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RESEARCH PAPERS FACULTY OF MATERIALS SCIENCE AND TECHNOLOGY IN TRNAVA
SLOVAK UNIVERSITY OF TECHNOLOGY
IN BRATISLAVA
2023, Volume 31, Number 52 DOI 10.2478/rput-2023-0004

VIRTUAL TRAINING FOR EFFECTIVE EDUCATION OF EMPLOYEES

Mariana MÁCHOVÁ[1], Tomáš MICHULEK[2], Ľuboslav DULINA[1], Martin KRAJČOVIČ[1], Martin GAŠO[1], Damian KOLNY[3]

[1]UNIVERSITY OF ŽILINA, FACULTY OF MECHANICAL ENGINEERING
DEPARTMENT OF INDUSTRIAL ENGINEERING
UNIVERZITNÁ 8215/1, 010 26 ŽILINA, SLOVAK REPUBLIC
mariana.machova@uniza.sk, luboslav.dulina@fstroj.uniza.sk,
martin.krajcovic@fstroj.uniza.sk, martin.gaso@fstroj.uniza.sk

[2]UNIVERSITY OF ŽILINA, INSTITUTE OF COMPETITIVENESS AND INNOVATIONS
UNIVERZITNÁ 8215/1, 010 26 ŽILINA, SLOVAK REPUBLIC
EDGECOM, A. S.
tomas.michulek@edgecom.eu

[3]UNIVESITY OF BIELSKO-BIAŁA, WIDZIAŁ BUDOWY MASZYN I INFORMATIKY,
KATEDRA INŻYNIERII PRODUKCJI
WILLOWA 2, 43-309 BIELSKO-BIAŁA, POLAND
dkolny@ath.bielsko.pl

Abstract

The article deal with the problem of choosing an effective software tool for developing virtual trainings. The Ella platform as an innovative solution for creating of virtual training is presented. In the introductory part of the article, the Ella platform is presented as the result of our development. Ella is an integrated software ecosystem as a basis of multiple software applications focusing on the design and analysis of internal e.g. logistics, monitoring, and simulation of automotive logistics assets, and safety systems, etc. This article is focused on virtual training using the Ella platform. Furthermore, the article provides an example of virtual training that has already been carried out, with the Ella platform used in the preparation.

Keywords

Industrial engineering, virtual training, augmented reality, virtual reality, education

INTRODUCTION

The training and its development were not initially considered to be activities that could help companies create added value and successfully meet the challenges of competition. Today,

however, this approach is gradually changing. Companies that use innovative training and development practices are more likely to perform better financially result than their competitors who do not. Training and development also help society develop the human resources necessary to meet competitive challenges. Many companies today promote learning through training, developing, and managing knowledge as it helps employees strengthen or improve their skills. As a result, it is possible to improve or manufacture new products, design new and innovative processes, and provide high-quality customer service. It is also necessary to ensure development activities and career management so that employees prepare for possible managerial and leadership positions, and that the motivation is to keep talented employees at all levels of the corporate structure. The emphasis on education through training, development and knowledge management is no longer in the category of so-called bonuses. Still, it is necessary if companies want to gain a competitive advantage and meet employees' expectations (Noah, 2017).

THE USE OF VIRTUAL REALITY IN EDUCATION

Teaching methods designed to teach complex knowledge and skills are often based on so-called managed social constructivist education theories. These theories promote the learning and mastery of authentic tasks in personalised and realistic situations. Immersive technologies make it possible to improve this type of education by fully immersing the user in the virtual environment. By creating richer stimuli, e.g., using headsets, it is possible to create sensory immersive, and thus deepen the effect of psychological immersion, thereby evoking a feeling of virtual presence (illusion of a place).

Virtual reality provides sensory immersive by focusing on audio-visual stimuli combined with haptic elements. The user can turn his head, as in the real world, while the virtual world responds to all movements and interactions to preserve the illusion of presence. Virtual reality learning has its advantages and shortcomings. It is necessary to know the basic principles, properly evaluate the suitability of the application of this technology and adapt it to the educational process requirements. With the proper implementation, virtual reality will effectively transfer training into practice (Allen, 2006; Beer, 2000).

FIVE PILLARS OF VIRTUAL REALITY EDUCATION

During the years of virtual reality development, many potential applications have emerged in the education process. Five pillars represent five reasons why virtual reality is beneficial as an educational tool (Liu, 2017; Bailenson et al., 2008).

Pillar 1 – A shift from the abstract to a specific one.

Virtual reality can transform abstractions into specific experiences, allowing a better understanding of the submitted substance. Rossou (2009) used the so-called virtual playground in his studio, as shown in Figure 1. In it, the virtual robot explained mathematical concepts, which provided a more amusing form of learning, helping children better understand the matter explained.



Fig. 1 *Virtual playground. Reprinted from [5]*

Pillar 2 – Act, not just observe.

Virtual reality allows trying the subject of education without affecting the real environment. This is particularly beneficial if the real situation is dangerous or difficult to imitate in practice. A good example is the training of future neurologists when training on living patients is often not an option.

Pillar 3 – To make it impractical or impossible in practice.

Virtual reality allows you to perform activities currently unfeasible in reality. This fact is often used in geology, where students can virtually visit places, they would not be able to visit.

Pillar 4 – Manipulate reality.

The real world is built on specific physical laws that virtual reality simulates. However, virtual reality is not bound by these laws and can change them. Students can try out movement on other planets or the impact of changes in physical laws, which can significantly help them understand their principle.

Pillar 5 – Beyond reality.

As already mentioned, virtual reality is often used to simulate or manipulate reality. But it is possible to take its boundaries even further. In the study, Bailenson (2008) presented a new way of learning, where each student was immersed in a virtual environment and perceived to be the centre of attention of the teacher. In a virtual environment, students were not limited by the number of seats, but they could all watch the lecture from the same place, i.e., the teacher-maintained eye contact with all the students simultaneously.

ELLA – PLATFORM FOR VIRTUAL TRAINING CREATING

Ella Platform was developed as part of our own research as an integrated software ecosystem on which multiple software applications are built. These applications focus on the design and analysis of internal logistics, monitoring, and simulation of automotive logistics assets also for virtual training. The platform allows individual solutions to share data about virtual worlds, objects and also to process common real-time information about the state of industrial operation. This helps provide users (customers) with uniquely integrated solutions with higher added value. The following technologies were used to create the platform: C++, Python, OpenGL PhysX and others. A large part of the system logic is scripted in Python through the visual programming module.

Ella thus contains a complete set of tools for the creation of industrial applications and software. Therefore, the Ella platform forms the basis for creating training programs in virtual training sessions. It has been developed and designed to allow efficient and easy programming using visual programming. This means all applications and software solutions can be programmed within the Ella platform with an integrated visual programming tool. Visual programming allows you to create variable systems, from small real-time vehicle control to complex virtual world simulations. As a result, it allows for high productivity when starting to work with the platform.

This software platform allows connecting a wide range of modules coexisting in a virtual reality environment. This is supported mainly by:

- Compatibility with Windows operating systems.
- Compatibility with modules created in C++ languages.
- Graphical core supporting OpenGL 3.3 and above.
- Integrated support for serialisation of modules.
- 3D user interface.
- Support of multi-monitor systems and touch control.

A graphical representation of the developed Ella core, tools and products is shown in Figure 2.

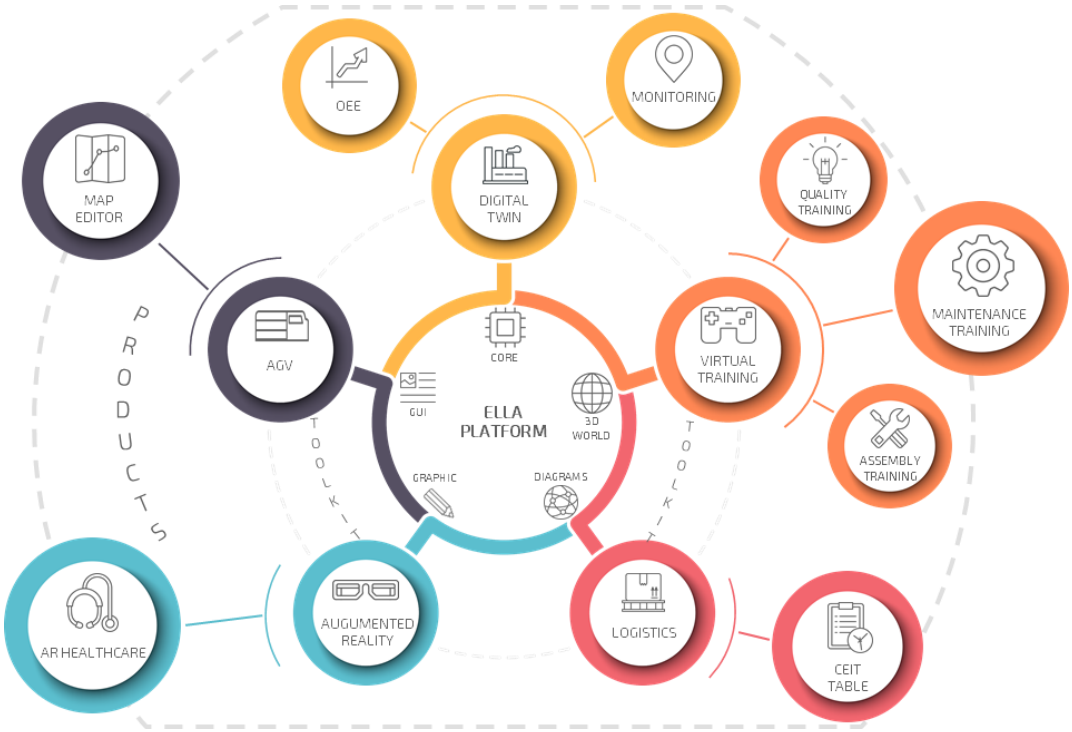


Fig. 2 *Ella platform – core, tools and products*



Fig. 3 *Example of visual programming in the Ella platform environment*

The Ella platform allows you to create training in a simpler 2D variant and the variant for full immersion into virtual reality. These variants are then accompanied by different minimum software configurations for the smooth creation and course of virtual training.

DEVELOPED APPLICATIONS OF VIRTUAL TRAINING IN THE INDUSTRY

The current rapid development and gradual decrease in virtual reality's investment costs help implementation in various industries. Businesses use the ability of virtual reality to

faithfully simulate the real process and situations that are dangerous and difficult to imitate. For this reason, it creates a suitable environment for safe and effective training. Many companies from different industries have adopted virtual training as part of their corporate education system.

In the current market, some companies offer virtual training solutions as a product for other businesses. One example is Edgecom's training solutions. For example, the training solutions offered include (Edgecom, 2021):

- Virtual maintenance-oriented training.
- Virtual training focused on assembly training and sequencing.
- Virtual training oriented on quality control.
- Logistics-oriented virtual training.

Virtual maintenance-oriented training allows the training of employees to master maintenance operations of industrial robots, CNC and other machines. Training guides the user through all necessary actions monitors his progress and warns of errors. Figure 4 shows a sample of the robotic cell maintenance process. The workout uses an entirely virtual environment with a high degree of interaction and a high level of immersion and a VR headset with the necessary sensors and controllers for smooth movement. It uses teleport as a type of locomotive.

One of the other solutions offered is virtual training in the assembly process. Complex assembly tasks are suitable for virtual reality training. Repeated virtual reality training streamlines employee performance and prevents costly errors that could affect production (Edgecom, 2021).

The employee is introduced through the assembly process step by step. This virtual process corresponds to its real copy using the same tools and movements. Training provides the necessary instructions for each operation. Figure 5 shows a sample of the virtual assembly training.



Fig. 4 *Edgecom Virtual Maintenance Training Solution. Reprinted from [1]*

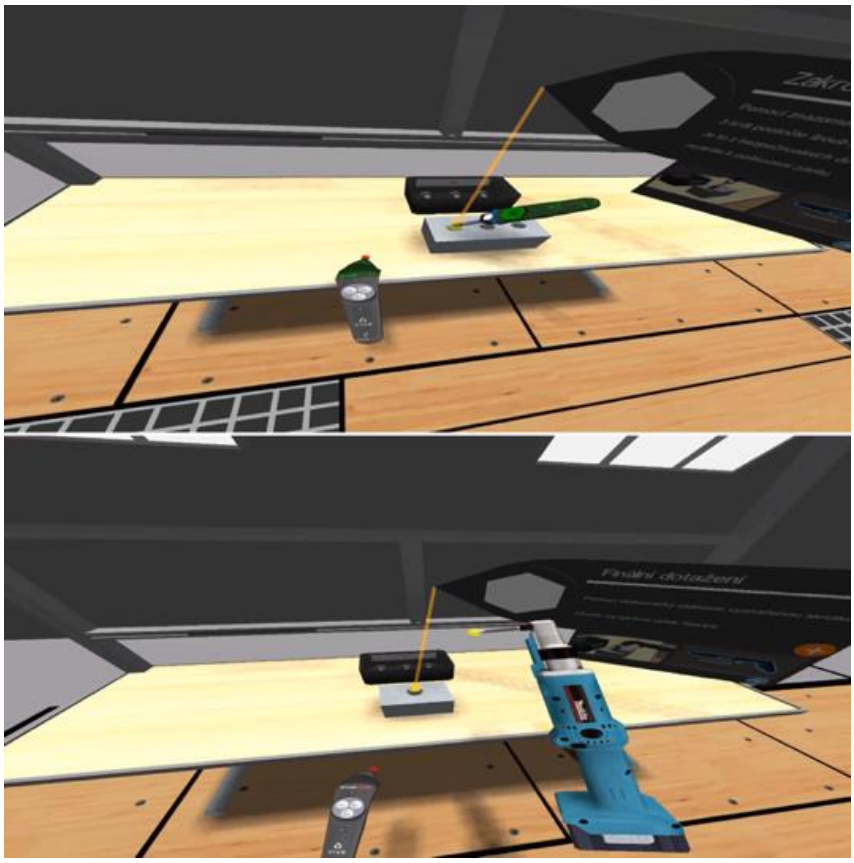


Fig. 5 *Virtual assembly training solution. Reprinted from [1]*

There is also a great interest in virtual training in the field of internal logistics. This type of training makes it possible to use the virtual environment and the faithful functional virtual model of the selected means of transport with identical control elements and driving characteristics of a real means of transport.

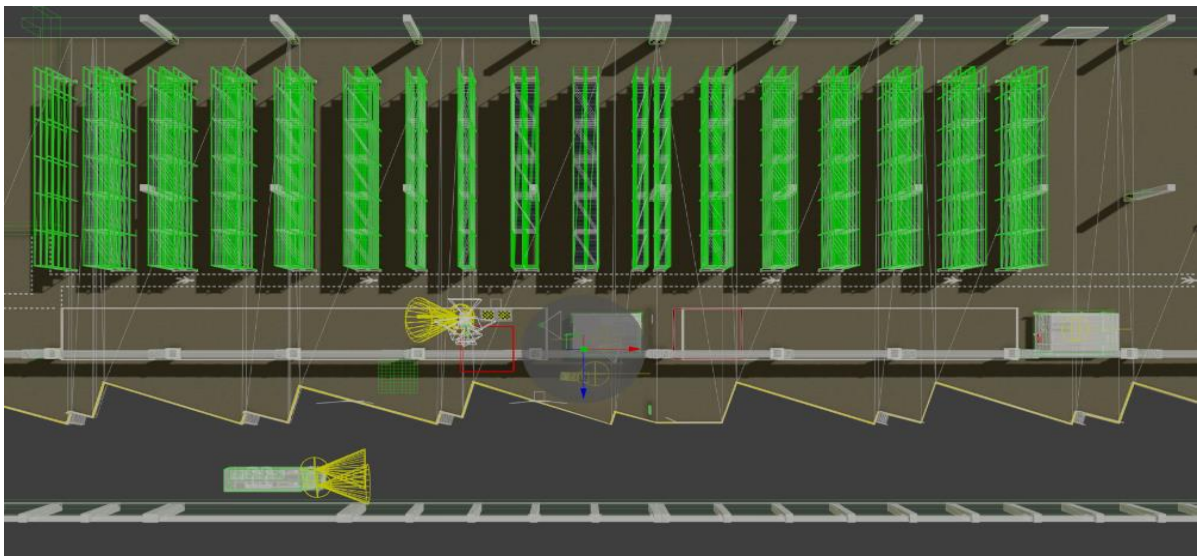


Fig. 6 *Environment solution for virtual logistics training. Reprinted from [1]*

Logistics training allows you to set different levels. Specific events in the level can be activated or deactivated for specific training. For example, if a worker bypasses a component interfering with the path of a forklift, this component can be activated, deactivated, or moved to another level. As a result, the trained employee will not know if and where this attention-

testing event will occur. These random events are specified during the process of collecting data on the real situation in the workplace. These can be falling crates, obstructions in the road, another intersection for forklift trucks, etc.

CONCLUSION

Ella platform is a comprehensive platform for connecting software and hardware components of virtual training. However, the use of virtual training in education has two main levels. The first is the already mentioned hardware and software security, and the second is the education scenario itself. The two areas cannot be separated. While the hardware and software sector is evolving very dynamically and is difficult to predict for the near future, the field of education scenarios depends on the development of industry-dominated work activities that we can better predict (Industry 4.0 and Industry 5.0, current requirements of enterprises for knowledge, skills and competences of employees). They are connected by postulates of didactics, psychology, or sociology. Part of the ongoing research is precisely the creation of procedures that allow such a combination of the two main levels so that economically or time-efficient and effective virtual training can be compiled.

The virtual training implemented so far for industrial companies that use Ella as a software platform has been for automotive production, logistics, or safety of operations. Their creation was based on specific customer requirements. Still, it was also necessary to reflect requirements that do not arise from these requirements but should be taken into account, for example, employee rotation, application of safety and ergonomics (in training but also in real conditions of work), thus industrial engineering principles. It would make it easier to develop these solutions if there were procedures that are common to the different forms of training and, at the same time, procedures on how to create training in different areas. These procedures would form a methodology combining the two education levels mentioned above. The creation and such methodology is the aim of further research by authors.

Acknowledgement

This work was supported by the KEGA Agency under contract No. 032ŽU-4/2021.

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ORCID

Mariana Máchová 0000-0002-9396-0240
Tomáš Michulek 0000-0003-0885-111X
Ľuboslav Dulina 0000-0002-5385-7476
Martin Gašo 0000-0003-0926-2923
Damian Kolny 0000-0003-4908-2142