THE ROLE OF MIXED REALITY IN THE EDUCATION AND PROMOTION OF CULTURAL AND HISTORICAL HERITAGE

I. Peteva, I. Trenchev, K. Bosakova, S. Dimitrova

University of Library Studies and Information Technologies (BULGARIA)

Abstract

Most paradigms for the use of 3D technologies in the teaching and promotion of cultural and historical heritage (CHH) have found that the advantage here is for virtual reality (VR). The purpose of this research is to provide a summarized review of the work on the first stage of the project “Application of mixed reality in the teaching and promotion of cultural and historical heritage (CHH) in a university information environment”, with Contract KP – 06 – OPR 05/14 from 17.12.2018. We briefly present our research of the presence of mixed reality (MR) in this field. Although most research and methods favour VR, we show that the combination of augmented and virtual reality enhances the perception of the ordinary observer.

In particular, here we demonstrate the possibilities of creating mixed reality with different computer programs and their application in learning. We present the results of two surveys conducted among two groups of students. The first group consists of students who are specializing in computer sciences, and the second – those who study cultural and historical heritage. The topic of the research is: are 3D technologies applicable to the education and promotion of CHH. Our results have confirmed that young people are open to these technologies and willing to be involved in new projects related to this topic. In addition, we plan to provide a statistical analysis and forecast of the impact of mixed reality on CHH training, development and promotion.

The study also synthesized the initial steps for the creation of a 3D model of the ancient city of Skaptopara in the region of south-western Bulgaria. Our analysis shows that the created model supports the development of cultural tourism in this region of Bulgaria, where archaeological excavations are ongoing. Another aspect of the development and promotion of CHH is the use of photogrammetry, the creation of a 3D object through photographic images. We have created 3D layouts of real objects that can be published on the Internet and successfully explored. This result is also presented in the paper.

Keywords: mixed reality, cultural and historical heritage.

1 INTRODUCTION

The issues presented in this papers are based on experience in cultural and historical heritage education at the University of Library Studies and Information Technologies. The university is one of the few ones in the Republic of Bulgaria that offer education in this field. It is well known based on many studies that the application of computer graphics is multidisciplinary and is still developing today. The impact of new technologies is increasingly used in many fields as well as in the humanities training. Our experience has shown that combining new approaches to computer graphics such as mixed reality helps to educate students in these specialties [1-3, 5, 7].

All higher education institutions are being pressured to present new, creative and dynamic curricula. The application of new technologies as virtual and augmented reality (mixed reality) is becoming increasingly important in the university information environment. There is a lack of people with the necessary educational background who can work with graphics systems. The new user interfaces are designed in a much more visual and intuitive way. At present, the knowledge required to create software applications differs greatly from traditional programming. These include creative skills such as graphic design, photogrammetry and most of all creativity [4, 6, 8-10].

Our university is researching the need for new multidisciplinary skills. One possible approach is to create interdisciplinary degrees such as computer sciences / cultural and historical heritage. If we examine the set of skills needed to develop these new graphical applications, we find that they are essentially different depending on the desired end result. If we take a brief look at and analyse students graduating from a traditional university, we will find different sets of skills that are appropriate for this new environment. Therefore, in this paper we will present our experience in this field [4, 11].

2 METHODOLOGY

Programs that model in three dimensions work with lots of data. These sets are usually just a list of X, Y, and Z coordinates in space. The program crawls objects one by one and draws up the projection on the plane we are looking at, i.e. computer screen, and then draws the images. There are many methods to facilitate image visualization. One such trick is to remove the back walls. This means that any parts of the objects that are not facing us are not displayed. The easiest method to hide the backside is the Z-buffer method, which is also known as the Depth-buffer method. It supports a separate screen buffer containing the depth of each pixel on the screen. When the program crawls the list of coordinates, projecting them on the screen, it observes the Z-coordinates for each pair of coordinates (X, Y). If the same pair of coordinates meet again when crawling the objects and the corresponding Z-coordinate is closer to us than the coordinate recorded in the buffer, then it is recorded in the place of the previous point. This only displays the points closest to us and obscures the rest. This method is simple and easy to implement, but there are two disadvantages. The first disadvantage is that it requires a lot of extra memory for the buffer. And the second disadvantage is that because the connection between adjacent pixels is not maintained, a staircase effect (aliasing) is obtained. There are special antialiasing techniques, but they work hard with the Z-buffer method.

Graphic systems can only offer modelling tools (and just a few ones) [2, 8, 11-14], and it is the application program that creates the model. The application program performs the following main activities, at the centre of which is the geometric model:

- maintenance – create, delete and modify elements and links in the model;
- crawl for visualization – presenting the geometric model information for the graphics system. This activity can be elementary for models whose objects are primitives of the graphical system: segments, arcs and waved ones. It can also be relatively complex if objects are not stored as graphical primitives, and each object is itself an algorithm for obtaining these primitives;
- search and analysis crawl – this activity is related to the execution of processing algorithms, as well as some specific analyses on it. Because of the importance of the model and the presence of powerful tools to support it, more complex interactive application programs are called geometric modelling systems [4, 8, 9, 11].

In addition to the requirements for the efficient execution of the above mentioned three activities, the following general principles are also observed in geometric modelling systems:

- correctness: the model accurately reflects the properties of real objects, does not contain contradictory data;
- power: the system allows modelling of sufficiently complex real objects;
- completeness: the available information allows the calculation of various geometric characteristics: area, torque, etc.;
- compactness: an opportunity for effective software implementation;
- openness: the ability to add new object types, links, and processing procedures.

Real-world objects are rarely indivisible. Even if they are monolithic, one models as composed of parts, each of which has a specific functionality. The human body is indivisible, described as a structure of arms, legs, head, etc. Particularly clear is the hierarchical separation of parts into objects that one creates. In design, this hierarchy is best isolated, where even each level of the hierarchy bears a separate name: detail, node, aggregate.

3 RESULTS

In this paper, we will introduce a new master's program in the application of 3D technology in the study and promotion of cultural and historical heritage. This program seeks to bring together computer skills and humanities training [12-14]. The program aims to provide students with a humanitarian background and experience the opportunity to combine these skills with the creation of 3D models of complex objects of cultural and historical heritage. We made a questionnaire survey among students, specializing in humanities, linked the cultural and historical heritage. 446 students participated in the survey, and the percentages were 40,6% men and 59,4% women [13-15]. The survey was conducted at four universities: University of Veliko Turnovo, University of Shumen, University of Library Studies and Information Technologies and South-west University (Figures 1 and 2).

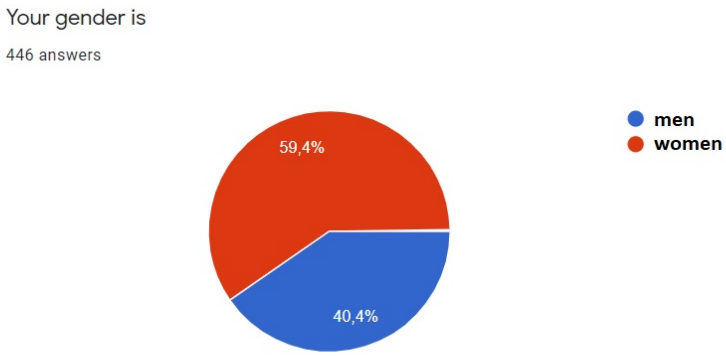

Figure 1. Percentage of men and women in the survey.

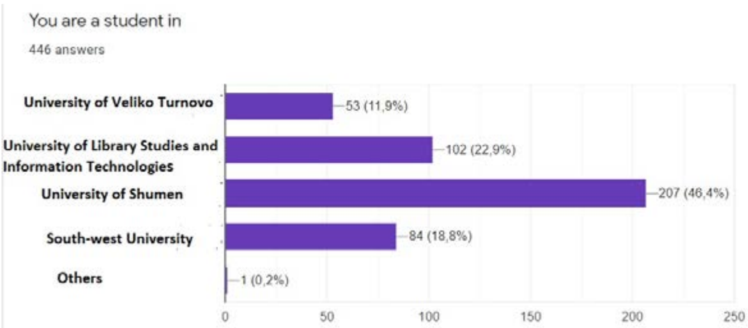

Figure 2. Presentation of four universities in the survey.

Our research has shown that students are eager to learn more about those new 3D technologies and their applications in their education. Our experience has shown that we need to combine the theory of computer graphics with practice; the way the laboratory environment is used and the ability to apply it in a real environment [17, 18].

This means that computer graphics can be taught in a simple and yet understandable way. For example, the right orthonormal coordinate system – the name itself for students is scary, but we can easily present it for students – that your right leg is x, the left – y, and your body is z. Everything is presented to the students in a demonstrative way.

Education as such concentrates on the theoretical aspects of graphics, design and knowledge, modelling and animation. The practical side generally involves reinforcing the theory, but it also acts as a means for students to enhance their creativity. Their involvement in practical tasks is also crucial, and thereby students often find that their work has a real end goal [14, 15, 17].

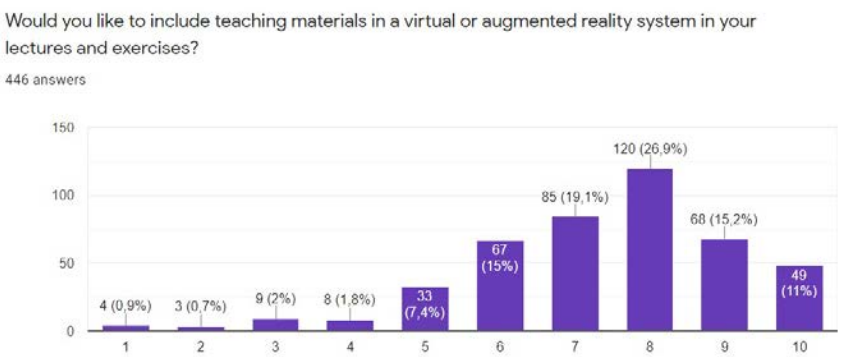

Figure 3. Students' desire to explore Augmented and Mixed Reality in their education.

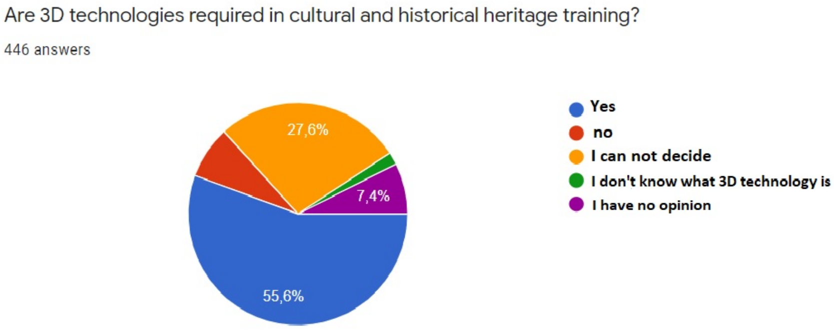

Figure 4. Students' desire for the application of 3D technologies in their education.

In practice, we use Autodesk products in our training. They are provided free of charge for education and do not put any watermarks on the use itself. Specifically, we stop on the Maya program.

Maya is an application that is used to generate 3D assets for use in movies, television, game development, and architecture. The software was developed by Alias Systems Corporation and was originally released for the IRIX operating system. However, this support was discontinued in August 2006 after the release of version 6.5. Maya was available in both "Complete" and "Unlimited" editions until August 2008, when it was turned into a single suite. Following a series of acquisitions, Maya was bought by Autodesk in 2005. Under the name of the new parent company, Maya was renamed Autodesk Maya. Besides that, Maya can be accessed with a student license for three years. It does not create watermarks during the output, making the student version of Maya suitable for portfolio creation. However, the files saved with this version are recognized by all Maya versions as files created by the student version. The permanent student license also allows the creation of non-commercial assets for non-commercial use in game engines such as the Unreal engine [2, 4. 8. 15, 19].

The program can be downloaded from the following address –https://www.autodesk.com/education/home.

Another advantage is that they have very good training guides. They are made for professionals as well as people who are first time learners in computer graphics (Fig. 5).

Training materials can be used both online and offline. All lectures and exercises are available in three languages – English, Japanese, and Chinese. All the exercises have files that support the training. It explains how to create primitive and complex scenes. Mel and Python scripting programming is also available for the more curious students.

In both languages we recommend the students – python. The reason for this is that, in addition to being a language for the Maya program, it can also be used for the blender.

Because Python is an interpreted language, it saves considerable time to develop, as it does not require compilation and linking to test an application. Moreover, being an interpreted language with an ideology similar to Java, an application written on it is relatively easy to port to many of the other platforms (or operating systems) [2, 7-9, 15].

Programs written in Python are quite compact and readable, and often shorter than C/C++ equivalent programs. Python is developed under an OSI-approved open source license, making it freely usable and distributable, even for commercial use. Python's license is administered by the Python Software Foundation [6-8].

The language's core philosophy is summarized in the document The Zen of Python (PEP 20), which includes aphorisms such as:

- Beautiful is better than ugly.
- Explicit is better than implicit.
- Simple is better than complex.
- Complex is better than complicated.
- Readability counts. [3]

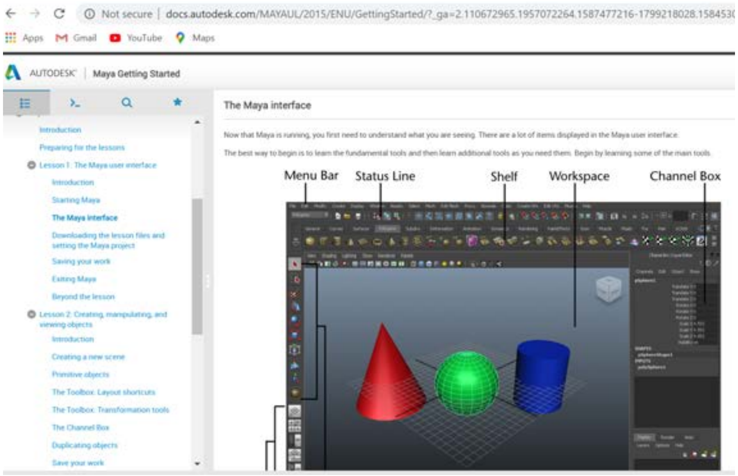

Figure 5. Presentation of the lessons of maya from the site Autodesk.

After the first semester students are introduced to the basic steps in Maya. We introduce them to and another powerful program – Unreal engine. It was originally created for gaming, but subsequently found many other applications such as television, visualization of architectural sites and more [4, 7. 11. 18].

Our program addresses many of the issues that are important for cultural and historical heritage content and training. We have included theoretical lectures in the fields of modelling, animation and computer graphics in our courses. The general idea is that the theory does not change remarkably, but the tools do. It is therefore important to emphasize theory more than tools. This has become apparent in several cases, such as the 3D animation industry, where software and competition updates are fierce.

The important thing we pay attention to our students is that tools are irrelevant. With good practice support, we are able to achieve this high standard of education.

Teamwork is often encouraged because this way students are trained in collaboration. Another aspect of our education is for students to complete separate individual projects. [5, 7, 14 -18]

One practical example we will present is the creation of a 3D model of the ancient Thracian city of Skaptopara. It was recently discovered during the construction of the Blagoevgrad Highway in Southwestern Bulgaria. We instruct our students to make small objects such as an ancient temple or an article. Our results do not claim to be of great historical credibility, as it is still a student development (Fig. 6).

The terrain work and the joy of the developed 3D models is satisfactory in itself.

Figure 6. The ancient city of Skaptopara near Blagoevgrad copy picture from https://www.novaduma.com/00603740-Made-in-Bulgaria-l.

4 CONCLUSIONS

We believe that there are three pillars on which good results rest:

- first, the combination of individual and group approach in training;
- second, the linking of theory and practice, which is the ideology of the programs we have developed;
- third, the way our students engage in practice.

That's why we believe that new technologies should take more place in both university and school education. The results would be more than amazing and students would be more confident in their own skills.

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