

A Review on Virtual and Augmented Reality in Engineering

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Abstract: Studies are discussed in this report about the usage of Virtual Reality (VR) and Augmented Reality (AR) technologies in engineering education. AR / VR applications are used widely in electronics, design engineering and servicing systems. The usage of AR / VR technology in engineering education is projected to popular the expense of high-cost equipment, such as labs and computers to be used in research. This research provides a simple implementation of the usage of AR / VR technologies in an advanced robotic programming route preparation. Engineering graphics (EG) is the result of knowledge being moved from design to manufacturing. It is important for individuals to learn ability to construct and interpret graphical representation of engineering structure. Therefore in any engineering institution, educating engineers capable of using the graphic language to interact are important. Nevertheless, in the school, where teaching time is minimal, it is challenging for the teachers to adequately explain the connection between the 3D geometry and its 2D representation using only one presentation technique. This research provides a short description of the possibilities of utilizing Augmented Reality (AR) in Graphics Technology education.

Keywords: Augmented Reality, Engineering graphics, Engineering education, Teaching reform, Virtual Reality.

INTRODUCTION

Criteria for labour market and employability have been main factors in changing the training, teaching and learning of engineering education. The UNESCO Engineering Study stated that the curriculum in engineering needs to get out of its conventional punitive fetters to encourage students to concentrate on "problem solving." Issue and project-based learning are traditional methods integrated into the curricula of engineering. Environment within emerging technology is evolving quite rapidly. You need to be educated differently, to improve the universe. This implies learning autonomy, which means being able to adjust the location, the speed and the learning style [1].

This suggests blended learning with emerging technology is evolving. The growing usage of hybrid, mixed learning, and entirely immersive distance learning courses gives learners options on how to combine their curriculum with other facets of their lives. As a consequence of digital technologies, this is a radical change in access to education. This is a profound change in the way learners are able to acquire information, expertise and competencies through the usage of technology, which can be beneficial in the growing interactive society to their potential jobs [2].

Learners develop new expertise through studying digitally, and educators continually understand the need to work on developing these abilities in order to deal with the vast quantities of knowledge that need to be checked, analysed, interpreted and learned. Online technology allows teachers to render instructional resources more immersive, entertaining, and versatile. This study discusses researchers on the use of Virtual Reality (VR) and Augmented Reality (AR) in engineering education. This research provides a simple implementation of the usage of AR / VR technologies in an advanced robotic programming route planning.

Innovation is about doing things which are beneficial differently. Innovative thought involves translating innovative concepts and approaches into strategies that address consumer demands or add substantial value to the goods and services created. Innovate to build a learning community and educational frameworks that grow and promote progressive and destructive, strategic individual thought that leads to problem solving. Innovation in engineering education means that: Engineering programs recruit innovative applicants, turn applicants into professionals that are well trained for professional engineering work, leverage emerging research and technology, sensitive to evolving environmental and socio-economic contexts [3].

Innovation in the engineering education program involves cross-disciplinary thinking with expanded usage of: task- and project-based thinking, community planning and assessment, realistic team learning, and research-based / enquiry planning. This program will be accompanied by; work on engineering education, interaction by business, relations with students, recruitment of personnel and broad teaching areas [4].

Enhancing Education System:

Changes in 21st century educational technologies will profoundly change the models of education. Innovative behaviours such as social networking, “internet of things” (IoT), cyber protection, business 4.0 impact educational technologies especially when discussing developments in digital technology. Technology is affected by the educational change. Because of this relationship, creative training joins development engineering education. Today, in the modern world, several universities may create some modern laboratories and experimentally implement some simple engineering principles to their students [5].

The greatest obstacle in the applicability of educational systems to manufacturing and other areas is that instructors are reluctant to reinvent themselves amid this extremely fast-paced technology. Sadly the coaches are late in making the requisite measures to adjust the material of the course to emerging technology. Therefore, the implementation of these creative methods is hindered due to the lack of adequate and required information about the scope of the engineering course of educators involved in learning technologies.

The applicants for engineering students who are to be educated in this period would be created from young people who were originally identified as the Z group. These students are now acquainted with the application and willing to utilize it. Presenting educational information for this community today would be a challenge to schooling as well as to obtaining relevant awareness. Since there are questions nowadays regarding which knowledge is accurate and credible despite the reality that knowledge is already so readily available. It's really convenient for students to access digital educational material. However, it is very necessary to recognize the appropriateness, validity and completeness of such content [6].

Engineering graphics (EG) is the result of knowledge being moved from concept to manufacturing. It is important for individuals to learn ability to construct and interpret graphical representation of engineering structure. Therefore in any engineering institution, educating engineers capable of using the graphic language to interact are important. In addition to knowing the relationship between three dimensional (3D) artefacts and their 2D representations, graphics education aims at recognizing the graphical relationships of sides, angles, lines, planes, improving their capacity to make sense of visual details, and encouraging critical reasoning and fostering analytical skills [7].

Education in engineering is a form of education in which facial education is favoured as it often includes scientific knowledge. Though techniques such as distance learning, online learning, etc. are commonly employed in the area of social science, adapting these modes of learning to engineering education entails several difficulties. Based on the areas, the computer sciences and lectures which have arisen as an extension of the sciences are somewhat specific. Such gaps make the digitisation of instructional materials challenging. The skills needed for a student of digital era engineering include the following: The ability to learn independently; Communications skills; Ethics and responsibility; Thinking skills (strategizing, critical thinking, originality, and creativity, problem-solving); Flexibility and Teamwork; Knowledge management; Digital skills. When analysing emerging technology for engineering education, digital innovations such as immersive schooling, distance education, interactive media, mixed media, and the internet of devices, computer laboratory, and internet-supported education technology are successfully utilized. Developing new technology, and especially learning management systems, and social networking, has fundamental consequences for teaching and learning design. One will see that, over a long period of time, schooling has embraced and developed technologies.

From previous advances in the usage of technology for schooling, there are some valuable insights to be learnt that certain promises made about a technologically developed technology are likely to be neither valid nor fresh. Modern technology very never entirely replacements with outdated technologies. Old technology typically persists, working inside a more specific “niche”, such as TV, or being introduced as part of a broader technological setting, such as Web television [8]. What separates the modern era from the previous periods, though, is the accelerated speed of technological growth and absorption in everyday life through technological-based practices.

Thus, it is reasonable to characterize the effect of the Internet as a paradigm change on education, at least in terms of educational technology. The students are also learning the consequences and incorporating them. Educational technology is transforming the way people communicate with the learning content and connect. The purpose is to build a positive atmosphere in which students can use their inherent cognitive

skills to understand complicated concepts and gain information through study, emulation and involvement. Advanced learning technology is most successful as it blends smoothly into the program, mitigates the inactive classroom environment and the vast number of students in a class, and also offers a platform with which students can partake with practical activities and gain information. Varieties of digital knowledge processing technologies have been created as a reaction to technical developments and are increasingly being utilized to improve learning experiences for students. Such additional resources include interviews, screen-casts and instructional apps for use on a personal computer and on mobile devices, like tablets and smartphones.

The emergence of immersive technologies, interactive content and software applications empowers modern-day pupils, because it offers incentives for faster and more efficient interaction with learning materials. The consumer-grade introduction of emerging technology for simulation such as virtual reality and digital reality has opened a way for learning in a manner that was previously unimaginable. For clarification, the concepts used in this research study were described as follows:

Virtual reality (VR): the senses of the consumer (sound, sight and motion) are fully submerged in a simulated setting that imitates the properties of the physical world by means of high definition, fast refresh rate head-mounted displays, stereo headsets and motion-tracking systems; Augmented reality (AR): digital images are superimposed on actual world utilizing a camera and computer (i.e., smartphone or tablet) The consumer will then communicate with the physical and simulated aspects of their natural environment; three-dimensional (3D) tablet displays: utilizing smartphones and tablets with high-resolution cameras to simulate pseudo-3D objects and landscapes [9].

Engineering Applications of Augmented Reality:

Augmented Reality helps one to connect visual knowledge to a real world perceived by devices. Which ensures that not only are able to see and reach the natural environment, but interactive elements such as pictures, photos, and sound may also be introduced. Which are tremendous consequences when it comes to education. The generation of today is the first to live surrounded by a multitude of screens: like tablets, smart watches, desktops, smartphones, laptops, and televisions. Technologies for Reality and Augmented Reality can and do help teachers motivate students to learn while making learning easier [10].

The students will communicate with actual, interactive objects around them in the applications of AR when virtual representations are applied to this environment. This method is used to get a clearer understanding of the items which have been encountered. AR may be seen in research of mechanical engineering; Technical Drawing; Manufacturing, Mechanics, Dynamics, Thermodynamics, Fluid Dynamics; Virtual Laboratories; Maintenance; Mechatronics and Control. The AR technology in the orthographic techniques of drawing has been illustrated in Fig 1.

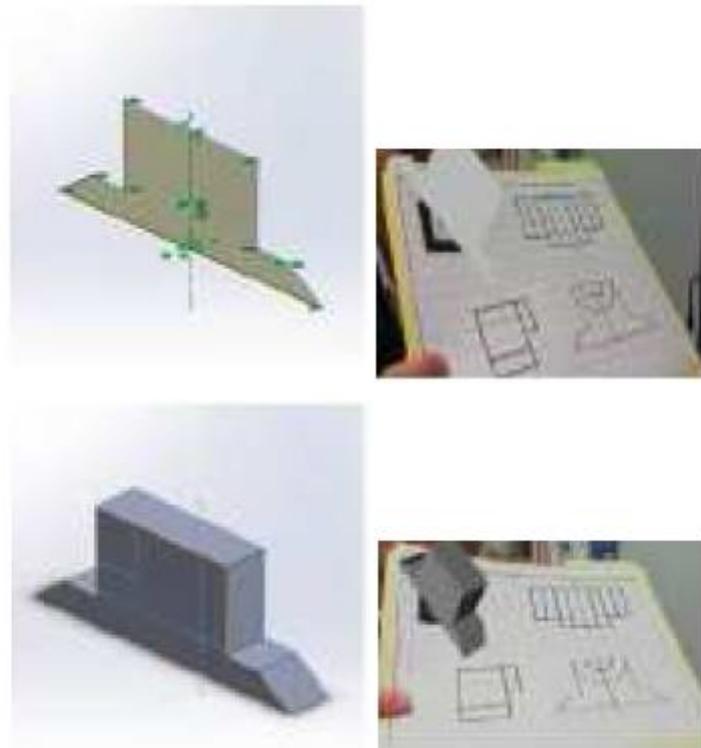


Fig 1: Augmented reality application on engineering drawing course.

Different fields in computer curriculum may also be used with virtual reality applications. Using this application, the students can see the quality of education in both the simulated and the actual world. Providing the items show in this manner enables the material to be understood sooner. The integration of AR technologies with educational subjects produces a modern form of digital framework for the real-life improvement, electivity and attraction of teaching and learning for students. The platform is a convenient path to develop in the teaching profession and to know how to practice in education. It encourages 'positive' learning, both in the psychological and physical context, enabling consumers to gain different cognitive experiences that will better set them up for their everyday activities. In the context of computer engineering education, researchers create a novel, virtual reality course. This immersive environment focused on AR has been used in circuit training. The students seem to display some compassion and empathy for this technology in this research, and they are inspired to use it, suggesting a well-planned AR implementation would allow them to execute learning processes. They assume that virtual reality is a cost-effective tool to offer more appealing material to the students than paper.

Educational Applications of Virtual Reality:

Virtual Reality relates to a high-end user experience that includes emulation and connectivity over several sensor channels in real-time. VR is capable of immersing one in their own computer-generated universe of making: a space, a community, the interior of the human body. For VR, every uncharted area in human imagination may be discovered. With the increasing need for creative innovation in higher education and the development of 3D simulation technology and computer equipment, a growing variety of teaching and educational tools for innovation can be found of virtual reality world [11].

With the benefits of being secure, cost-effective and completely controllable, augmented reality technology can be used as an instructional and training resource. Digital reality experiences often greatly improve the user process as they add excitement and interactivity to the learner. The education in engineering, though, is mainly abstract and nuanced. Digital technology adapted to such instruction has fantastic potential for modern type. The accepted methodology in engineering education is the use of experimental simulations to improve realistic awareness of the pupil. Laboratories are structured to develop the student's abilities to analyse and solve engineering issues with sufficient standards of critical thought and creativity; and to show acceptable rates of scientific reporting. Industry relies on identifying abilities to invent and perform. So planning for new technologies in both infrastructures and policies is important for educational institutes. To boost observable learning outcomes, researchers recorded virtual reality features such as 3D projection, interactive, photo-realistic, and immersive (sense of existence):

Develop automated problem solving capabilities to problems in real life; Exchange detailed technological knowledge both orally and in writing with team leaders and professionals; Examine the question of engineering in different modes; close observation of an entity or as part of a device as a whole; Promote innovation because it provides an incentive for creative development driven perspective; Promoting and improving strong communication skills among team leaders; Applying experience and reasoning to infer reasonable engineering opinion and decision taking; Encourage, in realistic words, to evaluate and suggest alternative market approaches in order to accomplish a common goal with technical problems.

Applications of AV/AR in Mechanical Engineering:

In this report, which discusses some of the uses of augmented reality and virtual reality, it was found that these innovations are being implemented in mechanical engineering education as a ground-breaking solution. The high expense of workshop construction costs in mechanical engineering education requires that the universities devote large budgets. On the other side, these creative developments may be regarded as effective approaches for delivering less costly and more practical technical technology for engineering training. For this research a robotic device was used utilizing VR technologies with the goal of building a lower-budget robotics training program [12].

Welding robots are a commonly employed tool in the field and in the context of production by engineering graduates, this technique will be learned in undergraduate training in robotics control courses in welding science classes. The VR technology built has allowed the students to program the welding robot in a realistic way. Figure 2 shows the VR-based Robotic Welding training system.

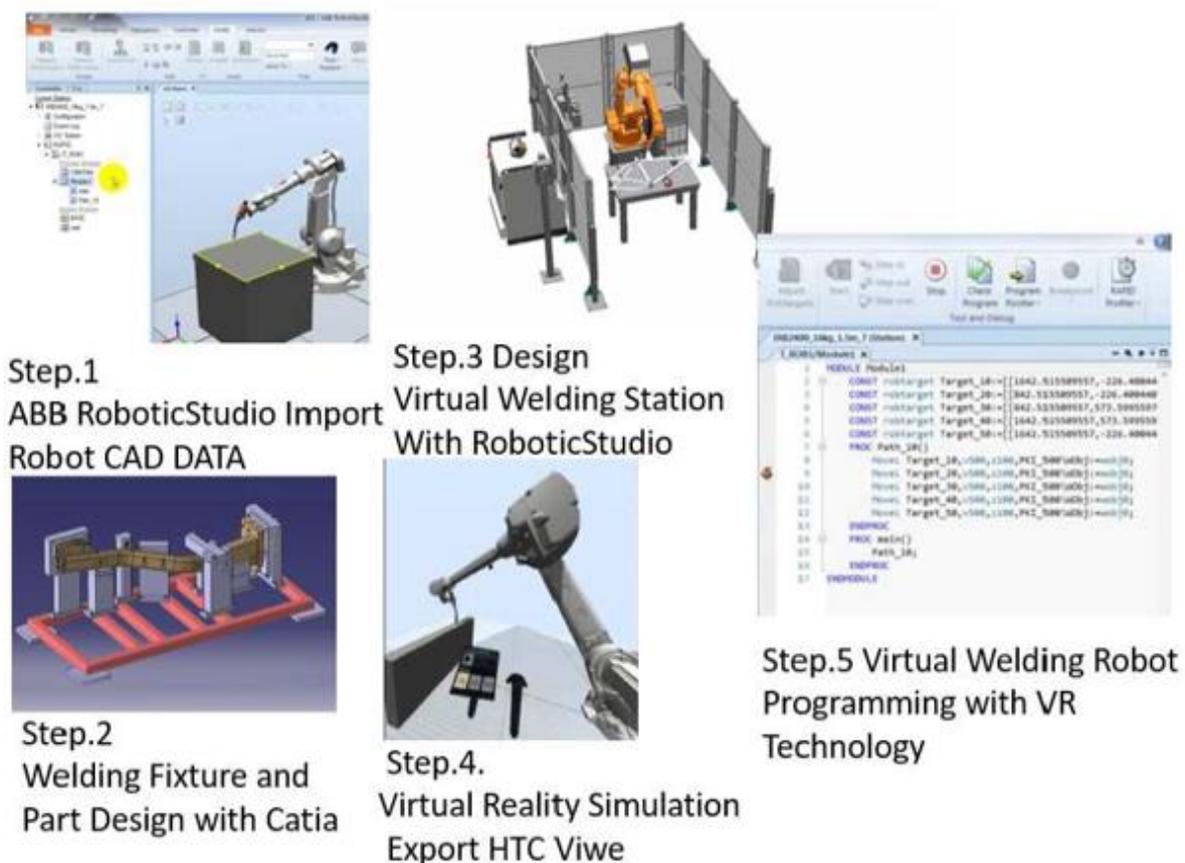


Fig 2: Virtual Reality based Robotic Welding Training System

CONCLUSION

This research has shown that AR / VR technologies can easily be used in engineering education. Studies of the engineering content of courses of technical have seen to be adaptable to this emerging technology. What's essential in these studies is that the course professor translates the applicable technologies and designs into digital material. AR / VR technologies will easily transition to the era of Industry 4.0 and the new generation of engineering students in engineering program. Digital technology has exploded. It was once an obscure computer science area, and is now an important subject for tomorrow's engineers. Digital teams develop across the globe and utilize visual and audio contact as well as social networking to connect. Platforms for VR cooperation are only a little farther forward. The students get to recognize the mind-sets

of the various sciences and societies via the interdisciplinary and multicultural design of the VR functional course classes. Lectures and laboratories on virtual reality will develop even more towards integrated VR solutions in all engineering areas.

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