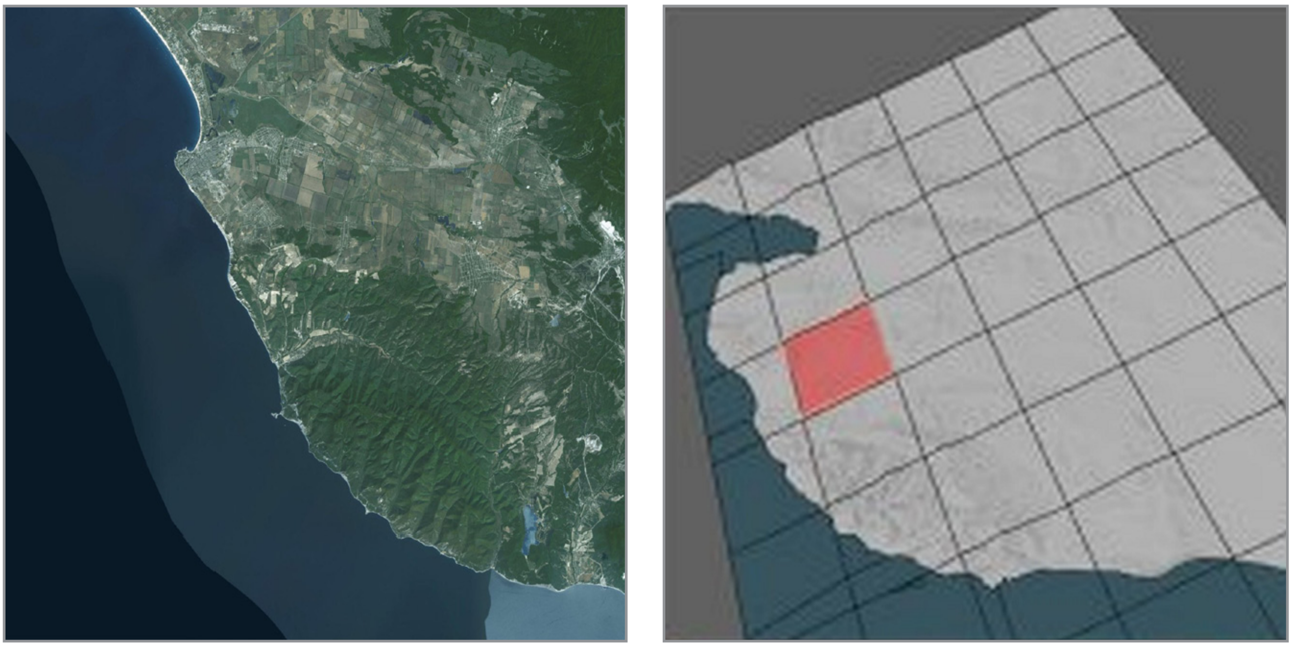

Fig. 6. The stages of recreating the ancient landscape of the Abrau Peninsula

insulas of the Northern Black sea: the Crimean (the centre of the capital – Panticapaeum (Παντικαπαιον)) and the Taman (the capital was Fanagoria (Φαναγορεια)), they had been located on two sides of the Kerch Strait (the Cimmerian Bosporus in ancient times), that's why this formation has received the name of Bosporus.

The South-Eastern periphery of this state with the center in ancient Gorgippia – modern Anapa – is located on the spurs of the Main Caucasian ridge, forming a single geomorphological area known as the Abrau Peninsula. This name is introduced to the scientific expressions by a geologist A. Konshin at the end of the nineteenth century: the Borders of the Abrau Peninsula are to the West and South of the Black sea, in the North and North-West the spurs of the Great Caucasus range.

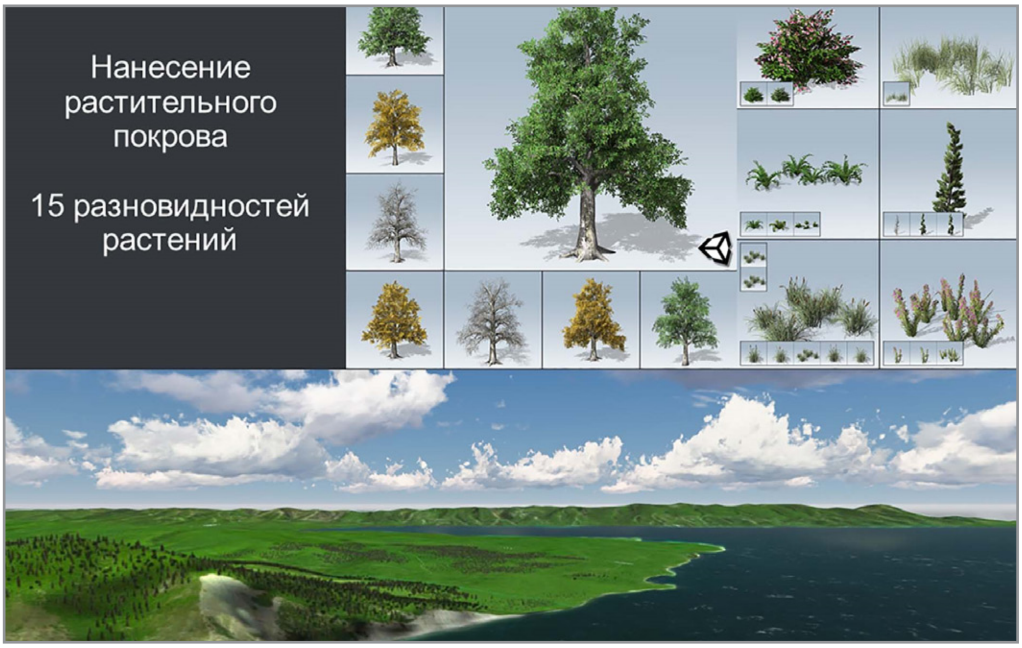

Fig. 7. The stages of recreating the ancient landscape of the Abrau Peninsula in Unity3D and Lumion Aboriginal culture

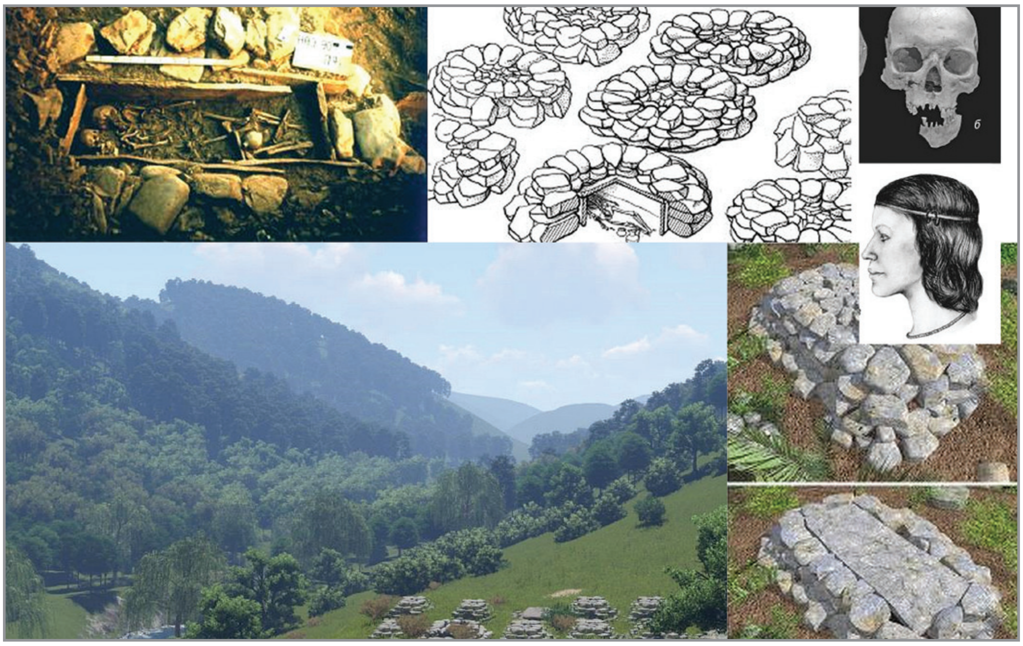

Fig. 8. The burial in necropolis in Lobanov Schel. Graphic reconstruction of the necropolis of the kerket aboriginal population on the Black Sea coast

The archaeological research on the Abrau Peninsula are significant rise in recent decades. Significant progress has been achieved due to the application of methods of landscape archaeology, non-destructive examination methods (remote sensing, magnetic survey) and also by involving experts from the field of paleogeography, paleoanthropology, archaeobotany and archeozoology. Important results are obtained in the study of the evolution of settlement patterns and infrastructure in the region, changes in economic activities, the dynamics of ethno-political processes in ancient times. They allow to state during five centuries from the Vth century B.C. to the first century A.D. the dynamic process of economic and political subordination of space located to the East and South of Gorgippia was under way.

The report provides visualized results of a comprehensive archaeological research on the reconstruction of

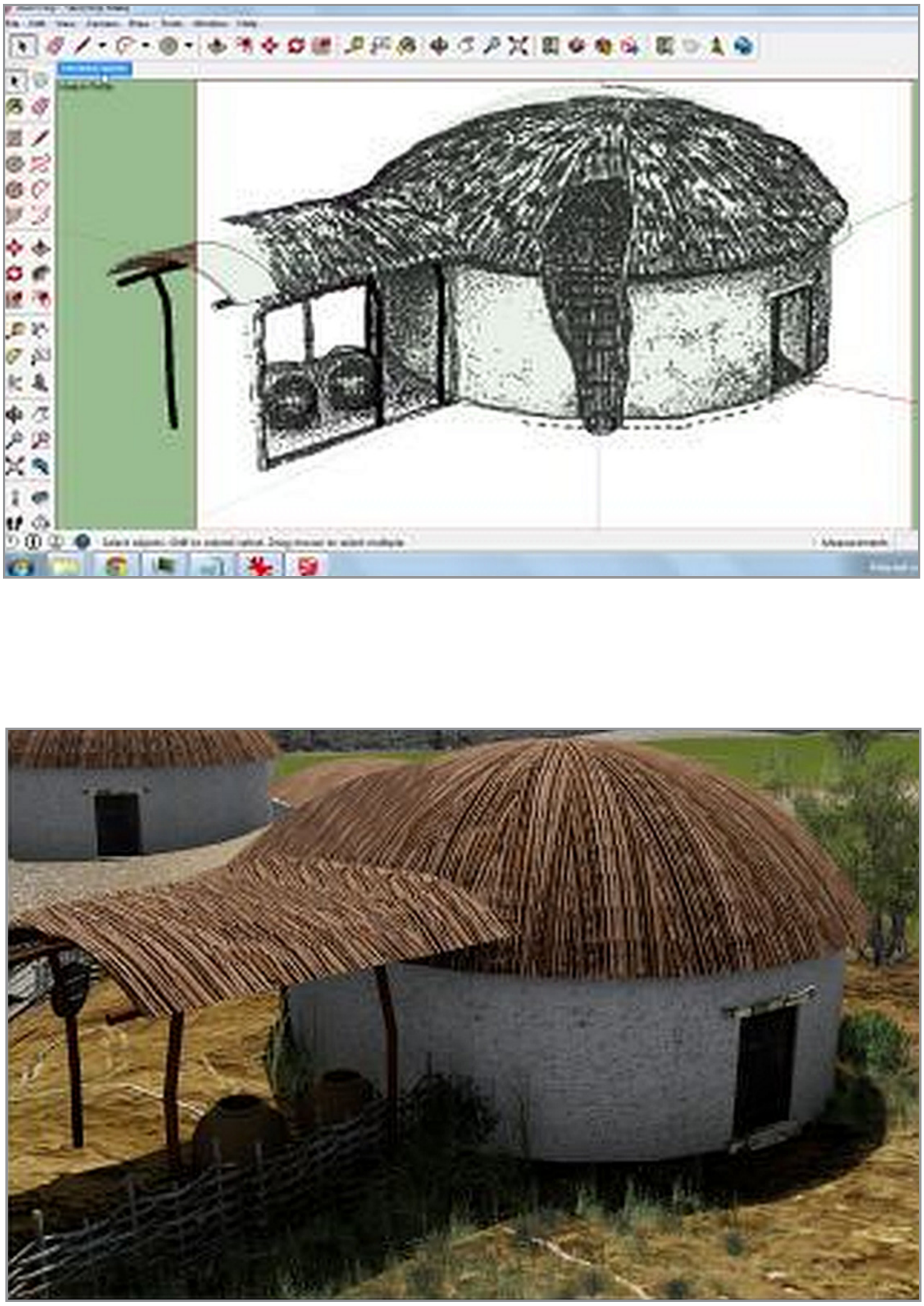

Fig. 9 (a, b). The process of the 3d-reconstruction in SketchUp and Lumion based on the image reconstruction of the residential structure in Turluk by A.V. Shevchenko

anthropogenic landscape in the Abrau Peninsula in the ancient times. They did not only illustrate the main stages of the subordination of this region to the authorities of the Bospores Kingdom in the image of the antique center Gorgippia, but also contributed significantly to the deepening of our knowledge of this process.

Reconstruction of the landscape of the Abrau Peninsula

The work was carried out in several stages. Using the program Unity3D and the component Real World Terrain data they have collected the STRM (Shuttle

Fig. 10. Anthropogenic landscape of the distant Chora of Gorgippia in the Hellenistic age

Radar Topography Mission) on the Peninsula territory together with the relief put on the portions texture of satellite imagery ArcGIS.

Reconstruction of the ancient landscape was not imply only a retouch of the traces of the modern economic activities, but also the correction of the coastline according to the isobaths with a limit of ten meters. It increased the land area in the Western part of the Tsemesskaya Bay, served the basis for restoring the ancient shapes of islands and capes on the coast of the Abrau Peninsula. For example in the place of the flooded area in Anapa.

Having received it the end the retouch of the whole the Peninsula, the file was divided into 54 plots to draw them on the territory model in Unity3D. As the texture the layers were drawn with a network of roads and waterways which were created on the on topographic maps of the Abrau Peninsula in XIX–XX centuries.

According to ancient authors, the VĨIst centuries B.C. in the territory from Gorgippia (Anapa now) to Torik (now Gelendzhik), South-West of Sindi tribes there had lived the kerkets and torets (Ps.Skyl. 72-75; Strabo. XI 2, 1; Plin. NH. VI. 17). Most of the known archaeological sites of pre-Greek population of the foothills – burial grounds, which date from within VĨIV centuries B.C., Their great number indirectly shows a rather high density of the local population during this period.

The topography of the tombs of the aboriginal population is characterized by a dense, ordered (as a rule rows) the location of burial structures, which testifies to the tradition and extremely regulated live of that population.

The neighborhood with the antique malls entailed some demographic changes. According to the materials of the aboriginal cemeteries we can speak about an increase in burial complexes from the second half of the VIth century B.C. Most of the graves date back to the Vth century B.C. a Certain demographic “burst” can be explained by an increase in political and economic stability and the displacement of the aboriginal people from the spaces located to the North of Syndic foothills.

Thanks to archaeology we have data on a significant social differentiation in the late ṼII centuries B.C. Moreover, aboriginal cemeteries there had been a widespread practice of the burial at the end portion of the stone box as a sample of ancient scrypt structures. Environmental factor contributed to the formation of centuries and even millennia-old traditions of economic activities.

Chora of Gorgippia in the era of Hellenism

At the beginning of the IVth century B.C., in the period of unification of the of Asian and European Bosporus centers in one state.

The Bosporus colonization of border areas receives a new impetus. Archaeological data about the advance of Bosporan people to the East and South-East off Gorgippia date back to the end of the IVth–IIIth centuries B.C. As a result in the end of the third century B.C. the whole Anapa plain had been was under the rule of Bosporan people. The land of the orgippiya citizens on the territory of the Abrau Peninsula was located in the spaces to the South of the ridge to Semiam from Gorgippia and to the East, to the confluence of three rivers Shomrinki (Shoumriver), Kotlama and Mackagi.

The Greek-Bosporan people contributed to the spread of the new ancient economic mode. In the IVth century BC there had been ancient manors peristyle type, made of adobe (mud) brick on stone foundations. The fields had been planted with wheat and grapes.

The economic structure of the distant periphery of Gorgippia was different from the mode near Hora: grain

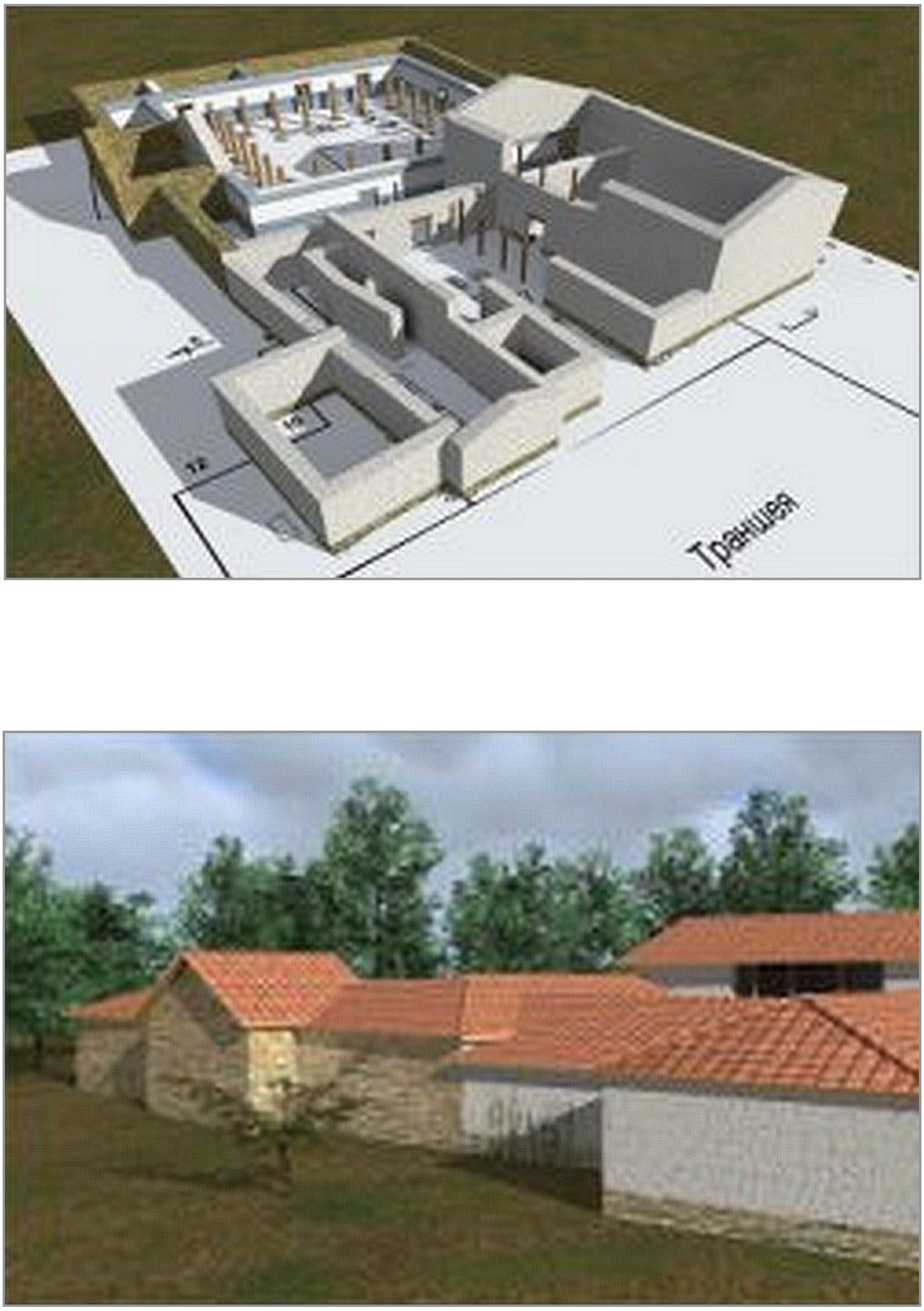

Fig. 11 (a, b). 3d reconstruction of the monumental public building on the Raievskii mound (NAHE IA RAS, excavation 1956-2005)

farming and domestic economy were developing in local centuries-old traditions of the foothills. In the many respects it had connected on a complex ethnic and political situation in the region. In thr area of the Rajewski settlement numerous Meotian burial complexes had been studied they are characterized by put under the head of the buried man a bowl. They testify to the involvement in the colonization of the Anapa plain the belligerent natives from of the interior areas of Zakubanye.

Chora of Gorgippia in the Early Roman time

Significant changes take place in this period, not only on the territory of the Chora of Hellenistic Gorgippia –

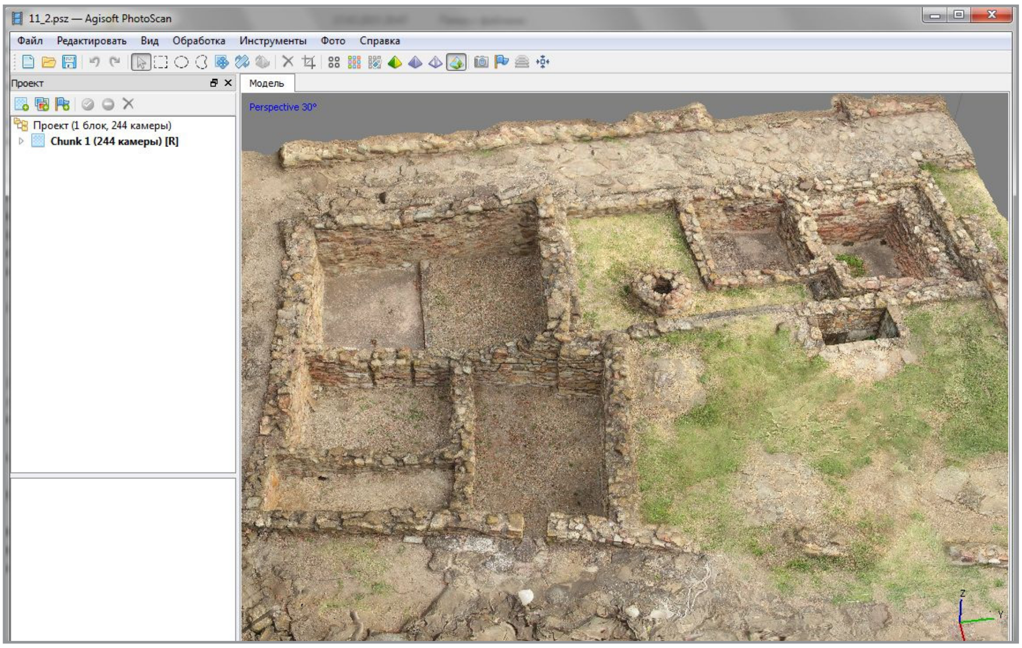

Fig. 12. Photogrammetry 3D model of Anapa archaeological museum (Agisoft Photoskan). Created by S.V. Koroleva

Fig. 13. 3d reconstruction of Raevskiy settlement

the Anapa plain, but on the Abrau Peninsula on the whole. More than two dozen of the fortified towers estates make their appearance there.

Almost complete absence of similar structures North of Gorgippia, their habitat in the region suggests that in the context of the change in cultural landscape was interested, rather the rulers of Gorgippia who had been in bad need to protect the main land and sea routes of the region under their control and not the Central government. Strategic route connects Anapa and the Tsemess Bay. Along the bay, in the river valleys of the Peninsula on the Black Sea coast as well as on the slopes of Northern and North-Eastern sections of the Markotkh ridge construction teams erect a two-chamber tower-shaped constructions with a stone basement.

Thus, the size of the region subject to Gorgipia is comparable to a Roman province. Coordination of local government was provided by administrative centers located both in the continental part (in the Raevskiy settlement), and on the coast: in the gorge of Shirokaya Balka and at the foot of the Koldun mountain ̃ the Myskhako settlement (the village of Bata: Strabo. XI. 2. 14.; Ptol. V. 8. 8.).

Summing up what has been said we would like to stress once again the visualization of the anthropogenic landscape which has been carried out was not a pure aim of the work done. In the process of the reconstruction of the character of the main monuments of cultural heritage of the Abrau peninsula we had a chance to put some questions which had not been raised before about the anthropogenic landscape of the chora Gorgippiya (house building, communication system), scales of monumental building on the early Roman time on the basis of the received reconstructions and the rates of output in the technologies of antic building; on the constructive peculiarities of the fortification of the Raievskaya fortress and their impact on the defense ability of the whole complex; on the exploitation features of the guard and signal system to was, internal construction of the tower constructions (distribution of rooms, ect.).

References

1. Rome Reborn. A digital model of ancient Rome. Gallery. [Electronic resource]. URL: http://www.romereborn.virginia.edu/gallery-current.php (accessed 11 Mar.2012).

2. Dell'Unto Nicolò, Marco Di Ioia, Fabrizio Galeazzi, Alessia Moro, Eva Pietroni, Valentina Vassallo, Lola Vico. The reconstruction of the archaeological landscape through virtual reality applications: a discussion about methodology // 3D – ARCH 2007: 3D Virtual Reconstruction and Visualization of Complex Architectures. ETH Zurich, Switzerland, 2007. [Electronic resource]. URL: http://www.isprs.org/proceedings/XXXVI/5-W47/pdf/dellunto_etal.pdf (accessed 11 Mar.2012).

TECHNOLOGIES OF IMMERTION IN VIRTUAL REALITY USING FOR THE EVALUATION OF DIFFERENT COLOR SOLUTIONS FOR FEODOROVSKY GORODOK REFECTORY 3D-RECONSTRUCTION

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This work is a part of cross-technological project devoted to virtual reconstruction of a Russian style architectural monument – Feodorovsky Gorodok in Tzarskoe Selo. [1].

A virtual reconstruction of totally lost Refectory interior was created at the Graphic Technologies Department in 2015 [2]. The only existing black-and-white photo, dated 1917 (fig.1), as well as the ruins fixation measurements and the vaults murals drawings, produced by an icon workshop according to a verbal description, were used as a source of information. The result of the reconstruction was a geometrically correct 3D model of the interior with applied murals drawings (fig.2) and an interactive application for viewing.

The realized project recalled an interest from Professor A. K. Krilov, head of Church Painting Restoration Workshop of the Russian Art Academy. He suggested to use the realized geometrically correct Refectory vaults scans as a basis for course works of second and third years students of the Academy of Arts. [3].

While working on murals reconstruction students usually face some difficulties in transferring of the flat sketches to the volume form, more of it, the Refectory vaults have a complicated geometry with a backward motion. Therefore after the students created polychromic flat sketches (fig. 3) these scans were digitalized and put in the interior 3D-model as textures (fig.4).

3D-model renders were converted to black-and-white. Except for the analysis of the spatial perception of the drawings, this method allowed to evaluate how much each of the suggested color schemes corresponded to the tone and contrast of the source historical black-and-white photo.

To provide the spectator with the possibility to feel inside the Feodorovsky Gorodok Refectory the 3D-model was imported to the application, created with Unity 5 software, suitable for viewing with virtual reality headsets. Also interactive elements (“Easter eggs”) were added to the scene; they allowed interacting with the model by changing the ceiling textures. The linked library Fibrum SDK and a code of our own were used for interactivity realization and providing the ability to move around the stage with the help of gaze direction tracking. The application was tested with Oculus Rift DK1 and DK2 head-mounted displays, and also with Samsung Gear VR headset with Samsung S6 Edge smart phone, and Homido headset with Sony Xperia Z2 smartphone.

The interface interactive elements were designed as Easter eggs with paintings in the ceiling style (fig. 5). Each of the “eggs” corresponds to one of the color schemes, suggested by the Academy of Arts students. When user’s gaze is fixed on an “egg”, the ceiling texture changes.

Fig. 1. Refectory interior, 1917

Fig. 2. Refectory interior virtual reconstruction, 2015

Fig. 3 - a. Murals sketches, fulfilled by Roman Shuvalov

Fig. 3 - b. Murals sketches, fulfilled by Viktor Sukchorukov

Fig. 3 - c. Murals sketches, fulfilled by Alexandr Habarov

REFERENCES:

1. Sopronenko L.P., Akulaeva E.A., Smolin A., Lavrov A., Zviagin K.A. Russian style through time. Experience of virtual reconstruction of the interior of the refectory of the Feodorovsky Gorodok in Tsarskoye Selo // SGEM Vienna – 2016
2. Sopronenko L.P., Akulaeva E.A. The virtual reconstruction of the interior of Refectory Feodorovsky town in Tsarskoye Selo // EVA 2015 Saint Petersburg. Electronic Imaging & the Visual Arts - 2015, pp. 119-121
3. Акулаева Е.А., Сопроненко Л.П.Методика использования виртуальной реконструкции при обучении студентов академии художеств//Сборник тезисов докладов конгресса молодых ученых - 2016

Fig. 4 - a. Different color schemes. The 3D-model

Fig. 4 - b. Different color schemes. The 3D-model

Fig. 4 - c. Different color schemes. The 3D-model

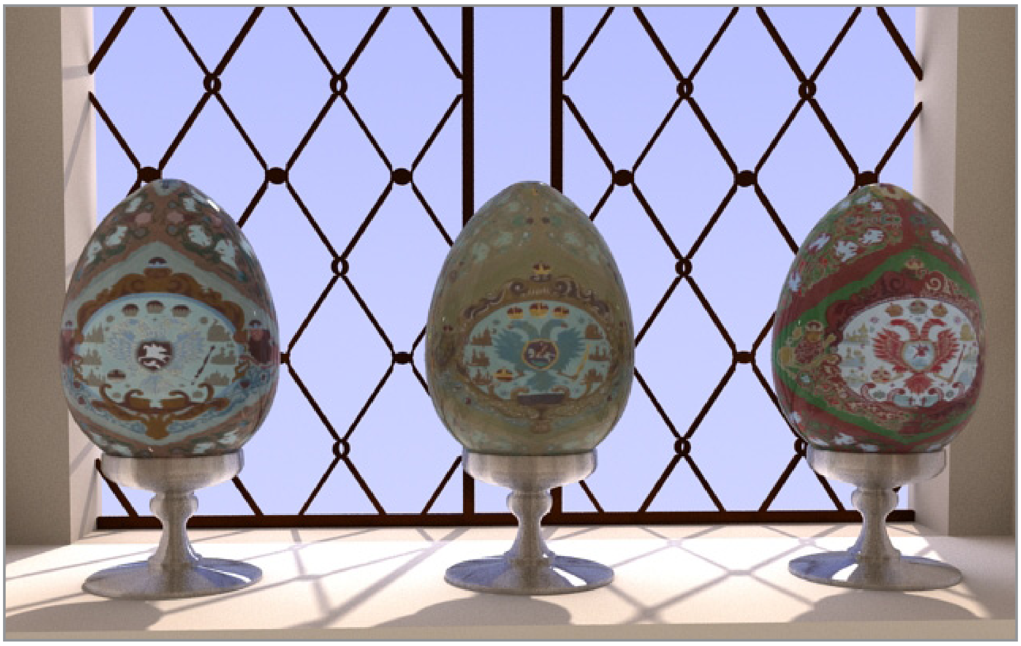

Fig. 5. The interface elements designed as Easter eggs

OMNIDIRECTIONAL EXTENDER FOR PLENOPTIC CAMERA CONCEPT

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Abstract

High-resolution panorama acquisition for HMD displays is feasible with lenses based on reflection and refraction principles, possibly assembled in a rig. To overcome conventional systems limitations,we propose plenoptic camera extender, as a convex polyhedron of plain, first surface mirrors. Conditions for seamless panorama generation with a resolution, comparable with resolution of sensor, are presented. In this paper design methods are provided, which use ray tracing and experimental mount with single moving mirror and screen with a hole as a tested facet. The rejection of zoom or wide field lenses and computationally intensive effects makes possible a cheaper panoramic video camera design.

1. INTRODUCTION

1.1. High Definition panoramic video requirements

Massive expansion of PC and game consoles in 90-es, as well as the progress in computer graphics and VR systems, forced optical engineers to look for panorama capturing solutions, such as used inQuickTime VR [1]or environment/refraction maps [2,3] for realistic visualization. 3D accelerators limitations, like cube map size, loosen requirements for such optical systems, while CPU/GPU performance did not allow panoramic video at all.

At the moment, VR HMD became more and more popular, demanding higher panoramic video content creation requirements with affordable price. Modern HMD, equipped with HD displays, are able to present panoramic video with incredible resolution and FPS rate. They represent FOV (approximately 90-120°) of sphere with 360° of azimuth and up to +/- 90° of elevation. Modern RAM and HDD sizes, CPU/GPU performance do not limit stream panorama video playback even on a mobile devices. It could be illustrated: Nokia OZO utilizes eight cameras with 2Kx2K resolution for 32Mpix panorama at 10-bit color depth, and its price is about 60 000$, when Nokia Lumia 1020, equipped with 41 Mpix camera, is about 250$. Our research goal was to study alternative principles for HD omnidirectional video creation in a cheap and simple way, without seams. We were looking for construction and optimization scenario for some class of constructions to make some proof-of-concept implementation feasible.

Optical engineers are facing a challenge of such resolution enhancement, and several approaches could be briefly grouped as follows: using refractive wide-angle lenses – dioptric cameras, with one or more reflective surfaces combined with lenses– catadioptric lenses. High resolution omnidirectional panoramic video could be captured only using a rig of expensive cameras –poly-dioptric approach, with overlapping fields of view,or single view schema [4,5,6].

2. LIMITATIONS OF CONVENTIONAL SYSTEMS

2.1. Catadioptric systems:resolution and size issues

Catadioptric system with a hyperbolic or parabolic mirror makes possible classical and simple capturing methods of omnidirectional panorama. Single viewpoint constrain could be achieved if rays, converge in a first foci of hyperbola, after reflection, reach a camera, placed in a second foci. Hence, distortions could be inversed by video processing, so strait lines could be rendered strait on a screen.

But video capturing needs greater optical power for higher FPS, so aperture should bebigger than in static, long exposure cases, used, for instance, to capture environment maps. Camera remains bulky, since reflector is bigger. Folded catadioptric system, proposed by S.K. Nayar [7], works much better. He notices that "When the lens is used to gather more light, each principle ray is accompanied by a bunch of surrounding rays, and a variety of optical aberrations appear, that make a design of folded system challenging… In compact systems (small mirrors with high curvatures) field curvature tends out to dominate on all other aberrations. In a single mirror system the image system is curved in a same direction as the mirror itself. Hence, in a two-mirror system it is to our advantage to use a convex and a concave mirror, so the field curvatures, introduced by the two mirrors serve to compensate to each other."

For camera, developed in 1999, 550 lineswas a good resolution. But requirement for modern VR content is one-two magnitude greater. Catadioptric systems are developing now in miniaturization direction, to produce tiny mobile camera extenders [8] or solutions like muFly helicopter at the ETH Zurich [9] for computer vision tasks primarily.

2.2. Dioptric and Polydioptric systems: stitching issues

Compact cameras, equipped with one or two super-wide-angle lenses, are becoming more common, and mass production significantly reduced their cost. But while high-resolution sensors, accumulators and video processing component are versatile, high quality lens production remains expensive. Modern 4K sensor, having a pixel size about 2 micrometers, exceed possibility of cheap lenses to give sharp images across the entire field, and if we are talking about panoramic video solutions, aberrations are noticeable. However, conventional compression techniques, resolution and HMD devices lens aberrations are impediments, too. Further progress of dioptric lenses parameters, such as FOV, extended DOF and compatibility withadvanced HD sensors, is expected, but any ens of that kind is unlikely to become cheap in the nearest future.

Film, captured by camera rig, was successfully demonstrated on 1900 Paris Exposition by Raoul Grimoin-Sanson [10]. Despite various enhancements, like 1955 Circle Vision 360° [11,12,13,14] nearby object might besplit into two, when it crossed the seams.

If the fields of views overlap, a seamless panorama reconstruction can be guaranteed for distant objects only. With a high resolution content, stereo matching is possible /or even some sort of depth reconstruction/. But in general case image stitching solutions, used for panorama acquisition [15], based on disparity estimation [16], o proposed for in autostereoscopic displays [17], could not solve this problem.

Since some areas in a scene are occluded on each of the captured images, multiple methods of "inpainting" [18, 19] were suggested to fix holes on a synthesized panorama, but this solution can be used for some special case only. Reflective or shiny surfaces appear different depending upon viewpoint. Grids or some regular patterns produce moiré when overlap. Water, foliage, hairs, or even plain color surfaces, like covered with snow, produce spatial and temporal artifacts. Appearance of nearby objects or moving parts reveals seams: there is no solution for all cases.

2.3. Overview of light field camera concepts

In conventional cameras, a sensor pixel averages the radiance of the non-vignetted light rays. Only two-dimensional projections of the light field from a 3D scene are captured. Lippmann and Ives [20,21] introduced parallax barriers and integral photography tospatially multiplex of the light field onto a 2D digital-image sensor in a discrete manner.

Limitations of that approaches stimulated in vention of holography to capture light field in a continual manner; there is no bound to move point of view when we are looking at a hologram.

It's quite impossible to explain advantages of plenoptic imagery, achieved by digital camera progress. One must see plenoptic images and play with sliders. We could notice, that viewpoint shift is very limited. General issues on plenoptic camera light field acquisition could be founded in [22,23]. Since this subject is intensively studied in last few years, we would like to refer only on few articles, where some similarity with our task is evident.

In [24], better depth estimation from captured light field was demonstrated. Image refocusing after capture for hand held camera was successively demonstrated by Ng et al. [25], establishing main feature that we do expect from plenoptic camera nowadays.

It is possible due to sensor resolution, mobile camera computational power and micro lens arrays production progress in 2005-2010. But first instances, presented in the market, demonstrated too low resolution. Than a multiple publications on resolution improvement succeeded, like presented by Georgievet al. [26], while cameras with

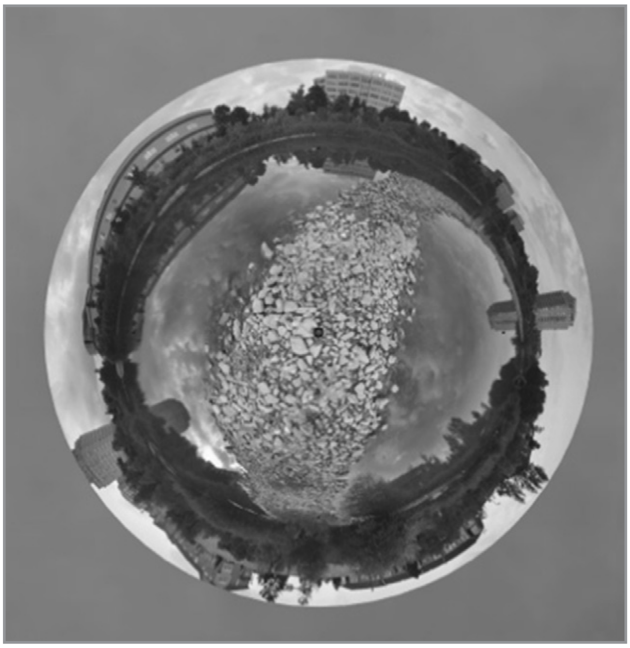


Fig. 1. Incoming rays converges in foci F1. Reflections from hyperbolic mirror are captured by camera in foci F2

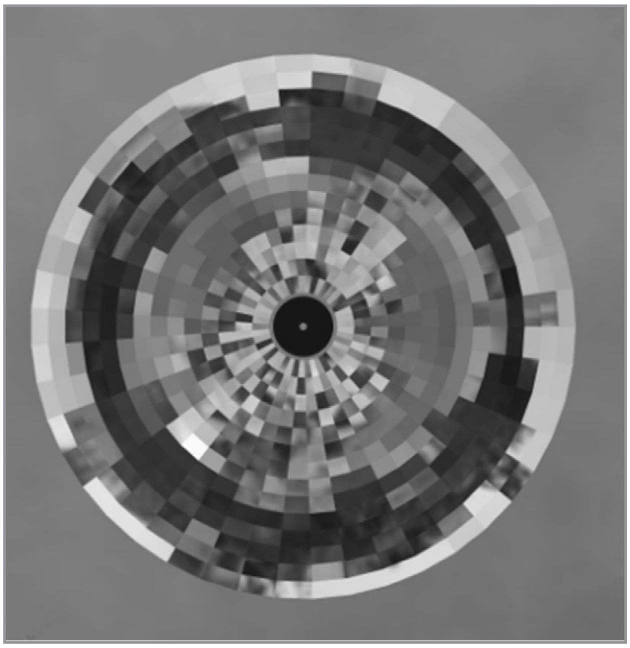


Fig. 2. If a smooth reflector is substituted by a facetted, and camera is placed in F2, only small solid angle is seen through facet. Camera is too far from reflector

much higher resolution, like Lytro Illum were presented. Right now, a giant 755 Megapixel camera "Lytro Cinema" was demonstrated, targeted to professional movie production [27]. Plenoptic cameras are produced by Raytrix [28], and multiple IHV also apply for various patents to add new or extend range of existing features.

Utilization of hybrid methods, like proposed by V. Boominathanet al. [29], is promising much better image-quality on a hybrid hand held camera.With semi- transparent mirror or by shifting micro lens array, system with much better resolution could be designed. Unfortunately, there is no such camera available now, but patents, like [30], could be found out.

Light field cameras can be categorized by how a 4D light field is encoded in a set of 2D images. Methods include multiple sensors using or a single sensor with temporal, spatial, or frequency-domain multiplexing. Wilburn et al. [31] describe a camera array. Liang et al. [32] achieve temporal multiplexing with a programmable aperture. Georgiev et al. [33] capture spatially-multiplexed light fields using an array of lenses and prisms.

Solutions, where concave mirror system accompany camera for some sort of light field acquisition, need to be overviewed briefly: it is a subclass of planar catadioptric systems.

For refocusing after shoot implementation [34, 35] fabricated faceted mirror arrays. Using several /35 and 20 images respectively/, captured in one shot, an image with new position of DOF could be synthesized. This concept is close somehow to Pelican Imaging[36] patented miniature design. Utilization of reflective schema could be useful for thin mobile devices, where optical axis placed vertically.

Compact object appearance was captured from different viewpoints using array of mirrors and single high resolution DSLR camera, as described in Y. Mukaigawaet al.[37] paper.

3. SYSTEM DESIGN ASSUMPTION

We did not study particular off-the-shelf plenoptic camera, but having some general idea of extender functionality, we tried to understand: what tools are needed to make a better system design, and how far it could be optimized? We expected that alongside with better plenoptic cameras availability, some compromise variant could be available soon .

Pure plenoptic video processing – not separate panoramic frames, generated from raw data,– could be achieved without laborious post production, used to simulate high aperture lens and thin DOF. Camera processors should only sample raw data and do simpler tasks, like weighted blending of pixels, convolution, upsampling and so on. For video coding, it could rely on a standard hardware coding solutions. Right now, build-in plenoptic cameras processors could not process panoramic HD video in real time,sincea single frame raw datarequire about 50 megabytes.

3.1. Extender Operation Principles

Image generation from plenoptic data allows limited shift of viewpoint in horizontal or vertical directions (forward and backward shift is possible, too) for images, available from web, or raw data processing software.

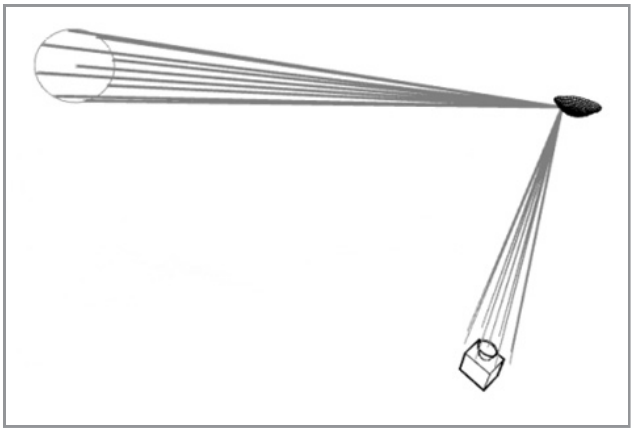


Fig. 3.With some limited shift only small solid angle of a panorama could be observed through a facet – but there are few facets to capture all panoramas without gaps

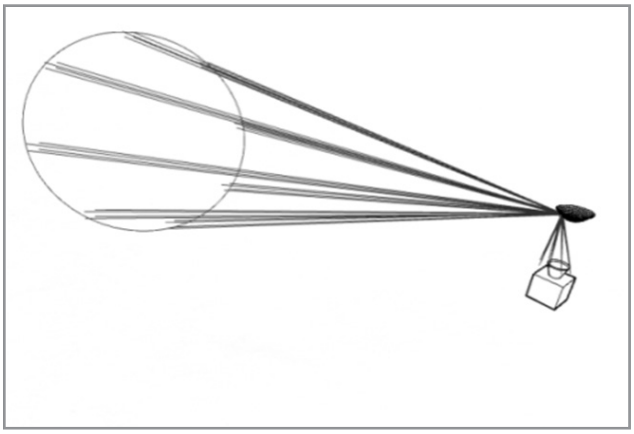


Fig. 4. If virtual camera points of view are distributed closer to reflector, greater solid angle could be observed through selected facet

We propose simple idea of extender shape: a convex polyhedron with a plain first surface mirrors that does not introduce aberrations. Polyhedron could be an approximation of someconic surface. Size and distance from lens could be chosen to fit frustum. Gem cutting equipment couldbe used for fabrication, and coating is required for greater lifespan.

To handle polyhedron of extender, a coaxial transparent hull is suggested. This detail could be implemented as toroid lenses, which introduce low aberrations. For instance, it could increase vertical field of view, or improve appearance of reflected image on sensor for some angles, or to achieve better sampling of environment: various optimization criteria could be used to design this part of extender.

3.2. Polyhedron reflector geometry and position placement

Performing optical design, engineers deal with smooth optical shapes and varies radiuses, distances between lenses, conic coefficients, glass materials, etc. By introduction of "non-optical" polyhedron shape, another set of toolsis needed to control conditions of image synthesis. When shifted virtual cameras observe environment space partitioning for every facet must be checked and evaluated automatically.

For a "off the shelf" plenoptic camera, extender optimization could start from a little range of elevations. Compromise between: wider elevation ranges, when space is sampled without gaps, and high resolution must be accomplished. Since reflector and image processing introduce some weak local artifacts, image appearance, by means of HMD displays, must be compared with expected high quality panorama (like presented on Fig 1).

As soon as panorama is captured without visible gaps, and no seams are visible, new facets on polyhedron could be added and tested.

There is no need to calibrate reflector precisely, since image from different facets overlaps.

If plenoptic camera frontal lens is placed in a second hyperbola Foci – relatively far, a lower field of view must be used, so reflector occupy all image. When reflector (foreground) is very close to frontal lens, it stays still on a synthesized images, while background moves, when camera position changes. It happens due to corresponding rotation of virtual camera direction.

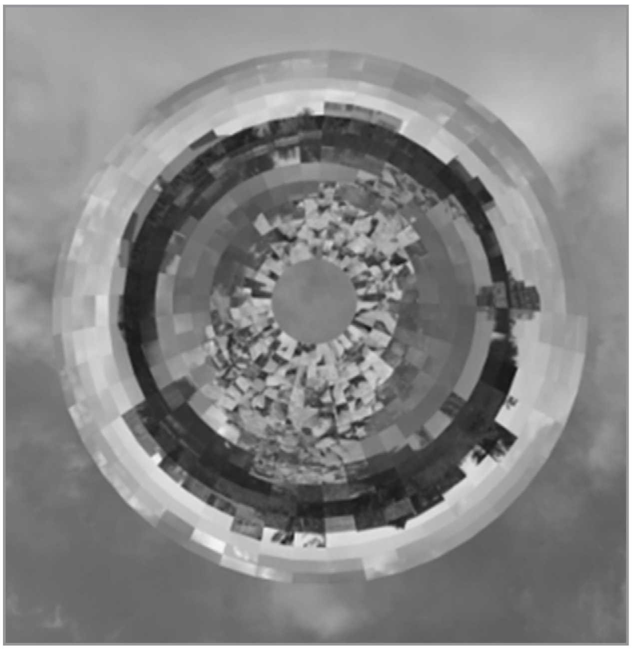
In this case, with available shift variations, very small cone (solid angle) is visible (fig 2 and fig 3). In fact, plenoptic camera could work as a perfect macro lens, reflector could be placed closer (Fig 4) to capture greater solid angle with a same variation of virtual camera shifts.

On fig. 5 and 6 reflections, captured from various viewpoints, are demonstrated.

On fig. 7 ray distribution is presented. After reflection rays converge in a regular manner, and directed to a plenoptic camera frontal lens.

3.3. Computational experiment

After camera calibration, it is possible to manipulate with its digital model to trace rays, starting from a surface of a front lens, for every pixel in a sensor, without actual knowledge of ray path in a lens.For every



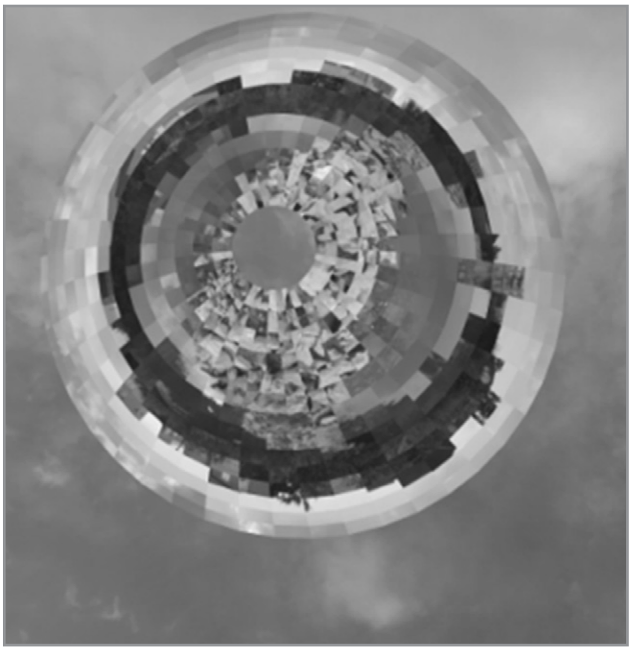


Fig. 5-6. Simulation of reflections, captured from various viewpoints

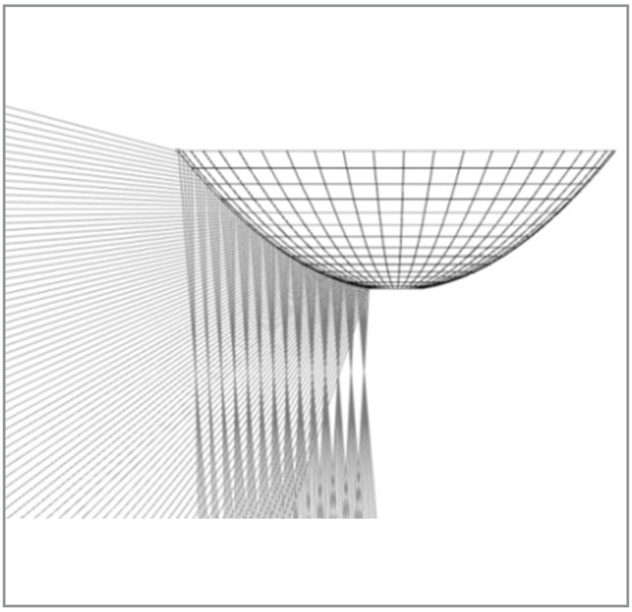


Fig. 7. Dense, 1° representation of incoming rays

known pixel position on a sensor inverse ray tracing could be performed. When using forward ray tracing, rays directed to first foci of hyperbola could be traced to camera (like on Fig 7).

Several rays, "emitted" by camera, could be matched with incoming ray. Using such correspondence, panorama generation could be evaluated for selected design.

3.4. Physical experiment

For anoff-the-shelf camera, construction of polyhedron mirror is easier using a mount with single moving mirror and a screen with a hole as a tested facet. Placing mirror in a position of selected facet, evaluation of space partition, seen through a hole, with possible shift of virtual cameras, could be achieved using software, like "Lytro Desktop". It deals with "focus stacking" representation, so screen is a foreground, and mirror is a rectangular hole, with a background seen through it.

3.5. Priorities for omnidirectional plenoptic camera design

Professional photographer knows where focus of his artwork must be placed, and appreciate features, delivered by special lenses or tilt-shift devices. Not just a possibility of refocusing images after capturing, but an ability to provide a system to substitute interchangeable lenses or huge camera set, used in artistic photography, was a design goal of consumer class plenoptic cameras.

A goal of DOF extension, when image is sharp everywhere, without bokeh-like effects, makes a plenoptic camera lens system design closer to a classical dioptric camera. But rayscan pass edges of a polyhedron, creating greater defocused non-confident area. When number of facets increase, more non-confident rays are obtained. Their attributes could be interpolated from neighbors in the 4D light field space. Shift of virtual cameras becomes smaller in this case, but it is more likely that it would be impossible to collect all required rays from raw data for greater elevations. Utilization of bigger facetscould force to increase shift of virtual camera positions.

Which design strategy is better? It is hard to answer without experiments: some problems could be solved by smarter image processing, or subjective comparison could give an answer.

4. CONCLUSION AND FUTURE WORK

Usingfirst surface mirror reflectors, plenoptic camera refocusing feature is traded in for HD omnidirectional panoramic video, presented on a VR HMD displays via conventional model of video streaming. Similarly to catadioptric approach, extender could use cheaper lenses with FOV < 52°.It does not need advanced ultra wide-screen lenses to capture omnidirectional panoramas. Zoom functionality is not required, as well as optical correction of distortions. Assuming that HD sensor captures redundant rays, a sensor with a few broken pixels and/or defect microlens array could be mounted with some shift to deliver cheaper mass production. High performance image processing, implemented on a camera side is not essential, while video compression would need more computational power. With digital panorama generation on camera side, data transfer of connection could be much lower, while generation of panorama only for specified ROI frustum or only in case of motioncould make it much more effective.

Design methods were suggested to achieve to achieve design goals – greater elevation range,when preserving-high resolution.

REFERENCES

1. E.C.Shenchang and E.Chen.“QuickTime VR: an image-based approach to virtual environment navigation”, in Proceedings of the 22nd annual conference on Computer graphics and interactive techniques (SIGGRAPH ‘95). ACM, New York, NY, USA, pp. 29-38. 1995.

2. http://www.pauldebevec.com/ReflectionMapping/

3. P.Haeberli and M.Segal. “Texture Mapping as a Fundamental Drawing Primitive”, in Fourth Eurographics Workshop on Rendering. pp. 259-266.June 1993

4. D.Scaramuzza. “Omnidirectional cameras”, GRASP Lab. University of Pennsylvania

5. R. Benosmanand S. Kang. “Panoramic Vision: Sensors, Theory, and Applications.”New York, Springer-Verlag.2001.

6. P. Sturm, S. Ramalingam, J. Tardif, S. Gasparini, J.Barreto, “Camera models and fundamental concepts used in geometric computer vision”, in Foundations and Trends in Computer Graphics and Vision 6(1–2).2010.

7. S.K. Nayar andV.Peri.“Folded Catadioptric Cameras”, in IEEE Conference on Computer Vision and Pattern Recognition.pp.217-223. June 1999.

8. Xing-Dong Yang, K.Hasan, N. Bruce and P.Irani.“Surround-see: enabling peripheral vision on smartphones during active use”, in Proceedings of the 26th annual ACM symposium on User interface software and technology (UIST ‘13). ACM, New York, NY, USA, pp. 291-300. 2013.

9. http://www.mufly.ethz.ch/publ-sc

10. https://en.wikipedia.org/wiki/Cinéorama

11. https://en.wikipedia.org/wiki/Circle-Vision_360°

12. https://michaelscroggins.wordpress.com/large-format-exhibition/

13. V. S. Nalwa, “A true omnidirectional viewer” Technical Report, Bell Laboratories(1996).

14. V. S. Nalwa, “Stereo panoramic viewing system,” U.S. Patent 6141145(2000).

15. A.Ebtsam, M. Elmogy and H.Elbakry. “Image Stitching based on Feature Extraction Techniques: A Survey” in International Journal of Computer Applications (0975 8887) Volume 99No 6. 2014.

16. M. Adam, Ch. Jung, S. Roth, G.Brunnett. “Real-time Stereo-Image Stitching using GPU-based Belief Propagation.” In Proceedings of the Vision, Modeling, and Visualization Workshop 2009, November 16-18,Braunschweig, Germany2009

17. M.Schaffner, F. K. Gürkaynak, H.Kaeslin, L.Benini, A.Smolic. “Automatic multiview synthesis - Towards a mobile system on a chip”inVCIP 2015: pp. 1-4

18. B. V. Batra, T. V. Ratanpara and M. S. Bhatt, “A survery: Recent trends in video in-painting techniques,” in Electrical, Electronics, Signals, Communication and Optimization (EESCO), 2015 International Conference on, Visakhapatnam, pp. 1-5. 2015.

19. C. Zhu and S. Li, “A New Perspective on Hole Generation and Filling in DIBR Based View Synthesis” in Intelligent Information Hiding and Multimedia Signal Processing, 2013 Ninth International Conference on, Beijing, pp. 607-610. 2013.

20. G.Lippman. “La Photographie Intégrale” Academie des Sciences 146 (1908), pp. 446–451.

21. H.Ives: “Parallax Stereogram and Process of Making Same.”US patent 725,567, 1903.

22. M. Levoy and P. Hanrahan.1996.Light Field Rendering.inProc.of SIGGRAPH, pp.31-42.

23. G.Wetzstein, I.Ihrke, D Lanman, W.Heidrich, R. Raskar and K.Akeley.“Computational plenoptic imaging”.inACM SIGGRAPH 2012 Courses (SIGGRAPH ‘12). inACM, New York, NY, USA, Article 11 , 265 pages. 2012.

24. E. H. Adelson and J. Y. Wang, “Single lens stereo with a plenoptic camera,” in IEEE Trans. Pattern Anal. Mach. Intell.14, pp. 99–106. 1992

25. R. Ng, M. Levoy,M.Bredif, G. Duval, M. Horowitz andP. Hanrahan.“Light field photography with a handheld plenoptic camera.”Tech. Rep. Computer Science CSTR 2005-02, Stanford University. 2005.

26. T. Georgiev, G. Chunev and A.Lumsdaine. “Super resolution with the focused plenoptic camera” IS&T/SPIE Electronic Imaging. International Society for Optics and Photonics, 2011.

27. T. Georgiev, A. Lumsdaine and S. Goma.“Lytro camera technology : theory, algorithms, performance analysis.” in Multimedia content and mobile devices, SPIE 8667, 2013.

28. https://www.raytrix.de/

29. V. Boominathan, K. Mitra and A. Veeraraghavan, "Improving resolution and depth-of-field of light field cameras using a hybrid imaging system." in ICCP, 2014.

30. "Digital camera including refocusable imaging mode adaptor" US Patent 20130076930

31. B.Wilburn, M.Smulski, K.Lee, andM. Horowitz."The Light Field Video Camera".in SPIE Electronic Imaging, pp. 29–36.2002

32. C.K. Liang, T.H. Lin, B.Y. Wong, C. Liu C.andH.H. Chen."Programmable Aperture Photography: Multiplexed Light Field Acquisition."inACM Trans. Graph. (Siggraph) 27, 3, pp. 1–10.2008

33. T.Georgiev, C.Zheng, S. Nayar, B.Curless, D.Salesinand, C. Intwala "Spatio-angular resolution trade-offs in integral photography" in Proc. EGSR, pp. 263–272. 2006.

34. M. Fuchs, M. Kächele and S.Rusinkiewicz."Design and Fabrication of Faceted Mirror Arrays for Light Field Capture". In Workshop on Vision, Modeling and Visualization, Nov. 2012.

35. W. Song ,Y.Liu, W. Li, Y. Wang. "Light field acquisition using a planar catadioptric system." in Opt Express. 2015 Nov. 30;

36. http://lightfield-forum.com/light-field-camera-prototypes/pelican-imaging-array-camera-light-field-module-for-smartphones/

37. Y.Mukaigawa, S.Tagawa, J. Kim, R.Raskar, Y. Matsushita and Y.Yagi. "Hemispherical Confocal Imaging Using Turtleback Reflector"inComputer Vision – ACCV 2010.Eds. Ron R. Kimmel, R.Klette, & A. Sugimoto. (Lecture notes in computer science, Vol. 6492.) Berlin, Heidelberg: Springer Berlin Heidelberg, pp. 336-349. 2010.

Section 4.
Digital Resources of Museums & Museum Communications

VIRTUAL BRANCH OF RUSSIAN MUSEUM AT SAINT PETERSBURG STATE UNIVERSITY: FIRST DECADE OF COOPERATION

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Abstract

The article focuses on theoretical and practical aspects of cooperation of museums and universities in training and research. The author bases her conclusions on years of experience in the Russian Museum State Project "The Russian Museum: Virtual Branch".

INTRODUCTION

Information technologies have opened a wide range of opportunities for cooperation between the organizations via network interaction and at the same time have generated some problems. Transformation of these problems to achievements is one of the sources for modern society progress. The Authors present experience of the responses to challenges in this sphere during decade of collaboration between Saint Petersburg State University and the Russian State Museum within the framework of an international project ”The Russian Museum: Virtual Branch”. There are theoretical and practical aspects of cooperation between museums and universities within educational and research activity considered, as well as application of electronic technologies for optimization of this work

There are the following strategic areas of the organizations' collaboration (1) development of modern eLearning resources for fields of history and culture of Russia or cross-cultural communication with participation of Russia, (2) creation of capability for integration of the materials into the international educational space, and (3) development of techniques for virtual learning environment of universities and museums. This activity promotes the growth of integrative researches in the field of humanities, including history, art criticism, pedagogics, sociology, psychology, cognitive science, etc. A theoretical component of the project activity is elaboration of methodology for progress in cooperation.

METHODOLOGY

The research methodology is Technological Pedagogical Content Knowledge Theory (TPCK/TPACK). The TPCK framework reflects the relationships between technology, pedagogy, and content [1], [2], [3]. The diagram shows the area of "pure knowledge" and segments where the two and three areas of knowledge are overlapped. Two - area overlaps contain Technology knowledge (TK), Content knowledge (CK) and Pedagogical knowledge (PK).

Technology knowledge (TK) refers to an understanding of the way that technologies are used in a specific content domain and go beyond digital literacy to having knowledge of how to change the purpose of existing technologies (e.g. wiki, google services, etc.) so that they can be used in a technology enhanced way. In this case, it is an understanding of the range of technologies that web designers use in fine arts and museums.

Content knowledge (CK) include knowledge of concepts, theories, and conceptual frameworks as well as knowledge about accepted ways of developing knowledge. In context of the Project, it is Fine Art History, Museology, and Information Technologies for Arts and Humanities.

Pedagogical knowledge (PK) includes generic knowledge about how students learn, teaching approaches, methods of assessment and operation of different pedagogical theories and practices. There are wide range of concepts in this area, for example Blended Learning, Web Learning, Edutainment, Mobile Learning, Multimedia Learning.

There are three - area overlaps: pedagogical content knowledge (PCK), technological content knowledge (TCK) and technological pedagogical knowledge (TPK). Pedagogical content knowledge (PCK) is knowledge about how to make a theoretical or practical subject understandable to learners. This is knowledge about how to integrate pedagogical approaches and content effectively, knowledge of what makes a subject difficult or easy to learn, as well as knowledge of common misconceptions and possible preconceptions, which students bring with them to the classroom.

Technological content knowledge (TCK) refers to knowledge about how technology may be used to provide new ways of teaching content. For example, digital animation makes it possible for students to conceptualize how historian events impute to fine arts, how shape, size and color are connected in the contemporary arts picture etc. Technological pedagogical knowledge (TPK) refers to the opportunities and constraints of technology as an enabler of different teaching approaches. For example online learning tools may facilitate learning for geographically separated learners, mobile learning provide students with appropriation pedagogical guide during excursions, multimedia technologies allow to understand deeper a brainchild of a masteries' author etc.

Therefore, technological pedagogical content knowledge refers to the knowledge and understanding of the interplay between CK, PK and TK when using technology for teaching and learning. It includes an understanding of the complexity of relationships between students, teachers, content, practices and technologies.

MAIN AREAS OF THE NETWORK ACTIVITIES

Today the project possess strong capacity for successful collaboration between the museum as the fine arts data provider and university as a teacher of this information for wide student's audience and designer of scientific knowledge. The Project's network united more than one hundred and eighty organizations; there are more of twenty universities among them, including six foreign universities. The extensive library provides the users with unique digital materials collection.

Russian museum and the multimedia library became a research base for the project members. Dozens of diploma works have been performed on the library materials, and the museum itself became a platform for student work practices for IT, designers, art critics and historians. There are possibilities of testing of the most ambitious student innovation in the application of information technologies in culture on the materials of the Russian Museum. The experience of such interaction has been implementing by Saint Petersburg State University, Saint Petersburg Polytechnic University, the Federal University of Krasnoyarsk, Chelyabinsk State University.

Common Projects

One of the main requirements of the modern university education is that the students are involved in research work at the earliest stages of learning. Students have possibilities to meet experts of the Russian Museum, collaborate on degree projects.

It is impossible to imagine a modern university without active research work and international cooperation. Among the activity of this kind we would like to mention the projects held in partnership with our organizations: International Project "Information Technologies for Sustainable Development of Museums" (2007-2008) [4], International Project "Creation of a New Tourist Route Between Estonia and Russia by Development of the Virtual World of the Russian Museum with participation of the Estonian and Russian youth" (2008-2009), International Conference "Museum-University: Collaboration in the Net" (2013).

International Project "Information Technologies for Sustainable Development of Museums" (2007-2008) includes two series of virtual workshops Sustainable Development of Museums (2007) and Development of Information Technology at the Museum (2007- 2008). Museums experts and artists, universities scholars and students of universities, galleries and museums of Croatia, Italy, Macedonia, Ukraine, and Russia presented their resources and discussed possibilities of collaboration. The project was sponsored by World Bank and was highly appreciated by experts and grantor. Outcome of the project is common courses and educational projects.

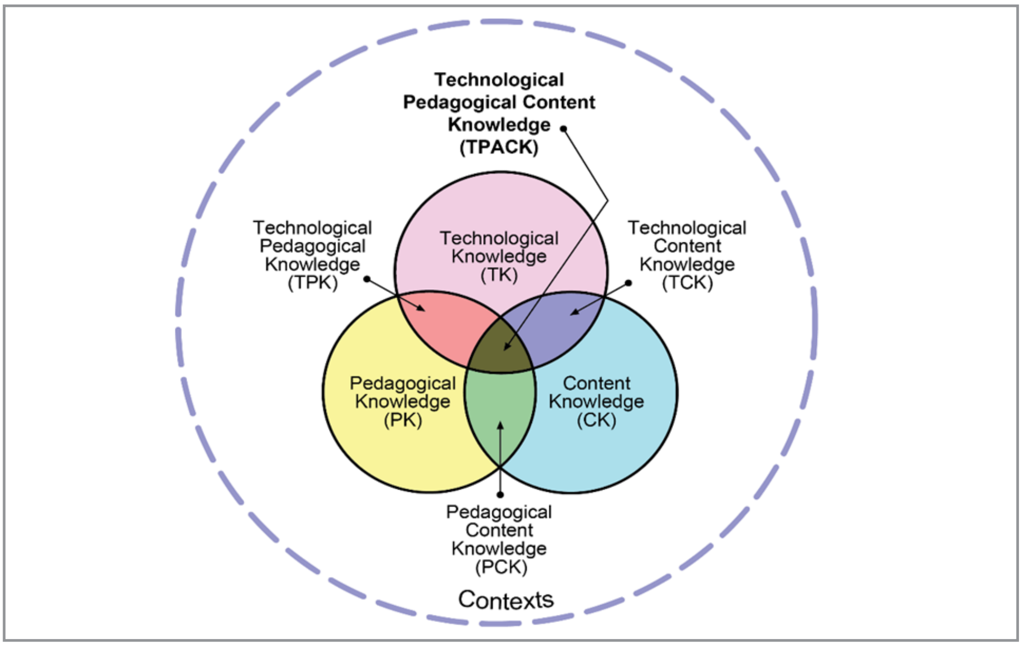

Diagram 1. Elements of Technological Pedagogical Content Knowledge Theory (TPACK)

EU BSR IIIB – INTERREG IIIA Priority North Program supported the Project "Creation of a new tourist route between Estonia and Russia by development of the Virtual World of the Russian Museum with participation of the Estonian and Russian youth". There were following participants Kohtla-Järve Museum of Oil Shale Russian State Museum, "Technologies of modern Education Company and students of Saint Petersburg State University, Herzen State Pedagogics University, Saint Petersburg Institute of Culture, Academy of Fine Arts, Tallinn University and Tallinna Tehnikaülikooli Virumaa Kolledž.

Four workshops for students were hold in frame of the Project. There were two are in Saint Petersburg and two ones are in Estonia. The seminars subjects were concern with learning of arts and computer modeling, contemporary computer technologies and technologies of virtual reality creation. Output of the project is multimedia program Painters of Estonia are in Russia, Russian Painters are in Estonia", numerous manuals on the fine arts, Open Internet book about the project.

Annual Workshops for Branches of the Network

Since 2005, Russian Museum has been holding annual seminars for heads of Local Project centers' on topical issues of the centers. It is noteworthy; most of them are related to the issues of creation of learning materials based on the digital library resources. There are most important among them: "The Russian Museum: Virtual Branch" is a Unique Object of Humanitarian Educational Environment, "Implementation of New Educational Technologies Through the Creation of a Bank of Teaching Materials in the Framework of the Project" Russian Museum: Virtual Branch", "Organization of Teaching and Educational Activity in Virtual Branches in Finland ", etc.

Blended Learning

"The Russian Museum: Virtual Branch" is not only the public access to artistic and scientific potential of the world's largest museum of Russian art, but also the possibility of fruitful cooperation on the basis of joint educational and research projects. Two major areas are developed based on the project in St. Petersburg State University: student learning and collaboration of experts in the arts and humanities.

Computer programs on the history of Russian art, videos and electronic catalogs of the largest exhibitions offered by the Russian Museum to virtual branches, can most fully and vividly present to students the artistic culture of Russia. In addition to the preservation of the Russian cultural and historical traditions, the project allows creating a multicultural environment involving partners from other countries and cultures. A good example is the seminar on "Information Technology at the Museum" within "Virtual Museums" course. Participants did not have to leave their classrooms in Finland and Russia, as it was organized through distance learning.

An important issue is the development of virtual resources that can be used in scientific and educational practice. These resources should be made by professionals and have the quality of reliability. Cooperation of museums and universities in this area is a matter of debate. Certainly, the priority in the development of computer programs on the history of Russian art, videos and electronic catalogs of the largest exhibitions belongs to the museum. University specialists will focus on developing electronic tutorials, conference websites and resources created at the university distance-learning portal.

Online Courses

Educational aims of the project, under the conditions of rapid development of Internet technologies, acquire new forms of realization, especially the active development of web learning.

Russian State Museum experts have developed three electronic courses for the participants of the project. There are the following: (1) "Russian Avant-Garde": development of the unique phenomenon of fine art from inception to end, the lectures are accompanied by the show of more than 200 works from the museum collection). (2) "Russian Art of the Late XIX to the Beginning of XX Centuries". (3) "Gardens of the Russian Museum "(three-century history of garden art based on the Summer Garden and Mikhailovsky Garden).The courses are designed for users' perception of computer files, text is written in accessible language. A test section allows the user to self-control the degree of assimilation of knowledge and provides students with ability to return to the main sections of the course at any point.

E-learning courses are used in the Project Centers, both for self-education, and as the guides on the history of Russian art, or as an ordinary textbook. These programs are available for the Centers visitors[3] and for a wider audience on the Internet Portal of the "Russian Museum: Virtual Branch" as an open sources [4].

Virtual Lyceum

Online lectures equipped with a video conferencing system have come to replace the electronic educational courses "Pages of History of Russian Art" intended primarily for self-learning. come. Since 2012, a Virtual Lyceum of the Russian Museum, has provided remote participants with a unique opportunity of live communication with famous experts of art history, museum studies etc. There are the following subjects of the lectures: Virtual School of Museology, Conversations about Arts with The Russian Museum, Meetings with Creative Persons in Multimedia Cinema, An Insight into the Collection of Museums of Russia etc. The lecture records are available on the Project YouTube Channel [5].

CONCLUSION

Methodology Aspects

Analysis of the Project experience suggests the following conclusions. The Digital Library materials are most demanded by users, sustainable forms of work centers with the Library programs are created and tested, and learning is the leading way of the branches' activity. The project has accumulated experience of interaction within the local community virtual branches of the Russian Museum, where the interaction exists both vertically (from the Russian Museum as a curator of the project) and horizontally (within the WF community).However, the potential of both ways of cooperation possesses significant reserves for development, especially in the segment of high school.

There are the following ways of collaboration between museums and universities today. The first one is providing students and teachers with materials for their routine work as well as inviting them to learning events to museums. The second one is creation of virtual learning objects aimed to teach individuals to understand fine arts, focusing on games [8]. Thus, activities related to the interaction of content and technology (see. Diagram 1) are the main route of the network cooperation. In other words, universities employ virtual training aids in classrooms made from brick and mortar [8].

Meanwhile, the aspect of pedagogical support of web learning in the network is waiting for its implementation[9]. A tool for answering this challenge would be to create a series of massive open online courses (MOOC) based on cooperation between universities and Russian Museum. The technological platform for the realization of these resources can be the Portal of Open Education of Russian Federation, the "Russian Museum: Virtual Branch" Portal or international MOOC portals.

Ways of the Network Development

Massive Open Online Course development opens up wide prospects for the development of the Project. There are the following among them: (1) development of the project educational aspect by mastering one of the most contemporary forms of educational resources, (2) integration into the international educational world through a very demanded form of online learning. Development of the Web 2.0 pedagogy concept through empirical and theoretical study of issues concerned with creation and development of the MOOC is very significant.

There are important tasks for the community of virtual branches to make available the infrastructure for networking, tools for processing and organizing information and training programs for universities as well as transmitting of this extensive knowledge. These are conditions for knowledge openness, wider communication and collaboration of experts without borders of geographical and political territories.

Integration of efforts of organizations participating in the project is required for working on these matters. In this connection some questions arise, namely forms of institutionalization, status of participants etc. It can be a kind of a virtual research laboratory, association of the branches or the Project resource center. November 2013, on the eve of IV Saint Petersburg Cultural Forum Russian State Museum conducted a survey of universities about creating an association of the Project branches, and this idea was unanimously supported. Saint Petersburg State University proposed the idea of creating a resource interdisciplinary center for project participants, integrating the experience of inter-regional cooperation project in the fields of arts, humanities, including electronic pedagogics, and technologies.

It is obvious that association would be beneficial for all the Project participants, it will raise the educational capacity of the participants in the areas of expertise and resources, the quality of professional training of specialists in arts, humanities, technologies, and strengthen communication between branches and give an impetus to the further Project development.

REFERENCES

1. Shulman LS. (1986) Those who understand: Knowledge growth in teaching. Educational Researcher, 15(4)
2. Mishra P, Koehler MJ. (2006) Technological pedagogical content knowledge: A framework for teacher knowledge. Teachers College Record, 108(6), 1017-1054
3. Schmidt DA, Baran E, Thompson AD, Mishra P, Koehler MJ, Shin TS. (2009)Technological pedagogical content knowledge (TPACK): The development and validation of an assessment instrument for preservice teachers. Journal of Research on Technology in Education, 42(2), 123-149
4. E. Gaevskaya. Russian Museum Virtual Branch at Saint Petersburg State University: Expertise of the Multimedia Content Applying, (pp.24-25). Internet and Modern Society. All- Russian Conference, St. Petersburg 27-29 October 2009. Internet and Modern Society 12th All- Russian Conference Proceedings. Saint Petersburg; 27-29 October 2009. – SPb: Faculty of Philology and Arts of St. Petersburg State University, 2009 – 148 pages. ISBN 978-5-8465-0965-8 //
5. Internet Portal of the “Russian Museum: Virtual Branch” as an sources for the Center’ visitorshttp://www.virtualrm.spb.ru/ru/resources/edu;
6. Internet Portal of the “Russian Museum: Virtual Branch” as an open sourceshttp://rusmuseumvrm.ru/virtual_offices/media/russkoe_iskusstvo/index.php
7. YouTube Channel of the “Russian Museum: Virtual Branch” https://www.youtube.com/user/RMVBDepartment
8. E. Gaevskaya. Education or Edutainment?, (pp.103-107). Electronic Imaging & he Visual Arts. International Conference 9-11 May 2012 Florence. Proceeding Electronic Imaging & the Visual Arts : EVA 2012 Florence / Edited by Vito Cappellini. – Firenze : Firenze University Press, 2012. 151 pages (Proceedings e report ; 88) http://digital.casalini.it/9788866555735 ISBN 978-88-6655-127-0 (print), ISBN 978-88-6655-130-0 (online)
9. E. Gaevskaya, N. Borisov. Video Conferences as an Instrument of International Network Community Development, (pp.45-46). Internet and Modern Society. 9th All- Russian Conference, St. Petersburg 14-16 November 2006. / Internet and Modern Society 9th All-Russian Conference Proceedings, St. Petersburg 14-16 November 2006 – SPb.: Faculty of Philology of St. Petersburg State University, 2006 – 206 pages. ISBN -5-8465-0603-8I

CONTEXT DRIVEN CONTENT PRESENTATION FOR EXHIBITION PLACES

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Abstract

The implementation of technology driven interaction scenarios in museums faces several challenges that mainly relate to seamless integration, enhancement of user's experience, and expansion of exhibition space. After 9 related articles analyzing, 4 new interaction projects under the heading "extended exhibition" are described in this article. Advanced functional prototypes range from an interactive outdoor guide using a lamp artifact that navigates users by light intensity, to a smartphone app that allows visitors to interact with the collection of the museum and to control the presented information density. Methodological tools, the way of implementation and project findings compared to current approaches are also examined.

INTRODUCTION

For decades, museums have offered audio guides or multimedia kiosk systems to their customers to present detailed content related to single exhibits or chapters of the exhibition. Recently, media guides based on smartphone technology and bring-your-own-device approaches (BYOD) tried to extend the presentation quality of additional information about presented items, as well as multi-users' installations. While audio guides and media guides along with kiosk systems provide a potentially personalized layer of information, often detached from the exhibition and the overall experience, multimedia installations offer a more integrated approach with a high potential capacity of narrative quality. The implementation of multimedia installations, due to their integrated

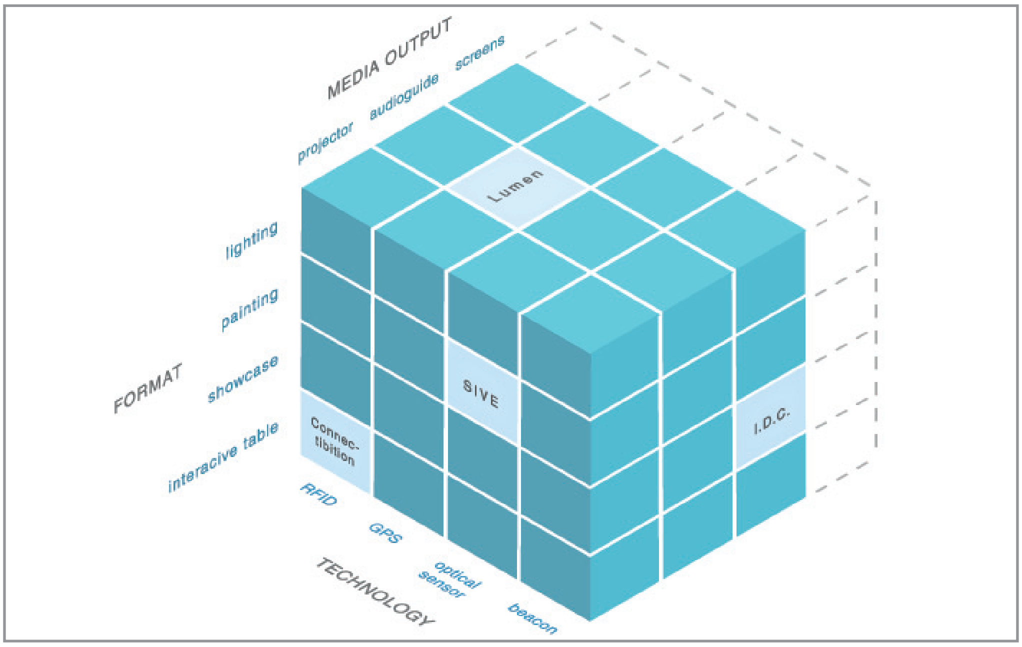

Fig. 1. 3D matrix of presentation formats, media output and positioning technologies

nature, may require custom design and engineering solutions while kiosk systems, audio and media guides can be planned and implemented successively (on system level).

The increased availability of Indoor-Positioning, using radio infrastructures like Wi-Fi, Beacons, RFID, Ultrasound or other sensor technique added with context driven machine intelligence offers new options to adapt presented media, to change the way of understanding and to interact with content and exhibits. This leads to our three design based research challenges:

1. Seamless integration into the natural exploration of an exhibition;
2. Enhancement of user's experience by means of contextual information and interaction or personalization in a narrative way;
3. Expansion of exhibition space by adding non-redundant layers of information to the existing space or opening up entirely new areas.

How could above mentioned technologies help to merge the qualities of digital content delivery media (audio / media guides / kiosk systems and customized multimedia installations), to create a user experience, which could be planned on system level as opposed to custom designed and engineered solutions?

APPROACH

Investigating into this research was the motivation for creating the setup that leads to several new interaction scenarios, applicable to the GLAM sector. In this paper we present a design based research approach (Venable, 2010 [1]) that addresses the upper research questions in four museum scenarios, developed simultaneously in one research process. These four case studies regarding the methodology of Yin, 2013 [2] were developed in a university based trans-disciplinary project "extended exhibition" [3].

The aim of this project was to produce functional prototypes to showcase interaction scenarios considering the parameters and challenges of our field of research. In order to identify possible starting points, extensive field and literature research in museums and exhibition space was conducted to create a comprehensive list of museum formats, digital output media and positioning technologies.

Then, in a collaborative effort, a 3D matrix of presentation formats, media output and positioning technologies was created to open up a roomfor possible technical combinations as carriers for interaction scenarios. In teams, in an iterative design process using an adopted variant of the "six thinking hats" method (De Bono, 1989) [4], these basic interaction scenarios were discussed, discarded or refined and extended until each team had a final concept paper as a basis for the creation of a prototype.

Each concept was inspected for necessary interaction or technological features to be evaluated by using a high-fidelity prototype, which was then built using off-the-shelf technology. The prototypes mostly consist of a functional object or installation supported by video prototypes and scenario presentations. Finally, the prototypes were presented to a wider public in an exhibition setup for the collection of pre-evaluation insights.

The demonstrated and evaluated prototypes and interaction models deal with technology driven approaches that could make the collection more accessible to the audience than current museum apps do, without compromising but strengthening curated work.

Fig. 2. Lumen prototype

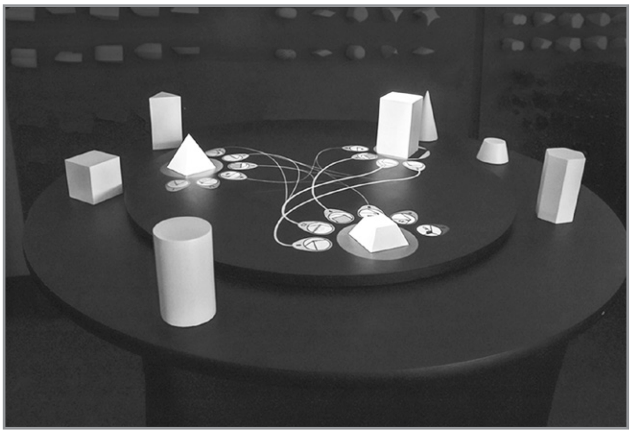

Fig. 3. Connectibition prototype

RELATED WORK

The related work mostly use locating technologies for advanced interactions with the collection of a museum or an adaptation of exhibits to the requirements of the visitors. A seamless integration of technology used was rarely taken into consideration. The table [Fig. 6] in section "Findings" summarizes the strengths of the examined work and illustrates where the developed projects can fill gaps. Using mobile devices like BYOD will be more efficient and pleasant as Tesoriero, et al., 2014 [5] wrote because just interesting exhibits will be visited. Another aspect for BYOD is the possibility of sharing content with other visitors. As Suh, et al., 2011 [6] mentioned shared content will be kept better in mind and could be used in social media campaigns. Using this technology has to be seen critically as well because it may distract and dominate the exhibition visit by the mobile device.

Rudametkin, et al., 2008 [7] focused on the experience of the exhibition. The given information, which was sent to a device, is adapted by the localization of movement of the visitor. Malerczyk, 2004 [8] used a more seamless way by visually hidden technology and controlled the interaction with gestures. Zabulis, et al., 2010 [9] showed a similar and more natural approach. The visitors' movement was tracked by a camera, which was used to configure the exhibit. The range of information based on the time of residence of the visitor. Many concepts try to enhance the users' experience by considering the personal characteristics of the visitors. Tesoriero, et al., 2014 [5] and Bohnert, et al., 2014 [10] use the specification of language, interests, duration of visit or handicaps to offer an efficient visit to the exhibition, guiding the visitor to exhibits corresponding to his personal profile. An exciting approach was developed by Zabulis, et al., 2010 [9]: the visitor's interest in a specific topic is not determined by the user's profile but by his movement pattern and resting times. Besides user's profile S. Alletto et al., 2016 [11] consider contextual data like the number of visitors in a showroom or emotions stated by other visitors. Certain concepts pursue the objective to meet the expectations of certain target groups: Suh, et al., 2011 [6] and Confalonieri, et al., 2015 [12] address visitors in groups; Rudametkin, et al [7], Zabulis, et al., 2010 [9], Tesoriero, et al., 2014 [5] and Bohnert, et al., 2014 [10] include foreign visitors or visitors with handicaps or try to meet the demands of both experts and flaneurs. Zabulis, et al., 2010 [9] and Malerczyk, 2004 [8] take a playful approach and let visitors encounter the exhibit in a narrative context analyzing paintings or reconstructing artefacts. Zabulis, et al., 2010 [9] open a new exhibition space by presenting large scale artefacts which are not accessible to public in actual size digitally. All related works miss demonstrating interconnections among the items of the exhibition.

IMPLEMENTATION

Following the approach four interaction scenarios were developed as prototypes: Lumen is an interactive lamp, which helps users to navigate and designed city tours in a new form. A smartphone, integrated into the body of the lamp, localizes the user's position via GPS and compares it with the coordinates of the next target. If a user moves the lamp into the direction of a target, then the lamp lights up in full brightness, controlled by an Arduino device [13]. With a greater deviation, the light is dimmed and shows the correct walking direction. At points of interest, the user gets some visualization covered by an opaque glass and audio guide for information about existing exhibits and relevant places. The user is included into exploring themes.

Connectibition is an interactive table surface for exhibitions to visualize relationships among exhibits, selected by a visitor. Vector projections illustrate the characteristics of the objects and existing relationships. Tangible objects, identified by RFID technology, can be placed on the interactive surface, whereupon the information for

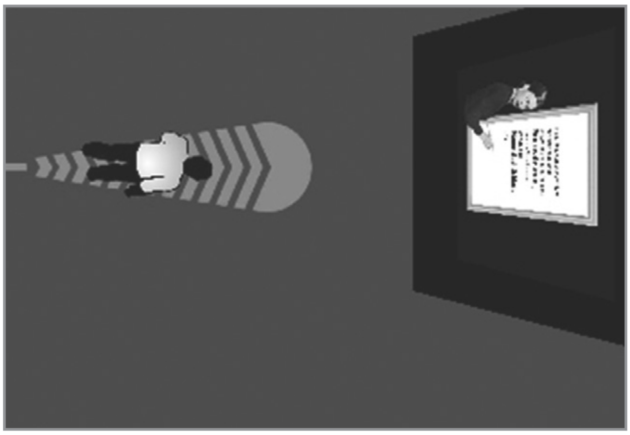

Fig. 4. SIVE interaction concept

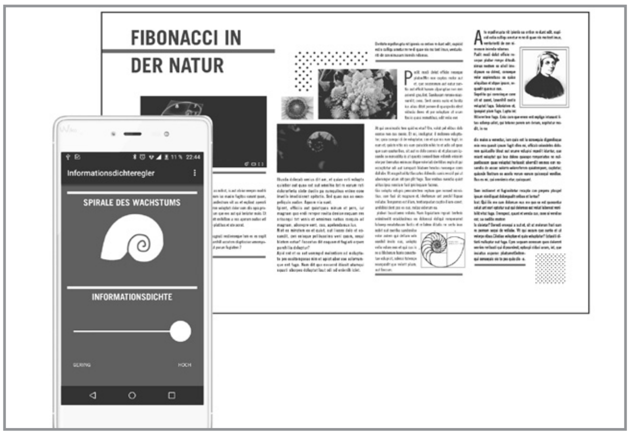

Fig. 5. I.D.C. application and exemplary display with maximal "density"

that object is visualized. If there are several objects on the surface, common features are highlighted and linked to each other. This technology may be adapted to the scope and depth of information. The concept is transferable to various subject areas.

SIVE, the sensor controlled content mediation device, is an interactive concept which can present pieces of art and artists step-by-step either on a canvas or on a screen. Visitors are guided by marks on the floor while a sensor registers their approaching. Depending on the visitor's position, various information is presented addressing his proximity. This allows visitors to determine the depth of the information presentation by their movement. This concept ensures that attention is directed to details e.g. at a layer based presentation. To detect the distance ultrasonic detectors are used. SIVE is adjustable to the needs of an exhibition. Pictures, texts, animations, graphs, videos, lights and sounds can be varied by the visitor.

As visitors differ remarkably in previous knowledge, duration of their visit or literacy they demand an individual amount of information. Controlled volume of information prevents the visitors from being overtaxed who then react with decreasing attention. The Information Density Controller (I.D.C.) offers a user-centered impartation of knowledge in exhibitions, adopting information dynamically to visitors' demand in amount and format, based on smartphone-technology and indoor positioning. The system – comprising of an application and exhibits with digital displays – enables visitors to manipulate the density of information for their walk through an exhibition. The visitors can regulate their individual density of information by using a slide control. An application installed on the visitor's mobile device notices which exhibit is nearby using beacon technology. The desired information density is transferred to the digital display in the exhibition space automatically. Information of low density addresses the experience-driven visitor; information of higher density is increasingly complex and text-laden in its presentation.

FINDINGS

Lumen uses smartphone technology integrating it seamlessly into the user's experience. By covering the display with opaque glass, using a spyhole and showing abstract visualizations only if necessary the user does not get sidetracked from the main focus. Therefore, he can act naturally as required by Zabulis, et al., 2010 [9] nevertheless using the entire range of smartphone functionality. Because of its self-explorative character Lumen enables the user to learn more efficiently as pointed out by Tesoriero, et al., 2014 [5]. Users learn based on experience about abstract content what makes the learning outcome more sustainable. Navigation is a fundamental aspect of Lumen. Location is determined by the GPS of the smartphone and the compass function allows navigation support via light brightness To guide the user securely an additional voice instruction will be spoken on long pathways. It strengthens the exploratory character, mentioned in Tesoriero, et al., 2014 [5]. Based on a storytelling approach Lumen enhances user experience and addresses new target groups: Focusing on group experience (Confalonieri, et al., 2015) [12] the content addresses groups of visitors in particular. Collective exploration strengthen the bonds and intensifies memory.

Without requiring any showroom to guide users, Lumen expands the exhibition space. GPS positioning and compass functions are provided by the smartphone device and controlled by an Arduino board. A high-performance LED is used for navigational hints and illuminates the desstinationwhen reached. In this way exhibits can be presented and do not need digitization as stated byZabulis, et al., 2010 [9]. Two conditions must be fulfilled for a usage: a) an acceptable route without barriers to avoid accidents. b) effectual darkness for navigational support with a light beam. There are plenty of new items that can be explored outside the showroom: statues, parks, original locales at historical places, (destroyed) buildings, etc.

In spite of a high of technical elements at connectibition, the visualization of relations and haptic elements of the exhibit are most dominant, asMalerczyk 2004 [8] and Zabulis, et al., 2010 [9] stated. The technique is seamlessly integrated and not visually perceived by visitors. Connectibition allows direct interaction with the exhibit by using objects as tangible interfaces. Rearranging the objects in different ways the visitor can explore interconnections and differences among certain exhibits. By combining objects of interest he can find out more about them. Malerczyk 2004 [8] uses a similar way to show more details of the aspect a visitor is interested in. This personalization of interests and the experiential learning enhances the user's experience. The exhibit can be configured by individuals and groups. The common interaction supports the ability of personal retrospection, as Suh, et al. 2011 [6] showed.

Similar to Malerczyk, 2004 SIVE works without any haptic controls and offers the visitor an intuitive access by the deviceless control [8]. The natural behavior of approaching an object in curiosity leads to further information. By interaction with visitors paintings can be expanded and modified in appearance depending on the distance (Zabulis, et al., 2010) [9]. The interest-based details can present different working states or special views of the paintings considered, which are normally hidden (Malerczyk, 2004; Zabulis, et al., 2010) [8,9]. Furthermore, it is possible to establish relationships amongst exhibits and to offer an interactive story. Besides the new presentation of content, the localization-based system can achieve new places and reach more audiences. Since the interaction has taken place without any additional tools, classical museum collection can be presentedto the public in atypical locations (Tesoriero, et al., 2014; Zabulis, et al., 2010) [5,9].

Taking into account the approaching era of ubiquitous computing the I.D.C. integrates mobile devices seamlessly into the visitor's museum experience by using bluetooth technology. Alletto et al., 2016 [11] provide a good basis for the concept of interaction of the I.D.C. In an exhibition the I.D.C. disappears from visitor's perception. Whereas other systems require the use of mobile devices during the visit or suspend visitors without any mobile device (Tesoriero, et al., 2014, Bohnert, et al., 2014) [5, 10] the I.D.C. demands a one-time setting and offers a standard view with average density of information to any visitor without a mobile device. Information is displayed on and about the exhibit. Adoption of information shown on the screen of a mobile device (Tesoriero, et al., 2014) [5] affects the visitor's exhibition experience, which the I.D.C. neither wants to cut nor to disrupt by navigational instructions. The personal information density does not only affect a single exhibit (Zabulis, et al., 2010) [9] but every digital display. In case of aroused interest or decreasing attention visitors need to adjust to the density of information. Zabulis, et al., 2010 [9] and Rudametkin, et al., 2008 [7] link the amount of displayed information to motion patterns or users' profiles, which do not allow targeted adjustments. The slider being the essential control element of the I.D.C. application offers an intuitive interaction using a simple metaphor with immediate feedback. I.D.C. is based on visitors who differ considerably in previous knowledge and literacyand should not be confronted with same density of information to avoid overload and frustration. Museums should reach out for the visitors' level of knowledge and experience. Whereas Tesoriero, et al., 2014 [5] and Rudametkin, et al., 2008 [7] consider language, physical handicaps and personal interests as a personalization of information, I.D.C. dynamically adopts information not only in amount and complexity, but also in approach. Displayed information of low density addresses experience-driven visitors (children, short-time-visitors) working with (moving) images. By selecting the setting high density increasingly nousdriven and text heavy types of information are built upon to address visitors with extensive knowledge and excellent literacy (experts). Whereas Bohnert, et al., 2014 [10] prioritizes certain topics and Rudametkin, et al., 2008 [7] filter exhibits using personalization - creating a sort of filter bubble - I.D.C. does not hold back any information. According to Zabulis, et al., 2010 [9] the visitor decides what exhibits he is interested in when strolling through the exhibition. This kind of visit allows "informal learning".

CONCLUSION

The iterative design process followed by the prototyping phase produces four demonstrators which are able to show the potential of the proposed interaction scenarios. The whole design process profits from the close cooperation of design and engineering professionals in both phases as design and technology were developed interdependently. Thus, functionality of the prototype could be assumed. While all prototypes demonstrate the look and feel of the proposed interaction scenarios, there still needs to be considerable thought put into aspects of technical scalability as well as into economic exploitation. Problems might occur when it comes to managing content or producing and maintaining lots of dedicated hardware units or apps across several platforms. The user's experience related challenge of accessibility also was not thoroughly considered in this stage of the project.

For all delivered prototypes the potential of creating user's experiences by positioning technologies was evaluated in field tests, either tracking the visitor or the exhibit. Existing exhibits or their replicas can be used as access to meta information (connectibition), the visitor can physically change explanatory perspectives towards an exhibit (SIVE), adjust to the information layer of a whole exhibition space, to his own pace of exploration, or whole new exhibition spaces can be created by the use of a narrative, guiding object (Lumen).

Apart from narrative interfaces enhancing the user's experience, tracking mechanisms and mobile devices could be used to increase accessibility to the exhibition and target specific visitor groups by language and thematically focused meta-information. As stated by Bohnert, et

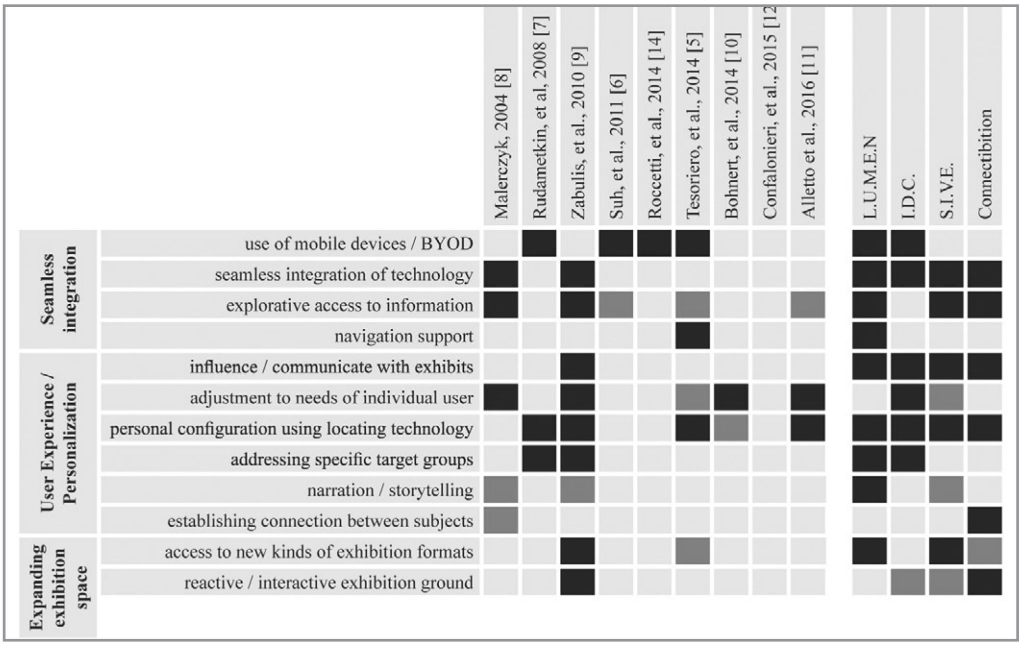

Fig. 6. Related work and developed projects compared to research questions

al., 2014 [10], at the same time gathering data about visitors' behavior could lead to valuable insights of the reception of exhibitions providing hints for improvement of content and presentation.

Analyzing the strengths of other work in this field – as shown in table 1 [Fig. 6] – compared to the projects presented here, a significant higher effect of seamless integration, user's experience/personalization, and expanding exhibition space could be demonstrated.

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Our four museum interaction scenarios are documented and enhanced with additional footage that lively shows the interaction on medium.com [3].

REFERENCES

1. Venable, John R. (2010): Design science research post Hevner et al.: criteria, standards, guidelines, and expectations. In: Robert Winter, Leon J. Zhao und Stephan Aier (Hg.): Global Perspectives on Design Science Research. 5th International Conference, DESRIST 2010. St. Gallen, June 4-5: Springer (Lecture Notes in Computer Science, Vol. 6105), pp. 109–123.

2. Yin, R. K. (2013). Case study research: Design and methods. Sage publications.

3. https://medium.com/extended-exhibition (25.5.2016)

4. De Bono, E. (1989). Six thinking hats. London: Penguin.

5. Tesoriero, R., Gallud, J. A., Lozano, M., &Penichet, V. M. R. (2014). Enhancing visitors' experience in art museums using mobile technologies. Information Systems Frontiers, 16(2), 303-327

6. Suh, Y., Shin, C., Woo, W., Dow, S., &MacIntyre, B. (2011). Enhancing and evaluating users' social experience with a mobile phone guide applied to cultural heritage. Personal and Ubiquitous Computing, 15(6), 649-665

7. Rudametkin, W., Touseau, L., Perisanidi, M., Gómez, A., Donsez, D., & Bull, S. A. S. (2008, July). NFCMuseum: An open-source middleware for augmenting museum exhibits. In International Conference on Pervasive Services (ICPS'08), Demonstration track, July (pp. 6-10)

8. Malerczyk, C. (2004). Interactive museum exhibit using pointing gesture recognition.

9. Zabulis, X., Grammenos, D., Sarmis, T., Tzevanidis, K., &Argyros, A. A. (2010, September). Exploration of Large-scale Museum Artifacts through Non-instrumented, Location-based, Multi-user Interaction. In VAST (pp. 155-162)

10. Bohnert, F., & Zukerman, I. (2014). Personalised viewing-time prediction in museums. User Modeling and User-Adapted Interaction, 24(4), 263-31

11. Alletto, S., Cucchiara, R., Del Fiore, G., Mainetti, L., Mighali, V., Patrono, L., & Serra, G. (2015). An Indoor Location-aware System for an IoT-based Smart Museum

12. Confalonieri, R., Yee-King, M., Hazelden, K., de Jonge, D., Osman, N., Sierra, C., ... &Prade, H. (2015). Engineering multiuser museum interactives for shared cultural experiences. Engineering Applications of Artificial Intelligence, 46, 180-195

13. https://www.arduino.cc (25.5.2016)

14. Roccetti, M., Marfia, G., &Bertuccioli, C. (2014). Day and night at the museum: intangible computer interfaces for public exhibitions. Multimedia tools and applications, 69(3), 1131-1157

LOOP CONTROL OF EMOTIONAL BALANCE IN A MUSEUM REALITY-VIRTUALITY CONTINUUM

PROBLEM DEFINITION AND PROPOSED APPROACH

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Abstract

The authors collaborate in exchange of knowledge and problem definition in the field of museum stu-dies in control loop of a reality-virtuality continuum. Their research activities focus on accessibility to cultural heritage museum collections in Russia and communication studies related to nonverbal signs of stress or negative reactions of visitors, aiming to improve emotions in virtual space.Consequently, adaptive interfaces to overcome such stress are deve-loped, deriving from research, design and validation of new methods and tools for personalized storytelling and adaptive guides, combining the Museum physical and digital world.

INTRODUCTION

The popular term "virtuality" is very attractive, especially in the field of digital heritage. Advertising the accessibility and the participatory culture in digital worlds, one forgets the pure value of cultural heritage and the main role played by new technologies applied for its dissemination. In the beginning of 21st century, websites on cultural heritage were uncommon. Today their percentage still is very low compared to the business sector of the global net. [1: 126] This fact shows week relevance of the products in the field of digital heritage. The studiesof this relevance and feedback from consumers of such products became effective tools for collaborations between museums. [2] While there is a set of international standards and recommendations for websites and multimedia programs in the field of cultural heritage [3,4,5,6,7], none include methods of feedback evaluation and psychological aspects of museum communication [8,9]. The next step in exploring virtual worlds should consider human aspects in adaptive and personalized environments [10].

Traditional museum studies take into account visitors' preferences according to gender, age or personal thematic preferences, so, they fix only grounding. Adaptive software takes this data and personalizes interface and content from the cognitive component point of view [11-17].The cases of implementation in museums are still a few. The set and quantity of information are recommended by level and preferences of a curator without psychological specifics of an individual. We could title this type of human-orientated adaptability – differential, not personalized. The positive experience during museum visit is related to the positive emotions experience. Strictly speaking, this is not the joy of cognition, but specific experience of museum communication, having a clear and valuable component. The research reported here focuses on this subject, by defining the problem in the field of museum studies in a control loop of a reality-virtuality continuum.

AIM OF INVESTIGATION

Our research goal is situated within the topic of museum communication studiesaiming at defining a new social paradigm where the individual and the community are in the center of the cultural heritage narrative, situated in physical and virtual museums. Consequently, we are looking at designing an adaptive interface for virtual and mixed museums as a system of improved interaction and social accommodation.

There are various ways to enhance museum space and museums' visitor experience [8].The various types of computer abilities allow developers a wide choice in the digital world [17]. The conservative museum society has little chance to follow all technological changes, resulting that they relate to virtuality as a new type of a book with images.A best example is a long-term discussion on the definition of "virtual museums" [18 - 20]. Any application of a common terminology describing the parts of a computerized virtual system [17] for museums or similar cultural institution needs is helpful and gives many advantages [21, 22]. One of them comprisesthe new communication media for museums, such as dedicated websites. It starts before the visit when potential visitorsbrowse the website of a museum and get preliminary information on collections and exhibitions. Once visitors enter the physical museum they may get in contact with museum staff, explore exhibits, be led by museum guides or have implicit or direct contact with curators. Over the years several approaches and methodologies have been developed to collect feedback from visitors [23]. Recent research revealed that visitors who prepare their museum experience (through virtual interaction with the museum collection through the internet) have a richer visiting experience than the casual visitors; there is a difference in age groups and gender between real and virtual visitors [24]. Consequently, adult visitors often come to museums not only for an edutainment experience but to experience positive emotions (good feelings) from dedicated cultural events.

Human-orientated platforms for education and training are innovative methods accessible to everyone. Online access allows distributed users to jointly operate in a common virtual space [25]. The same approach can be used in museums. In the same time, projects aiming to control behavior of visitors in a museum space should consider its cognitive component. Electronic devices may be applied to evaluatevisitors' satisfaction from the information gained during their visit. [26] There are several reasons why many computer applications for communication of Cultural Heritage in museums, or those aimed at improving the museum experience, are not adaptive. A counter example is the experience to combine virtual models of museum objects with text information / Braille script and quick audio guides for augmented reality at archaeological exhibitions [27]. Apart from facilitating communication for disabled visitors, casual adaptation implies only age and native language. Now it is turn to make a human-centered system with virtual environments.

Communication plays a leading role in the formation of a positive visiting experience of museum exhibitions, particularly for the mutual adaptation of visitor and museum artifact: any communication process provokes changing of information and mutual adaptation of subjects [28]. The archaeological exhibition is a message with encoded information, including facts, ideas and emotions, which are translated to visitors by means of verbal communication (text description) or nonverbal (images). This encoded information relates to the object itself, as an archaeological artifact once part of a (non-existing anymore) culture, but it is also a museum exhibit in the modern present and as such often embeds values of a "precious", "art" object. Moreover, the message transmitted by the object and its communicative apparatus is manipulated by the curator of the exhibition, the archaeologist who excavated it, or the communication expert who prepared the communication material. The visitors' channels of reception can be natural (sensor systems) or artificial;the number of recipients may differ from single persons to a group. Their reaction becomes an indicator of effectiveness and adequacy of the communication apparatus to transmit the message and to be positively received by the visitor. The result of communication can be expressed as a change of behavior of the recipient or an increase of his resistance to absorb the message.

Within the artificial intelligence domain, cognitive psychology defines "frames" as the (ideal model) structures of information and certain stereotypes helpful for adaptation of human behavior in a new environment or an unknown situation. [29] Action and interaction during communication are on verbal and non-verbal levels. Verbal communication uses human speech, while non-verbal communication usespara-linguistics, proxemics, body language, gesture, kinesthetic or olfactronics. [30] Thus communication is a synthesis of sensor and social processes that can be applied in the museum communication, resulting in a visitor model of personal exploration of a museum space characterized by an evaluative judgment.

Emotional state of museum visitor during museum communication is not abstraction. While the evaluative judgment is a social attitude, it is formed on three levels:

- expectation and satisfaction;
- attitude (affective and cognitive);
- behavior.

This way the emotional state is an attitude – ability to change behavior. The verbal instance of attitude is described by scaling psycho-physiological parameters that express emotional (affective) components(Thurstone-type Scale, Likert Scale etc.); one-dimensional scales and factor analysis measure the cognitive component. Unfortunately, the revealed contradiction between fixed verbal reactions and real behavior of humans during the attitude measurements makes unreliable any prediction of behavior. Adaptive software and personalized interface attempt to change attitude and frame. The idea of research consists in analyzing the change in attitude, relying on existing psychological theories (Congruence theory, Cognitive Dissonance theory,Balance theory), individual specifics of recipients and the study of structure of their attitude.The authors suggest to study the emotional basis of cognitive dissonance of visitors interacting with virtual environments designed at enhancing their museum experience and located in the physical museum space. Such a study must consider the special character of the stimulating materials (museum collections) and the possibility to field-modeling cognitive and emotional components of visitors.

DISCUSSION

Traditional information services in museums still rely on notes on paper or screen, sometimes with some photos or video recordings. All these sources are passive. Individual visitors are able to manage language or to make a choice between digital data. Active interaction in virtual world requires additional efforts mainly from curators. Modern museum world applies various types of virtuality, as defined by Milgram: reality, virtuality, and augmented reality and augmented virtuality between them [31]. Taking advantage from the attractive side of new technologies, designers and museum curators do not take in account the most part of possibilities and advantages. New approaches require fast and stable Internet connectivity, additional installations or even establishing networks, all difficult to install in old buildings or historic monuments, such are most major museums. Projects become too expensive to be implemented and sustained without proven evidence of their relevance and added value. The design of an adaptive virtual / mixed museum requires analysis of the factors of complexity of object/events of Cultural Heritage. Adaptive interface for visitors of virtual or mixed museumcan be human-centered, system-centered or cross-adaptive. Semi-custom survey results, qualitative questions and demographic reports of museum audience allow developers to get initiation factors and their source, to find ways of adaptation (instance, navigation) and criterion for design, realization and implementation of effective communication applications.

Different types of museums (traditional, virtual and mixed) have similar problems of interaction with visitors, caused by complex materials such as cultural heritage collections misunderstanding. One needs an introduction to a world of an unknown culture as it is for anyone visiting a foreign country. The archaeological exhibition on Pazyryk culture at the State Hermitage Museum, a famous and impressive example of multicultural relations in ancient world, is proposed for experimental work on emotional experience and a cognitive dissonance in museum space.

The attention of museum experts, sociologists and psychologists is focused on demands of modern museum visitors.We need to consider artifacts because our case study includes modeling of emotional state of a priori non-motivated visitors of the archaeological exhibition, and emotion is always subjective to the relation to an object. This is the reason why we propose to address the experience of museum communication at the archaeological exhibition as an attitude including three elements: affective, cognitive and conative. Selected archaeological finds will play a role of visual stimuli of emotions for a psychological study.

Typical fruitful communication is followed by the elaboration, some psychological positive or negative stimuli, e.g. encouraging noises or puckered brows. Evidently, the museum artifacts, even the world known ones, have no ability to support communication this way. Absence of psychological stimuli demonstrates interruption in contact.Because of this failure, the numerous attempts to make museums interactive appeared. That was the reaction to the demand of communication with visitors in case of absence of communication with other visitors or museum stuff.

In order to make the interface of a computer system interactive and adaptive one needs a system backed by scientific evidence of parametric criteria for the estimation of human state [32, 33]. Our aim is to formalize emotional estimations in reality-virtuality continuum of museum in order to stabilize the reaction. The empirical scale of estimations of tones/levels of emotional experience will be elaborated and tested at the exhibition: visual evaluation of non-verbal messages, sensor data and self-estimation. Collected data will permit to design an optimized scenario of behavior in the reality-virtuality continuum and develop a technical decision for control loop. Consequently, we need methods for the evaluation of psycho-physiological parameters of visitors in museum space. In order to solve the problem we need to collect and analyze changes of these parameters and self-estimation of subjects at the test exhibition (Fig.1).

Fig. 1. View of the exhibition in room 26 at the Winter Palace. First look from entrance

CONCLUSIONS

An evaluative component of museum communication is based on a positive emotional experience. Visitor and museum exhibition interact during museum communication. Sometimes there is a direct influence of the space, the exhibits or the information field on the viewer, included in the community of museum visitors. Elementary act of communication in a museum is in seeing the point of the exposed objects. The implications can be perceived on the different level of conscious. The museum task is to manage information and to control with the help of the information.

Numerous theories on emotions and approaches to study them prove the complexity of phenomenon in psychology. The further research activities will focus on accessibility to cultural heritage museum collections in Russia, for communication studies on nonverbal signs of stress or negative reactions of visitors, aiming to improve emotions in virtual space and the consequent development of adaptive interfaces to overcome such stress and on research, design and validation of new methods and tools of personalized storytelling and adaptive guides, combining the physical with the digital world of the Museum based ICT.

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REFERENCES

1. Гук Д.Ю., Определёнов В.В. Методические аспекты анализа и контроля эффективности информационных ресурсов музея в сети Интернет // Информационные ресурсы – футурологический аспект: планы, прогнозы, перспективы. Материалы X всероссийской научно-практической конференции “Электронные ресурсы библиотек, музеев, архивов”, 30-31 октября 2014 г., Санкт-Петербург. - Санкт-Петербург : Политехника-сервис, 2014. - С. 126-137.

2. Актуальность и релевантность информационного поля в межмузейном виртуальном пространстве /Д.Ю.Гук, В.В. Определёнов// Информационное общество: образование, наука, культура и технологии. Матер. XVIIIконф. «Интернет и современное общество (IMS-2015). Санкт-Петербург, 24-25 июня, 2015. Санкт-Петербург: ЛИТМО. С. 196-207.

3. PSI Directive. Directive 2003/98/EC of the European Parliament and of the Council of 17 November 2003 on the re-use of public sector information. OJL 345, 31.12.2003. p. 90.[Электронный ресурс] Режим доступа: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32003L0098:En:HTML. Дата доступа: 31.12.2014.

4. Принципы качества веб-сайтов по культуре. Руководство. Москва: АВГУСТ-ПРИНТ, 2006. 61 с. [Электронный ресурс] Режим доступа: http://ifapcom.ru/files/publications/Kachestvo_websaitov_po_kulture.pdf. Дата доступа: 01.05.2016.

5. McKenna G., Ronde-Enslin S., Stein R. Lightweight information describing objects (LIDO): the

international harvesting standard for museums. 2011. [Электронный ресурс] Режим доступа: http://www.athenaeurope.org/. Дата доступа: 01.05.2016.

6. Horvat M., Bogunović N., Ćosić K. STIMONT: A core ontology for multimedia stimuli description // Multimedia tools and applications. Vol.73, №3,2014.pp. 1103-1127.

7. ISO 21127:2014 Information and documentation – A reference ontology for the interchange of cultural heritage information. [Электронный ресурс] Режим доступа: http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=57832. Дата доступа: 01.05.2016.

8. Технические рекомендации по созданию виртуальных музеев. Версия 1.0. 2014. [Электронный ресурс] Режим доступа: http://mkrf.ru/documents/recommendations/virtmuseums. Дата доступа: 01.05.2016.

9. Dudley S. 2012. Materiality Matters: Experiencing the Displayed ObjectUniversity of Michigan Working Papers in Museum Studies. № 8.

10. TrendsWatch2016. AAM, 2015. [Электронный ресурс] Режим доступа: http://www.aam-us.org/resources/center-for-the-future-of-museums/projects-and-reports/trendswatch/trendswatch2016. Дата доступа: 01.05.2016.

11. Bertola F., Patti V., Lieto A. ArsEmotica for arsmeteo.org: Emotion-Driven Exploration of Online Art Collections //Proceedings of the Twenty-Eighth International Florida Artificial Intelligence Research Society Conference. Ed. by I. Russell and W. Eberle. Hollywood, Florida. May 18–20, 2015. Palo Alto: AAAI Press. pp.288-293.

12. Hage van W.R.et al. Finding Your Way through the Rijksmuseum with an Adaptive Mobile Museum Guide.7th Extended Semantic Web Conference. Heraklion, Greece, 2010.pp.46-59.

13. Roussou, M. A vision of adaptive cultural experiences through the use of interactive storytelling in museums // International Workshop on Virtual Archaeology: Museums & Cultural Tourism. Vol. 25. 2013. p. 28.

14. Ardissono, L., Gena, C., Aroyo, L., Kuflik, T., Wecker, A. J., Oomen, J., Stock, O. PATCH 2015: Personalized Access to Cultural Heritage. // Proceedings of the 20th International Conference on Intelligent User Interfaces.2015. pp. 447-449.

15. Pujol, L., Katifori, A., Vayanou, M., Roussou, M., Karvounis, M., Kyriakidi, M., ... & Ioannidis, Y. E. (2013). From personalization to adaptivity-Creating immersive visits through interactive digital storytelling at the Acropolis Museum // Intelligent Environments (Workshops). 2013. pp. 541-554.

16. Damala, A., Schuchert, T., Rodriguez, I., Moragues, J., Gilleade, K., &Stojanovic, N. (2013). Exploring the Affective Museum Visiting Experience: Adaptive Augmented Reality (A2R) and Cultural Heritage // International Journal of Heritage in the Digital Era, 2(1). 2013. pp.117-142.

17. Architecture of virtual worlds. Ed. M.B.Ignatiev, A.V. Nikitin, A.E.Voiskounsky. 2nd edition, SUAI, Saint-Petersburg, 2009. 288 p.

18. V-MUST. Virtual Museum Transnational Network. 2011. [Электронный ресурс] Режим доступа:http://v-must.net/virtual-museums/what-virtual-museum. Дата доступа: 01.05.2016.

19. Hermon S., Hazan S. Rethinking the Virtual Museum // Digital Heritage-2013. Proceedings. Marseille, 2013. pp. 625–632.

20. Гук Д.Ю., Определёнов В.В.Виртуальное пространство как место межмузейной коммуникации / Д. Ю. Гук, В. В. Определёнов // Современные тенденции в развитии музеев и музееведения. Новосибирск: Автограф, 2014. С. 63–70.

21. Murphy A. Technology in Museums: making the latest advances work for our cultural institutions. 2015. [Электронный ресурс] Режим доступа: http://advisor.museumsandheritage.com/features/technology-in-museums-making-the-latest-advances-work-for-our-cultural-institutions/. Дата доступа: 01.05.2016.

22. Tillotson K. How museums learned to stop worrying and love the digital world //Star Tribune March 5, 2016. [Электронный ресурс] Режим доступа: http://www.startribune.com/how-museums-learned-to-stop-worrying-and-love-the-digital-world/370986261/. Дата доступа: 01.05.2016.

23. Beacons, QR Codes And 3-D Printing: Enter The Museum Of The 21st Century. [Электронный ресурс] Режим доступа: http://artery.wbur.org/2015/09/14/museums-digital-technology. Дата доступа: 01.05.2016.

24. Modeling of a communication with virtual visitors of the museum web-site "Virtual archaeology"/D. Yu.Hookk, V.V.Opredelenov, T.Yu.Kharitonova// 43rd Computer Application and Quantitative Methods in Archaeology (CAA'2015). Book of abstracts. Siena: University of Siena. C.272–273.

25. Sequeira L.M., MorgadoL.Virtual Archaeology in Second Life and Open Simulator // Journal of Virtual Worlds Research Vol. 6, No. 1. pp. 1-16.

26. Hashemi S.H. Visitor Behaviour Analysis: Connecting the Physical to the Digital in Museums. 2016. [Электронный ресурс] Режим доступа: http://mesch-project.eu/connecting-physical-world-to-the-digital-world-in-museums/.

27. Touching an Ancient Stone: 3D Modeling and Augmented Reality Techniques for a Collection of Petroglyphs from the State Hermitage Museum / D.Hookk, N.Pikov, M.Rumyantsev, M.Vishniakova, I.Kizhner/ 2nd Digital Heritage International Congress. Vol.2. Granada, 2015. pp.727-728.

28. Основы теории коммуникации. Учебно-методическое пособие для студентов / Сост. Ж.В.Николаева.- Улан-Удэ: ВСГТУ, 2004 С. 4.

29. Некрасов, С.И. Значение теории фреймов в современной науке / С.И. Некрасов, Н.С. Молчанова

; Московский гос. техн. ун-т гражданской авиации // Научные ведомости БелГУ. Сер. Философия. Социология. Право. - 2009. - № 16(71), вып. 10.-С. 13-17.

30. Почебут Л.Г., Мейжис И.А. Социальная психология. – СПб.: Изд-во «Питер». 2010., С. 333.

31. Milgram P., Takemura H., Utsumi A. and Kishino F., Augmented Reality: A class of displays on reality-virtuality continuum//Proceedings of SPIE. Vol.2351, 1994. pp.282-292.

32. Мухина О. В., Никитин А. В. Метод адаптивного представления интерактивных электронных сред с погружением// Информационно-управляющие системы, №1, 2010. С.14-17.

33. Riva G., Raspelli S., Algeri D., Pallavicini F., Gorini A., Wiederhold B. K.andGaggioli A. Interreality in Practice: Bridging Virtual and Real Worlds in the Treatment of Postraumatic Stress Disorders //Cyberpsychology, Behaviour and social Networking. Vol. 13, №. 1, 2010. pp. 55-66.

360 3D VIRTUAL TOUR MAKING AND PLAYBACK ON SMARTPHONES AND AUTOSTEREOSCOPIC DISPLAYS

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Abstract

The article covers the combined use of new technologies enabling to develop a spherical (360) 3D tour demonstration system and presents the example of such a tour through The Museum of the World Ocean, Kaliningrad. The research unites several technologies: spherical stereo image visualization, autostereoscopic image format, and non-contact control technology embedded into the program system. The article describes 3D tour realization with the help of the program system developed for spherical stereoscopic image demonstration on smartphones, as well as autostereoscopic (AS3D) displays.

DEVELOPMENT TRENDS OF VISUALIZATION TECHNOLOGIES

Means of demonstration develop the image and make it more and more realistic. It is caused by change of quantitative characteristics: image resolution increases as well as the frame rate. This ability to transfer large bulks of data establishes the basis for a major breakthrough: 3D images.

Internet technologies used for multimedia data delivery on TV-sets and mobile devices (smartphones) has become widely spread.

One more trend is interaction between the viewer and the image (interactivity), which is becoming more popular thanks to the use of the Internet and new peripheral sensors being developed.

The above mentioned changes have established the basis for new “user-device” and “viewer-image” interaction forms.

USE OF 3D TECHNOLOGIES

High-definition video technologies enabled to offer stereoscopic (3D) materials to viewers. Display manufacturers developed device models supplied with special (polarized) glasses required for 3D channels watching.

However, after some surge the interest in 3D TV has decreased considerably. The reasons for that are the following: production of the materials is quite a difficult process, and, what is more, it is totally inconvenient to put on glasses when watching TV.

Based on the HD displays there also appeared glasses-free 3D visualization devices (autostereoscopic 3D). Video content production for such devices is even a more complicated task, and the 3D effect leaves much to be desired. The usage of ultra-high definitions, 4K UHDTV (2160p) and 8K UHDTV (4320p), allows to improve considerably the 3D effect of autostereoscopic displays. Such devices are still rarely used due to the high price and the special format required, however, their sphere of application is widening.

Implementation of the 3D visualization technology is a natural extension of the trend connected with the increase of image realism. With the display resolutions becoming higher and other technological innovations it will be possible to create holographic images with the full three-dimensional sensation.

TECHNOLOGIES COMBINED

For a long time sci-fi literature and movies have been endowing future image transfer systems with the ability not only to demonstrate 3D pictures but also cast the

Fig.1. Nokia OZO camera for spherical shooting

Fig. 2. Construction for spherical stereo shooting for 12 GoPro cameras

viewer into the environment with real images and sounds and enable to influence the course of the ongoing events. Some elements of this fancy picture are available on the current level of technological development.

In the Immanuel Kant Baltic Federal University visualization lab created by Triaxes Company we carry out a project on Creation of the new "viewer-image" interaction model, which combines the newest developments.

The main components of the project:

1. Spherical stereoscopic shooting;
2. Glasses-free 3D effect creation;
3. Non-contact interaction with the image;
4. Demonstration on a mobile device (smartphone).

Complementary use of the above-mentioned technologies enables to show a spherical 3D image to the viewer who can interact with it without putting on any special devices.

SPHERICAL SHOOTING

The first spherical (360) video was published on the Facebook social network on September 23, 2015. It

Fig. 3. Menu of the spherical tour through the Museum of the World Ocean on a smartphone screen

Fig. 4. Fragment of a spherical stereo image on the smartphone screen

was a "Star Wars" trailer that enabled to change the view direction. Earlier in 2015 Youtube realized 360-degree video playback. Being marketed as innovative and titled as "for the first time ever" these functions have been welcomed by visitors of websites with enthusiasm.

Certainly, this viewing method is not new and appeared in the cinema much earlier. Stanislaw Lem in his book "Summa Technologiae" (1964), marks panoramic and spherical video/movie demonstration as an attempt by film theaters to oppose the increasing popularity of TV.

The new wave of interest in spherical video is connected with the spread of VR glasses enabling to synchronize the viewing process with head turns.

The source of spherical video content is computer modeling or shooting with specialized cameras. A number of companies have presented their solutions in this sphere. The Nokia OZO camera is depicted in Fig. 1 [1].

One of the kinds of spherical shooting is spherical stereoscopic shooting. For that purposes constructions based on a set of synchronized cameras are used, such

Fig. 5. Viewing the spherical stereoscopic image with the help of the smartphone and stereoscope

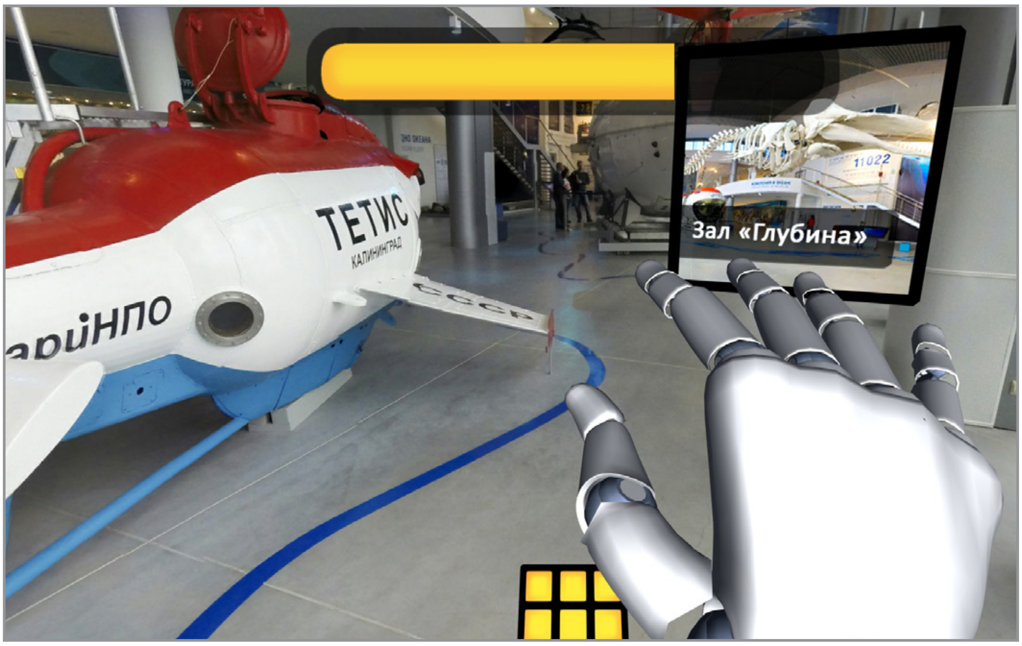

Fig. 6. Fragment of the spherical photo augmented with interactive graphics on the screen of the autostereoscopic display

as, for example, a mount for 12 GoPro cameras from 360Heros Inc [2].

Static spherical pictures can be shot by one camera mounted on a 360 pano head by means of shooting in all directions. Then the resulting frames are processed by the software and assembled into the composite spherical image. If the stereoscopic shooting is performed, channels must be synchronized while being processed.

VIEWING SPHERICAL PANORAMAS IN SPECIAL GLASSES

Stereoscopic format of spherical panoramas provides not only 360-degree vision but also creates the 3D effect.

Oculus Rift, Samsung Gear VR and other specialized VR glasses are widely known. These devices have embedded position sensors and provide each eye with the

Fig. 7. Display interactive control of spherical panoramas with the help of gestures

corresponding channel of the spherical panorama creating a realistic sensation of being inside the image.

360 3D PLAYBACK ON SMARTPHONES

The main drawback of 3D visualization devices is their relatively high cost and the requirement of additional data provider device. Therefore stereoscopes for smartphones have becoming widespread. Thus, anyone can make his/her own 3D display out of a smartphone. An increasing number of users encouraged the development of relevant applications for smartphones.

360 3D PLAYBACK ON AUTOSTEREOSCOPIC DISPLAYS

New opportunities are offered when spherical panoramas are viewed on autostereoscopic (AS3D) displays. The differential peculiarity of such displays is the glasses-free 3D effect. The combination of the 3D effect and spherical image demonstration on AS3D displays enables to provide the viewer with the totally new sensations of dipping into the 3D image without the use of special equipment that must be put on.

PROGRAM SYSTEM

Orbis Vision is a program system developed to solve the task of spherical image creation and 3D playback.

Abilities of the system:

- sphericalc360 3D image viewing;
- image output in 2D or 3D;
- following the scenario;
- viewer interface;
- viewing control via interaction of the user with motion sensors;
- operation under control of various operating systems;
- additional data output.

Example of a spherical tour through the Museum of the World Ocean

The Orbis Vision system was used to create a demonstration virtual tour through the Museum of the World Ocean, Kaliningrad.

A stereo camera mounted on a 360 pano head was used to create stereoscopic panoramas. From 18 to 24 frames shot with the rotating camera were used for a spherical panorama.

Spherical panoramas were augmented with active objects. By interacting with them the viewer can move, get additional information, open the menu, change the viewing mode. A virtual tour represents images logically grouped together with the ability to move from one hall into another one. Fig. 3 demonstrates the main menu of the spherical tour.

Program system workflow on smartphones

The Orbis Vision system can be used to demonstrate virtual tours on mobile devices (smartphones). The basis of the virtual world that we create is a stereo pair of spherical photos projected on spheres with a special visualization “map”. The peculiarity of such a map is that coordinates are closely concentrated around the sphere poles. In the same way does the density of the longitude-latitude intercrossing increase when approaching to the poles of the globe. The usage of this spherical image demonstration method allows to watch a 360-degree panorama from the center of each sphere without any distortion. We can place the camera in the middle of each sphere and show the image to each eye of the viewer. As a result, by placing his/her smartphone into a special stereoscope the viewer can watch a virtual 3D world (Fig. 4).

The user controls the virtual tour by turning the head and passing the marker over active zones. The system uses the abilities of the gyro sensor/accelerometer embedded into a smartphone. The application gets data from the sensors and changes the viewing angle of the virtual cameras depending on user's head turns (Fig.5).

Apart from the spherical panoramic image (photograph) the virtual tour has some elements that the user can interact with by means of non-contact control to perform actions directed by the active zone. Thus, the application allows to move from one spherical panorama to another one, open the configuration menu, switch from the 2D to 3D mode without physical interaction with the screen of the device. The element of non-contact control is a gaze direction pointer placed on the camera for the left eye that helps to detect which of the active image zones (control objects) the user is observing at the moment. Each of these objects contains a program structure that reacts on a pointer-over event. As a result, the system processes the interaction of the user's gaze direction with a particular control element, and performs the actions specified by the scenario.

Program system workflow on autostereoscopic displays

For autostereoscopic displays the program uses the visualization method similar to the one for smartphone. But in this case a 2D image of the real world and its depth map are used rather than a stereo pair of spherical panoramas. The depth map is the information that characterizes the distance from each point of the image to the viewer. It is convenient to show the depth map in the form of the monochrome image where brightness shows how distant the objects in the image are from the camera. Thus, each point of the image is characterized by brightness, color and remoteness. Such a format is called 2D+Depth [4].

The processor of autostereoscopic displays gets a 2D+Depth image from the application and generates a number of images showing the virtual world from different angles. Together with the ability of displays to show glasses-free 3D it allows the user to see the appropriate image with each eye. It creates the 3D effect of the content shown on the display (Fig.6).

Interaction of the user and the program is realized with the help of the Leap Motion control sensor. This sensor helps to determine the user's hand position in the virtual world of the spherical panorama and facilitate interaction with the active elements of the scene (Fig.7). These active elements and the user's hand model are 3D objects with build-in program sensors. This structure allows the program system to process user's interaction with various control elements.

The program system can work with various sensors and peripherals for non-contact control. There's also back-up mouse control realized in the program system. The cursor on the screen is connected with the gaze direction pointer (the one used in the application for smartphones), which allows to interact with the image active elements.

CONCLUSION

Spherical 3D image playback is a qualitatively new step in the development of means of visualization. Nowadays the development of the demonstration technologies is aimed at the increase of image realism. Application of autostereoscopic (AS3D) displays combined with program complexes for spherical 3D image demonstration allows the user to feel the space of the image. Apart from image visualization modern program systems provide the user with the ability to interact with the virtual reality with the help of various motion sensors, which enables to organize the user-computer control in a very natural way. The viewer appears inside the image, where he/she has the panoramic view, can move, as well as see the whole space in 3D and interact with the image using gestures.

New means help to improve the way the user perceives different graphic materials. It enables to create virtual tours, presentations and advertising stands of a qualitatively new level. In particular, the Orbis Vision system is being used in museums and educational organizations for virtual educatory tours creation. Thus, people can visit places inaccessible in ordinary conditions, which is of vital importance for the disabled. The example of such a tour, created for the Museum of the World Ocean in Kaliningrad, is available for download and can be viewed on smartphones [5].

REFERENCES:

1. Nokia OZO - professional Virtual Reality camera. https://ozo.nokia.com/
2. 3D Full Spherical 360 Video Gear. http://shop.360heros.com/3DH3PRO12-360-VIDEO-360-HEROS-3D-360-VIDEO-p/3dpro12.htm
3. LYTRO IMMERGE, The world's first professional Light Field solution for cinematic VR https://www.lytro.com/immerge
4. Philips 3D solutions 3D Interface Specifications White Paper. http://www.business-sites.philips.com/shared/assets/3dsolutions/downloads/3DInterfaceWhitePaper.pdf
5. Demonstrational virtual spherical tour through the Museum of the World Ocean, Kaliningrad. https://play.google.com/store/apps/details?id=com.OrbisVision.WorldOceanMuseumSpheroTour

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