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DEVELOPMENT OF VIRTUAL TOURS OF MEMORABLE PLACES ASSOCIATED WITH THE RESIDENCY AND ACTIVITIES OF FAMOUS PERSONALITIES

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ABSTRACT

The article deals with development of virtual tours to memorable places associated with the residency and activities of famous personalities of Russia using specialized equipment (Insta360 Pro panoramic camera with "fish-eye" lenses with the viewing angle of 200° and 3DVista Virtual Tour Pro software). When creating virtual tours, it was made possible to move from one time period (present time) to earlier historic periods for a memorial place under study, which allows user to independently conduct visual analysis of its development dynamics. When creating a virtual reconstruction of a memorable place, we used: graphic editors for textures processing (GIMP, Adobe Photoshop); three-dimensional editors for creating 3D models (Google SketchUp, Blender, Autodesk 3D Max, Autodesk Maya, Cinema4d); 3D engines for combining three-dimensional models, landscapes, lighting, atmospheric effects, and generating (rendering) final three-dimensional scenes, reproducing sound and character animation, controlling interaction and behavior of scene objects, and providing interactivity with users (Unreal Engine 4, Unity 3D). Implementation of a virtual tour was carried out on the example of Satin and Rachmaninov estate at the village of Ivanovka in the Tambov region (Russia). Visualization was done for two time periods. The first period covers the present days of "Memorial estate of S.V. Rachmaninov" (1873-1943) – a prominent Russian composer, pianist, and conductor who managed to combine trends in musical art of Russia and Western Europe creating his own original musical and compositional style. The second period (the beginning of the XX century) is associated with the residency of S.V. Rachmaninov in the estate.

Keywords: information system, virtual reconstruction, virtual tour, 3DVista Virtual Tour Pro, Unreal Engine 4.

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INTRODUCTION

The phenomenon of immersivity (from English immersive – creating an effect of presence, immersion) has become one of the main trends in the field of distribution and demonstration of cultural heritage objects [1]. An immersive virtual museum environment can play a crucial role in spreading cultural information in an entertaining educational way. Such technologies have made it possible to enrich museums with digital content adapted to historical and cultural context. Immersive technologies use various approaches to interact with the virtual environment, including sensory, hardware, multi-user, multi-modal, combined, and others.

There are several ways to achieve the effect of immersion. Currently, researchers identify four ways of representing reality: virtual reality (VR), augmented reality (AR), augmented virtuality (AV) and mixed reality (MxR). Often, to avoid repeating the abbreviations "AR/VR/AV/MxR", the term "immersive reality" is used as a general term representing all these variants [2].

Virtual reality (VR) is an artificially created fictional space that the user is immersed in. As hardware, users usually apply, for example, virtual reality glasses or a helmet that provide visual representation of virtual reality. Virtual reality ensures a deep level of immersion into a virtual world without any or very limited possibility of direct interaction with the immediate physical environment. In this case, maximal immersion effect is achieved when the user is almost completely isolated from the real world and sees only an artificial environment.

Augmented reality (AR) is based on the completion of a real physical space using virtual technologies that are superimposed on the real world modifying and complementing it. This system combines real and virtual content into a single scene, while providing a real-time interactive environment.

Augmented virtuality (AV) complements virtual environments with live event scenes and elements from the real world. That is, the main base environment is not a real physical space (as in augmented reality), but a virtual one. Augmented virtuality should not be regarded as a simple extension of virtual reality, since the main purpose of adding live scenes to virtual environments is to improve our understanding of the underlying virtual environment. Virtual reality does not provide a direct link to our real world, which augmented virtuality does to a certain extent, since live scenes are broadcast from the real world. Interaction and presence in a virtual environment that simulates physical world in real time can indirectly affect our perception of physical reality.

Mixed reality (MxR) is the result of combining real and virtual worlds to create new environments and visualizations where physical and digital objects coexist and interact in real time. A person can assess the foreground and background, location of objects relative to each other and, most importantly, there appears a point of contact between real and virtual objects. Let's say, there is a need to design a new modern building in the historical center of the city. In augmented reality mode, the object is simply superimposed on the existing urban development as an additional layer. The facade of the building will be visible, but it will not be clear how the building contacts with other buildings, whether it blocks trees, sidewalks, communications, and other objects. In mixed reality mode, this information will often be available, because the system calculates possible collisions between virtual and real world objects.

SOFTWARE AND SPECIAL EQUIPMENT FOR CREATING VIRTUAL TOURS

To develop interactive virtual tours of memorable places associated with residency and activities of famous figures in Russia, it is required to use special equipment and appropriate software [3]–[5].

3DVista Virtual Tour Pro [6] is software for creating interactive virtual tours that allows, among other things, creating panoramic views and realistic interactive tours. With this software, users can create high-quality panoramas using 360° technology (photo and video shooting in 360 degree format). Moreover, it supports modern virtual reality devices: Samsung GearVR, Oculus, VIVE, Google Cardboard. The 360° technology (for both video and photo) "immerses" users into historical heritage objects by showing them from non-standard angles and draws attention to important details. One of the advantages of the program is that virtual tours created using 3DVista software are multi-platform and can be viewed on Mac, PC, iPhone, iPad and Android in any modern Web browser (Firefox, Internet Explorer, Chrome, Safari, etc.) without downloading any additional programs, players or plugins. To do this, a person should place a pre-created tour in the program on a Web server. Users can freely move around the panorama (look left, right, up, move from one panorama to the next, just as if they were moving from one room to another). It is possible to open information windows that provide additional information about a particular panorama object and contain text, video, and graphic information. A virtual tour can be accompanied by a background sound, which is a piece of music or a recording of the guide's voice giving a virtual tour. Thus, immersiveness and interactivity distinguish a virtual tour from a simple photo or panorama.

To get panoramic photo and video images in 360° format, the following hardware and software are required: a digital camera, a computer, a special program that allows to transform several photo or video images into a spherical panorama (in particular, 3DVista Virtual Tour Pro package includes a 3DVista Stitcher 4 program) [6]. However, to significantly increase the quality of the resulting panoramas (especially video material), it is recommended to use additional special equipment.

It is much more efficient to shoot video and photo material in 360° format using special cameras, for instance, Insta360 Pro panoramic camera. This is a professional camera with 6 fish-eye lenses with the viewing angle of 200°. The camera not only allows taking photos and shooting 360° degree video in ultra high resolution UHD 8K, but making stereo shooting in 3D mode, automatically stitching photos and videos in 360° degree format, as well as broadcasting online video in real time. This camera is stationary and the mode of shooting from a tripod is the main and most preferred one.

For shooting dynamic scenes in motion, it is possible use Insta360 One X action camera. Image quality is slightly lower than that of Insta360 Pro stationary camera: the camera has 2 fish-eye lenses with the viewing angle of each lens of 200°. However, it provides quite high quality and good image detail. The weight of this camera is only 120 grams. It can be easily fixed, for example, on a selfie stick and take a spherical video of a visitor passing through the corridors and halls of a real museum.

Both cameras are compatible with 3DVista Virtual Tour Pro software package, as well as with all popular models of virtual reality glasses.

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Spherical photo and video cameras provide excellent results, but only allow shooting objects that exist at the time of shooting. Currently, certain methods, algorithms, software architectures, and frameworks for historical reconstructions that are more of a research nature are mentioned in [7]–[9].

Reconstruction refers to re-creation of the appearance and construction of an object of historical heritage based on preserved fragments, remains, available historical information obtained using modern methods of historical science, as well as the historical background of the era when the object existed. In this case, the term 4D virtual reconstruction applies to virtual computer-aided reconstructions, where time is one of the dimensions, and 3D tools are used for spatial analysis of the reconstructed object in its historical evolution [10].

However, there are no specially developed packages, such as three-dimensional modeling programs, for historians. Therefore, software products (both commercial and freely distributed) developed for more general purposes are used for modeling and presenting damaged or destroyed historical objects in a virtual environment.

These include image editors used for processing textures (GIMP, Adobe Photoshop); editors for creating three-dimensional models (Google SketchUp, Blender, Autodesk 3D Max, Autodesk Maya, Cinema4d); three-dimensional engines (3D engine), used for combining three-dimensional models, landscapes, lighting, atmospheric effects, and generating (rendering) the final three-dimensional scene. They reproduce the sound and animation, control the interactions and behavior objects (calculates physical effects, such as falls and collisions) and provide interactivity with the user (Unreal Engine 4, Unity 3D, CryEngine, Source). Game engines help to reveal the nuances of lighting and movement, and provide an opportunity to demonstrate all the details of the reconstruction during a "virtual walk" [11]–[13].

One of the leaders among game engines is Unreal Engine 4 (UE4) [14]. Its advantages include a rich toolkit. In addition to traditional C++ programming language, UE4 uses Blueprints visual editor, which allows users to create game scripts without actually writing a single line of the code.

UE4 supports a variety of texture formats, accurately conveys physical properties of materials, allows to change objects in real time, select lighting sources automatically, add fog and other effects, and so on. The official online store of Epic Games has a rich collection of ready-made assets (both paid and free). The engine adapts flexibly to the development platform, which allows optimizing games for consoles, mobile gadgets and PCs. Virtual reality hardware devices are also supported. It should be noted that image quality is high (if the platform features are used correctly). Real-time ray tracing, soft shadows, and reflections are supported. The quality of the final image is quite commensurate with photorealistic, which allows using the game engine even in the film industry. The disadvantages of UE4 include a high entry threshold (the engine is designed more for professionals than for beginners), a drop in performance even on powerful computers, which requires game developers to optimize the code. However, if UE4 capabilities are used to create 360° photos and videos, where recalculation of the image at least 30 times per second is not required as in games, this becomes less critical, since users can spend as much time as necessary on the final rendering of the finished image.

Epic Games founder Tim Sweeney says in the interview with The Verge that the world of visualization is changing: "We understand that Unreal Engine 4 is a common language between different areas." Today, in addition to gaming applications, UE4 is used for the needs of film industry, architectural and landscape visualizations, and historical reconstructions.

The high quality 360° photos and videos obtained with UE4 can then be used to create virtual tours in 3DVista Virtual Tour Pro program.

VIRTUAL TOUR OF SATIN AND RACHMANINOV FAMILY ESTATE IN THE VILLAGE OF IVANOVKA IN THE TAMBOV REGION

Implementation of the virtual tour was carried out on the example of Satin and Rachmaninov family estate in the village of Ivanovka in the Tambov region (Russia). At the same time, two time periods are visualized: the first period covers the present days of the "Museum-reserve of S.V. Rachmaninov" (1873-1943) - a Russian composer, pianist, conductor, who managed to combine different directions in the musical art of Russia and Western Europe creating his original musical and compositional style; the second period – the beginning of the XX century is associated with the stay of S.V. Rachmaninov in this estate.

Figure 1 shows a fragment of a circular panorama of the virtual reconstruction of Satin and Rachmaninov family estate at the beginning of the XX century. Figure 2 shows a present days photo of the estate. Figures 3 and 4 show fragments of circular photo-panoramas of the interior: the house and the wing of the Museum-reserve of S.V. Rachmaninov" at present.

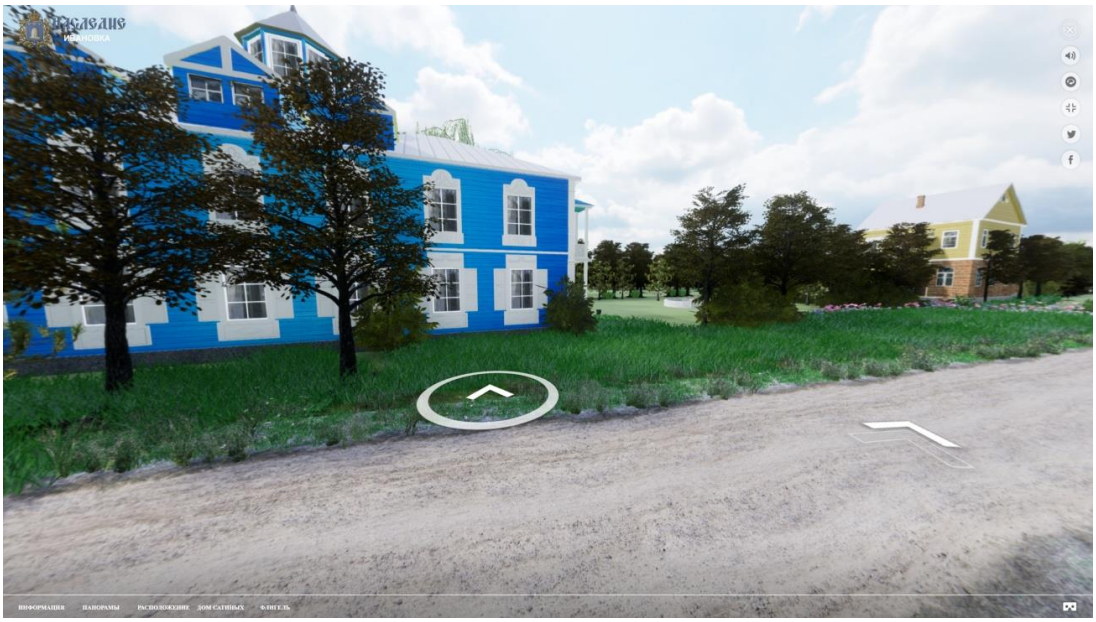

Fig. 1 Fragment of a circular panorama of virtual reconstruction of Satin and Rachmaninov family estate at the beginning of the XX century

https://doi.org/10.5593/sgem2020/2.1/s07.017

CONCLUSION

In this paper, the authors have developed a virtual tour of Satin and Rachmaninov family estate in the village of Ivanovka in the Tambov region (Russia). At the same time, two time periods are visualized. The first period covers present days of the "Museum-reserve of S.V. Rachmaninoff" (1873-1943) - a Russian composer, pianist, conductor, who managed to combine various directions in the musical art of Russia and Western Europe, creating his original musical and compositional style. The second period (the beginning of the XX century) is associated with the stay of S.V. Rachmaninov in the estate.

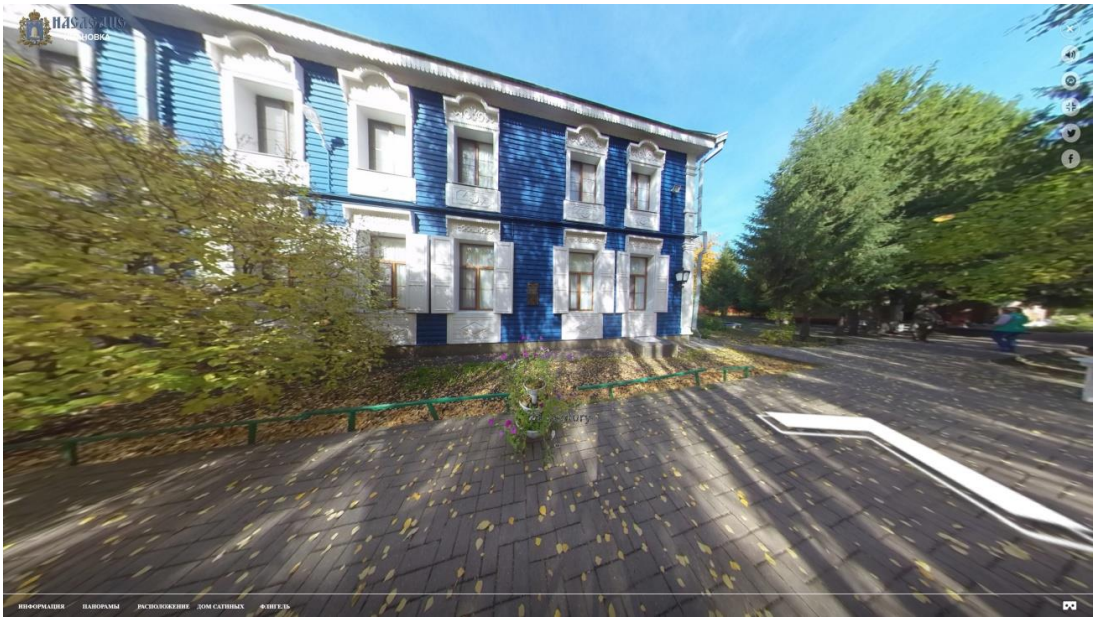

Fig. 2 Fragment of a circular photo panorama of the "Museum-reserve of S.V. Rachmaninov" at present

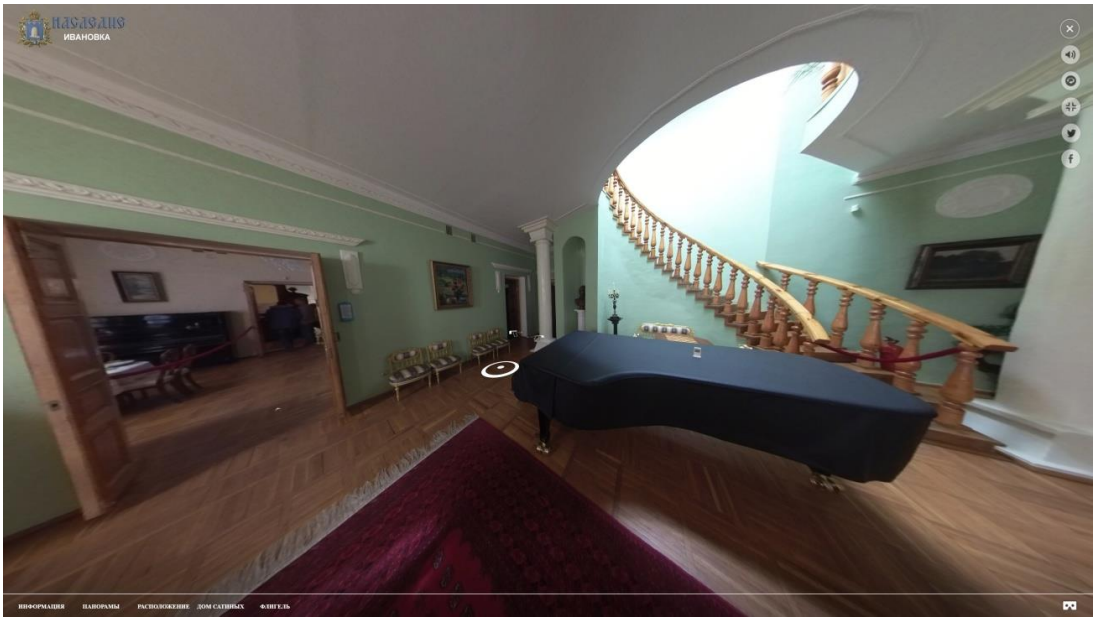

Fig. 3 Fragment of a circular photo-panorama of the interior of the house at the "Museum-reserve of S.V. Rachmaninov" at present

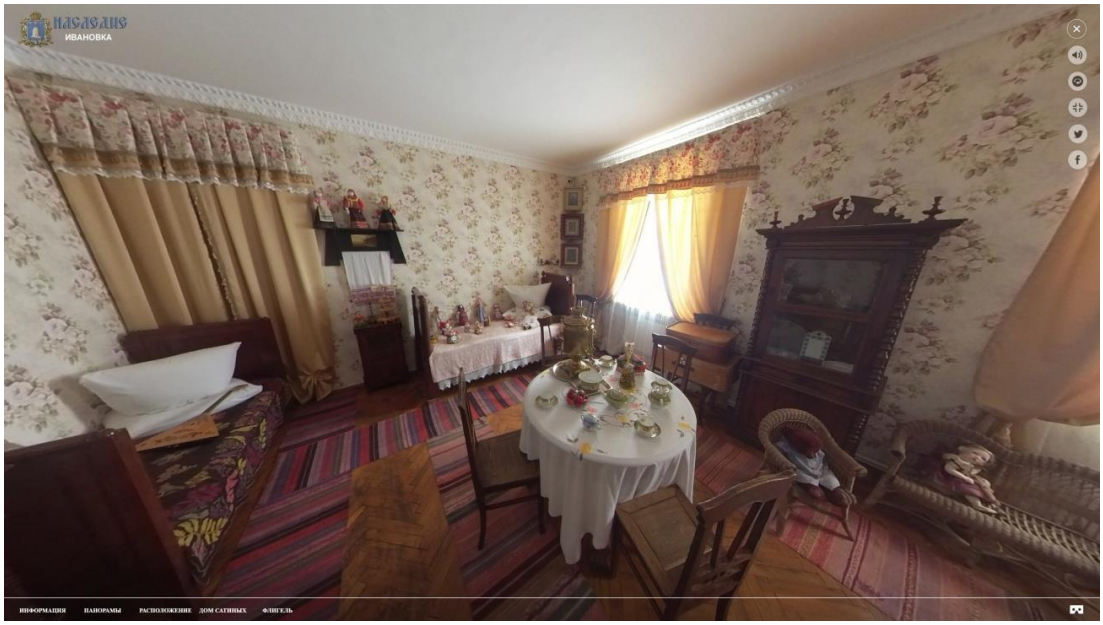

Fig. 4 Fragment of a circular photo-panorama of the interior of the wing at the "Museum-reserve of S.V. Rachmaninov" at present

When creating a virtual tour, special equipment was used (Insta360 Pro panoramic camera with fish-eye lenses with 200° viewing angle of each lens) and 3DVista Virtual Tour Pro software. When creating a virtual tour, it is possible to move from one time period (present time) to earlier development periods of the studied memorial place, which allows users to independently conduct visual analysis of its development dynamics.

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