Chapter 8
Advanced Augmented Reality TAPS Software for Visualizing 4BL Mechanisms with Touch to Print Technique

ABSTRACT

Many learning methods have changed the way students learn. One method that is achieving much attention is augmented reality (AR). AR is a technology that blends simulated and real environment during the learning, interaction, and visualization process. As such, an AR ATAPS with a new interaction technique (touch-to-print) was designed, tested, and evaluated. The aim was to provide an improved user interface i.e. without having to use markers so as the learner could focus more on the visualization process. The AR ATAPS is capable of recognizing the 4BL mechanisms (based on Grashof's law and user input data) (i.e., drag-link, crank-rocker, double-rocker, and parallelogram linkage) and have been used in this study as an adjunct to traditional problem-solving method. The touch to print interaction technique, which is the main contribution of this research, has been useful to engage the user in the problem with a new interactive and learning experience as compared to the previous method (i.e., the use of markers to interact with a virtual object). The interaction technique method uses seven functions that are recognizable by the ATAPS (rotational, link colour change A, B, C, D, pause and voice command) for the user to touch the symbols on the paper and the system to model and analyze accordingly in real-time 3D environment. This study explores how far AR technology has come to support students in their

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learning and interest in using this technology. The objective of this chapter was to determine the usefulness of touch to print interaction user interface for an AR application. A hands-on practical lab was conducted with first year engineering students at UNITEN. The evaluation and effectiveness of the AR ATAPS as an alternative to textbooks and current software learning packages was examined by means of a single-institutional evaluation study using mainly statistical quantitative techniques and ANOVA analysis. The prospective study (total sample size = 30) at University Tenaga Nasional (UNITEN) validated aspects of AR ATAPS interaction technique and provided feedback on the interface design and its problem-solving method. The results of the study showed that most of the participants never been experienced with AR applications before, but the ideas of implementing AR as a simulation tool for learning the kinesthetic and dynamic subjects is well accepted with a very beneficial feedback. Based on the findings, it was found that there is a positive changing in terms of the visualizing and imagining of the four-bar linkage mechanisms (4BL) which led to a good understanding of this subject. Further development of AR applications in the learning environment is being discussed.

INTRODUCTION

In general AR is a computer based system which has the ability to combine the real world and computer generated data. In this system, virtual objects are blended into real scene in the real time. Due to this capability, instructors can imagine the high potential that this technology might have if employed in the field of education. Ludwig et. al., (2005) define AR as Human-computer-interaction, which adds virtual objects to real senses that are provided by a video camera in real time. On the other hand Zhou et. al., (2008), simply defines AR as a technology "*which allows computer generated virtual imagery to exactly overlay physical objects in real time*". Others define AR as a system that combines the real world with the computer-generated information in a real environment, interactively and in real time, and which align virtual objects with physical ones, (Höllerer et. al., 2004).

Generally, AR combines three dimensional (3D) computer-generated objects and text superimposed onto real images and video all in real time. An interesting definition of AR has been described by (Azuma, 1997), as a variation of virtual reality (VR). VR technology completely immerses a user inside a synthetic environment. While immersed, the user may not see the

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