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A REWIEV ON AUGMENTED REALLITY AND VIRTUAL REALITY IN ENGINEERING EDUCATION

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Abstract
In this study, studies on the use of Augmented Reality (AR) and Virtual Reality (VR) applications in engineering education are shared. AR / VR technologies are used successfully in engineering design, production technology and maintenance engineering. It is expected that the use of AR / VR technologies in engineering education will decrease the cost of high cost hardware such as laboratories and devices to be used in education. This work includes a basic application of the use of AR / VR technology in the path planning of an industrial robotic programming.

Keywords: Augmented Reality, Virtual Reality, Engineering Education.

INTRODUCTION

Labor-market and employability criteria have become key drivers of curriculum, teaching and learning reform in engineering education (Case, 2011). The UNESCO Engineering Report reported that the engineering curriculum needs to rid itself of its traditional disciplinary shackles and allow students to focus on 'problem solving' (Wall, 2010). Problem and project-based learning are common approaches integrated into engineering curricula. World is changing very quickly within digital technologies. To change the world, you need to be taught differently. It means the flexibility of learning, which means being able to alter the place, the pace and the mode of learning. This mean mixed learning is developing with digital technologies. The growing use of mixed learning provision, hybrid and fully online distance learning courses is offering choices for learners about how to integrate their education with other aspects of their lives. This is a fundamental change in the access to learning as a result of digital technology. There is a fundamental change in the way that learners are able to gain knowledge, skills and competencies through the use of technology, which is going to be useful for their future employment in our increasingly digital world. Learners are gaining digital skills when learning online and educators are increasingly recognizing the need to focus on honing these skills to cope with the massive amounts of information that needs to be searched, refined, categorized and understood. (Amber & Neil, 2017). Digital technology is enabling teachers to create more interactive, engaging, flexible learning materials.

In this study, researchs on the use of Augmented Reality (AR) and Virtual Reality (VR) applications in engineering education are shared. This work includes a basic application of the use of AR / VR technology in the path planning of an industrial robotic programming.

ENGINEERING EDUCATION AND INNOVATION

Innovation is about doing useful things differently. Innovative thinking means that converting novel ideas and methods into solutions that meet new needs or adding significant value to established products and services. Innovate to create a learning culture and curriculum structures that develop and foster critical independent thinking that is radical and disruptive and contributes to problem solving. Innovation in engineering education ensures that: degree programmes attract proactive students, transform students into graduates who are well prepared for future engineering practice, exploits new science and technology, responsive to changing socio-economic and environmental contexts. Engineering education curriculum innovation includes cross-disciplinarily with increasing use of: problem and project-based learning, group learning and assessment, authentic workplace learning, and research-based/enquiry learning (Tilley & Roach, 2017). This curriculum must be supported with; engineering education research, industry engagement, connections with alumni, staff development and expansive teaching spaces.

Needs For 21. Century Engineering Educations

The changes in education technology in the 21st century can fundamentally affect the education models. Especially when innovations in digital technology are addressed, innovative lifestyles such as social media, internet of things (IoT), cyber security, industry 4.0 are affecting educational technologies. Engineering is influenced by this change in education. Because of this interaction, innovative education enters engineering education in technology. Today, many universities can establish some virtual laboratories and experimentally introduce some basic engineering concepts to their students in the virtual environment. The greatest difficulty in the applicability of training technologies to engineering and other fields is that educators can not renew themselves in parallel with this incredibly fast-paced technology. Unfortunately, the trainers are late to take the necessary steps to adapt the course content to new technologies. In addition, the application of such innovative approaches is delayed due to the lack of sufficient and necessary knowledge about the engineering course content in the educators who are interested in educational technologies. The 21st century is called digital age. The engineering student candidates who will be trained in this age will be formed from young people (born after 2000) who were initially known as the Z-generation. These students are already now knowledgeable and able to use technology. Presenting educational content for this generation today will be an obstacle to both education and access to adequate knowledge. Because nowadays, there are concerns about which information is correct and reliable against the fact that information is now very easy to reach. Access to digital education contents is very easy for students. However, the appropriateness, correctness and completeness of these contents are very important.

REWIEV ENGINEERING EDUCATION TECHNOLOGY

Engineering education is a type of education in which facial education is preferred because it contains mostly science education. In the field of social science, although technologies such as distance learning, electronic learning, etc. are widely used, applying these learning methods to engineering education involves some difficulties. The engineering sciences and lectures that have come to the fore as an application of the sciences are very different according to the fields. These differences make it difficult to digitize educational materials. The skills required in a digital age engineering student include the following (Bates, 2015):

- Communications skills
- The ability to learn independently
- Ethics and responsibility
- Teamwork and flexibility
- Thinking skills (critical thinking, problem-solving, creativity, originality, strategizing
- Digital skills
- Knowledge management

When current engineering education technologies are examined, education technologies such as virtual education, distance education, virtual reality, augmented reality, internet of things, virtual laboratory, internet supported education technologies are used effectively. The development of new technologies, and especially learning management systems, lecture capture, and social media, have radical implications for the design of teaching and learning. It can be seen that education has adopted and adapted technology over a long period of time. There are some useful lessons to be learned from past developments in the use of technology for education, that many claims made for a newly emerging technology are likely to be neither true nor new. Also new technology rarely completely replaces an older technology. Usually the old technology remains, operating within a more specialized 'niche', such as radio, or integrated as part of a richer technology environment, such as video in the Internet.

However, what distinguishes the digital age from all previous ages is the rapid pace of technology development and our immersion in technology-based activities in our daily lives. Thus, it is fair to describe the impact of the Internet on education as a paradigm shift, at least in terms of educational technology. Educators are still in the process of absorbing and applying the implications.

Educational technology is changing the way people engage and interact with learning material. Its goal is to create a powerful environment where the student can use their innate abilities of learning to grasp complex concepts and acquire knowledge through observation, imitation and participation (Goodyear & Retalis, 2010). Technology enhanced learning is most effective when it seamlessly integrates into the curriculum, mitigates the passive lecture experience and the large number of students in a class, and also provides a tool within which students can engage in meaningful experiences and gain knowledge (Garrison & Akyol, 2009). In response to technological advancements, varieties of multimedia information delivery tools have been developed and are currently in use to enhance students' learning outcomes. These supplementary materials include podcasts, screencasts and educational software available for use on a personal computer and mobile devices, such as smartphones and tablets (Scalise et al., 2011; Green et al., 2012; Molnar, 2017). The availability of multimedia technology, digital content and software empowers the modern-day students as it provides opportunities to engage with learning materials more easily and effectively. The consumer-grade release of new visualization technologies such as virtual reality through the Oculus Rift (Sullivan, et al., 2017) and Samsung Gear VR (Kim et al., 2016). and augmented reality have paved a way to learn in a manner that previously not possible. For clarity, in this research study, the terms applied have been defined as follows:

- Virtual reality (VR): The user's senses (sight, hearing, and motion) are fully immersed in a synthetic environment that mimics the properties of the real world through high resolution, high refresh rate head-mounted displays, stereo headphones and motion-tracking systems.
- Augmented reality (AR): Using a camera and screen (i.e., smartphone or tablet) digital models are superimposed into the real-world. The user is then able to interact with both the real and virtual elements of their surrounding environment.
- Three-dimensional (3D) tablet displays: Utilizing high resolution screens on tablets and smartphones to visualize pseudo-3D models and environments. The user interacts with digital aspects on the screen and manipulates objects using a mouse or finger gestures

AUGMENTED REALTY (AR) AND ENGINEERING EDUCATION APPLICATIONS

Augmented Reality allows us to add virtual information to a real environment that is being viewed via technology. This means that not only are we able to see and touch our natural surroundings, but we are able to add in virtual features, such as images, videos, and sound. The implications of which are enormous when it comes to education. Today's generation is the first to live surrounded by a multitude of screens: The Smartwatch, the Smartphone, tablets, laptops, desktop computers, televisions, and cinema screens. Reality and Augmented Reality technologies can and do help teachers motivate students to learn whilst also making learning easier. In AR applications, the students can interact with real, physical objects around them while virtual models are being added to this world.

Using this technique, they have a better perception of the objects they observe. AR can be use in mechanical Engineering education;

- Technical Drawing
- Virtual Laboratories;

Mechanics, Manufacturing, Dynamics, Fluid Dynamics, Thermodynamics v.s

- Mechatronics and Control
- Maintenance, vs.

Figure 1 is Shows to usage of augmented reality technology in basic orthographic drawing technics.

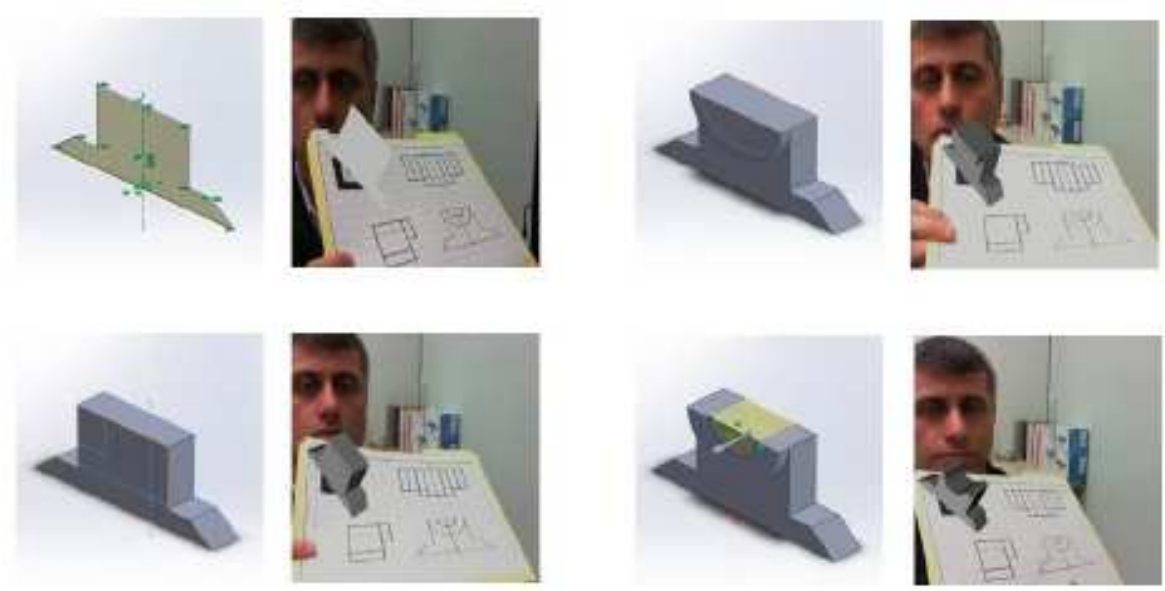

Figure 1: Augmented reality application on Engineering drawing course.

It is also possible to use different areas of engineering education for augmented reality technology. With this technology, the students can see the educational contents in both virtual and real environment. Providing the appearance of the contents in this way allows the content to be grasped more quickly. The combination of AR technology with educational subjects brings about a new type of automated application for the enhancement, e□ectiveness and attractiveness of teaching and learning for students in real life. The technology provides a simple way to make progress in the field of teaching and in learning how to train in education. It promotes 'active' learning, both in the psychological and physical sense, encouraging users to have several thinking perspectives, which should set them up adequately for their daily activities (Martin-Gutierrez et al., 2010).

Martin-Gutierrez et al., (2012) develop a novel augmented reality course in electronic engineering education purpose. This AR based virtual lab was used for circuit education. In this study the students tend to show some sympathy and kindness to this technology, so they are motivated to use it meaning that a well-planned AR application will allow them to perform learning processes. They believe that augmented reality is a cost-effective technology for providing students with more attractive contents than paper.

VIRTUAL REALITY (VR) AND ITS EDUCATION APPLICATIONS

Virtual Reality refers to a high-end user interface that involves real-time simulation and interactions through multiple sensorial channels. VR is able to immerse you in a computer-generated world of your own making: a room, a city, the interior of human body. With VR, you can explore any uncharted territory of the human imagination. With the increasing demand for innovative in higher education for

engineering, and with the advancement in 3D visualization technologies and computer hardware, a growing range of engineering teaching and training material can be utilized in virtual reality environments. Virtual reality technologies can be used as educational and training tool with the advantages of being safe, cost-effective and fully controllable. Also, virtual reality environments enhance significantly the learning experience as they provide the learner with realism and interactivity. However, engineering education is predominantly descriptive and complex. The application of virtual reality to such teaching has great prospects for new style (Kartiko et al., 2010). The recognized technique in engineering education is the use of laboratory demonstrations to enhance the student's practical knowledge. Laboratories are designed to improve the student ability to investigate and solve engineering problems with appropriate levels of independent thought and creativity; and also, to demonstrate suitable levels of reporting technical information (Balamuralithara & Woods, 2009). Industryrelies on distinctive skills to innovate and compete. Thus, it is essential for educational institutes to prepare for emerging technology in both infrastructures (Al-Zoubi et al., 2007) and policies (Lamb et al. 2010). Abulrub et al., (2011) reported the virtual reality features such as 3D visualization, photorealistic, interactive and immersive (sense of existence) to improve tangible learning outputs:

- Develop autonomous problem solving skills for real-life challenges.
- Share complex technical information with team members and professionals both verbally and in writing.
- Examine engineering problem in diverse modes; close inspection of an object or as a part of a whole system.
- Support creativity as it provides a chance for insight based on innovative technology.
- Encourage and develop effective communication skills among team members
- Apply knowledge and logic to conclude sound engineering opinion and decisions.
- Encourage to consider and propose different business solutions to achieve a specific task in practical terms for engineering problems.

AR/VR APPLICATION IN MECHANICAL ENGINEERING EDUCATION

In this study, which reviews some of the applications of virtual reality and augmented reality, it has been seen that these technologies are applied as an innovative approach in mechanical engineering education. The high cost of laboratory installation fees in the education of mechanical engineering requires the allocation of significant budgets by the universities. On the other hand, such innovative technologies can be seen as suitable solutions for providing less costly and more realistic educational technology to engineering education.

With the aim of constructing a lower-budget robotics training system, a robotic system was used in this study using VR technology. For this purpose, VR simulations have been used to program a welding robot with VR technology.

Welding robots are a frequently used technology in the industry and it is necessary that this technology be taught in undergraduate training in robotics control course in welding technology lessons in the course of manufacturing by engineering students. The developed VR technology has made it possible for students to program the welding robot in a practical way. VR based Robotic Welding training system shows figure 2.

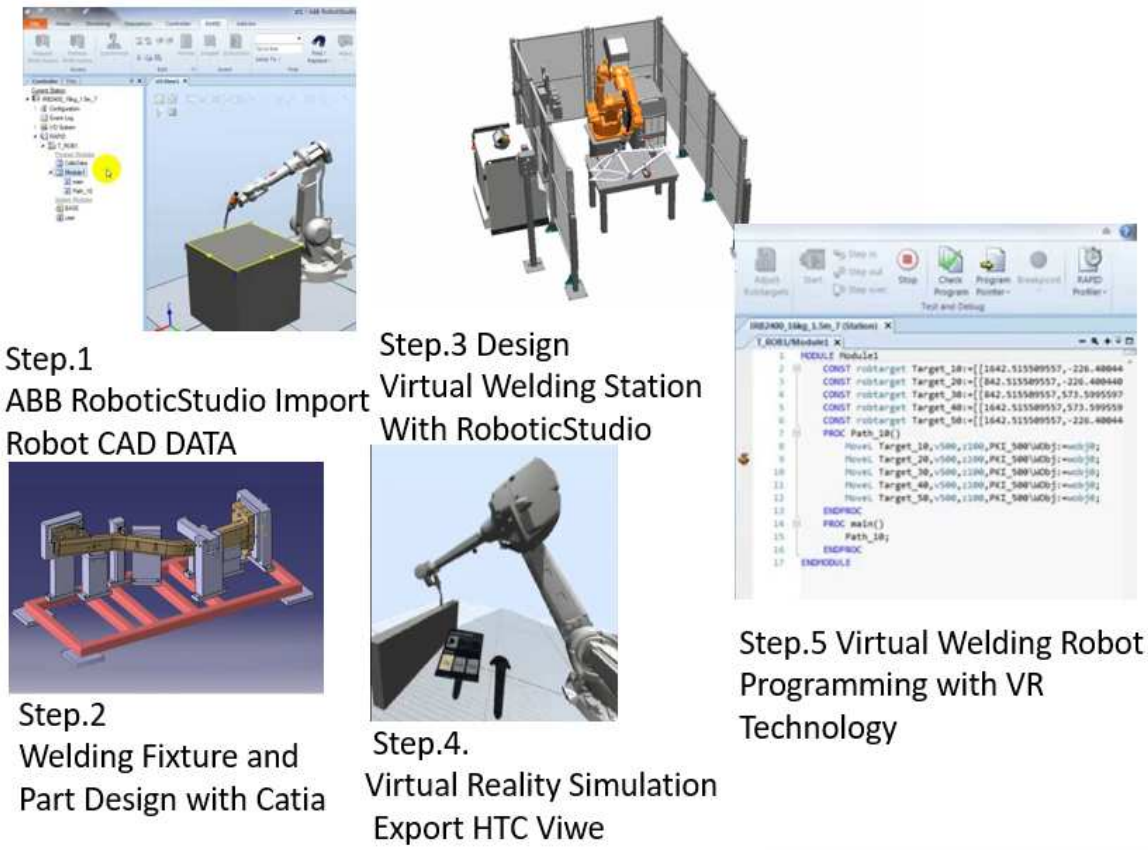

Figure 2: Virtual Reality based Robotic Welding Training System

VR based Robotic Welding training system which is given figure 2. Consist of 5 steps. Step.1 is virtual welding robot is created with using ABB RoboticStudio program. This program is simulating real robotic structure which is produced by ABB Robotics. Step.2. welding fixtures, parts and equipment is designed with Catia V5R6 PLM software. In Step.3. Virtual welding station is created with Step.1 and Step.2 output cad data. In step.4. Created virtual welding station is upload Virtual Reality Environment with using ABB RoboticStudio program. In this step, user interface and virtual robot working limits and places created in virtual environments. The last Step.5 is user step, student moves to robotic welding torch virtually in VR platform. RoboticStudio VR Platform is automatically created digital welding path program related to student hand movements.

CONCLUSIONS

This study has shown that AR / VR technology can be used easily in engineering education. Studies of the engineering content of engineering courses have been shown to be adaptable to this evolving technology. What is important in such studies is that the relevant software and designs are converted into digital content by the course instructor. AR / VR technology is able to provide rapid adaptation to the age of industry 4.0 and the digital age of engineering students in engineering education. Virtual reality has grown up. Once an exotic field of computer sciences, it is now an important topic for the engineers of tomorrow. Virtual teams are forming all over the world and make use of video and audio communication as well as social media to communicate. VR collaboration platforms are only a step further away. Through the interdisciplinary and international nature of the VR practical course groups, the students learn to know the mindset of the other disciplines and cultures. Virtual reality lectures and laboratories will develop even more in the direction of integrated VR solutions in all areas of engineering.

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