Using Augmented Reality in Computing Higher Education

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Abstract. In the past, the only way to receive educational content was through traditional methods, which included engaging the learners in full interaction with non-interactive books. Nowadays, we can generate three-dimensional virtual vision by using high-performance computer graphics, which is called Augmented Reality (AR).

This research focuses on investigating a new approach to emerging and integrating computing education with AR technology in Saudi Arabia.

The research will follow the design science methodology which is a mixed method approach for data collection and analysis.

As design science research is considered to be problem focused research, its main tasks are the illustration of the design problems and evaluation of design solutions.

Keywords: Augmented reality · Computer science · Augmented reality in education

1 Introduction

Augmented Reality is defined as using augmented video by covering an image with generated data in order to achieve a high performance three-dimensional image [1]. It will give three-dimensional virtual vision by using high-performance computer graphics [2]. Furthermore, it augments virtual media by modelling the real world with the user's complete control on both view and interaction. It will provide a multi view of the real objects covered with computer generated virtual objects.

This interactive simulation of the real world is done by engaging regular space, place and things that are partly unmediated [3]. It allows the real-world objects to combine with virtual objects or information. Thus, virtual objects seem to synchronize within the same area of the real-world objects. Using AR enhances user interaction and perception with the real world, and the augmented virtual object can offer information which cannot easily be detected with the user's own senses. The information transmitted by the virtual objects can give the opportunity to the user to examine actual real world tasks [4].

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In recent years, a large number of research studies have evaluated the impact of applying AR to learning. These research studies can provide valuable information for both educators and AR designers who are enriching the new generation of minds through novel technologies. The benefit of harnessing results of research studies, supported with practical testing, can give practical and theoretical guidance to current and future educators who are interested in AR.

Although much research has investigated the impact of using AR in education as a simulation for practical education, with positive results, the possibility of integrating AR applications in Saudi Arabia has not been fully investigated, which is the main contribution in this research.

AR can be applied using wearable devices which have been used in several areas such as therapy of movement disorders and administration of drugs. Google Glass, which is an example of a wearable technology, has recently been used through medical training role-play tasks that can provide observation recording. Observation recording gives helpful information to be used through reflective learning and group debriefing, and a recording includes: patient attention, patient times spent on focusing several information sources [5]. One of the main approaches for using AR in education is the educational laboratory, which gives the student the opportunity to do an experiment virtually, as using the required equipment is more expensive and limited access [6]. The integration of AR technology components, such as animations, video, and images into a real lab environment has enhanced the student's science Learning capabilities as well as the student's laboratory skills. Moreover, AR can give the student the opportunity to observe some events which are impossible to be seen by real laboratory settings, for example molecules movement. Studies have reported that the usage of AR components on labs has improved the student's laboratory performance. In addition, the usage of AR has a significant impact on the increase of student's interaction which definitely affects their learning outcome [7].

AR has been widely introduced in the education area, and highly positive impact has been recorded in various courses. However, the Saudi Arabia education system has not fully deployed AR in its courses to improve the courses outcome, which is the focus of this research.

The overall motivation for this research is applying an AR system to computer hardware labs in Saudi Arabia where it has never been tested as an educational tool.

2 Problem Definition and Proposed Solution

Computer science is generally regarded as a hard subject to learn and teach, as the nature of implementing both the practical and scientific approach is challenging [8]. Computer hardware is a field where it is desirable for the labs to offer the full hardware equipment in order for the student to be engaged in understanding the lesson. Without such equipment having been provided the students will find it difficult to understand the main concepts of the lesson, and may not be able to work with hardware. On the other hand, the lecturer will spend extra time in teaching and illustrating to help the students to understand the hardware. Therefore, the learning efficiency will drop, which will affect the university outcomes for both students and lecturers.

This research addresses the following problems related teaching and learning hardware in computer science:

- The current knowledge approach using the traditional "unplugged" style of teaching hardware, which results in incomplete and difficult to understand material and may not provide students with the best educational experience;
- The lack of hardware material equipment provided to student;
- The difficulty of teaching computer hardware in theoretical way for the lecturer;
- AR tools simulating equipment in hardware computer labs.

1. **Proposed Solution**

Computer hardware labs are difficult to use and are poorly accessible for the student most of the time. Therefore, we propose to apply an AR simulation tool as a potential solution to give the student the familiarity with the equipment to reduce the damage of the hardware and offer the time needed for the student to be more engaged with the material and the augmented hardware.

3 Methodology

The research will be mixed methods using both quantitative and qualitative data. It will follow the design science approach as a methodology.

The reason behind following the design science research is that design science is technology oriented and is focused in producing a valuable technology product [9]. It is considered to be a problem focused research approach which analyses the problem and develops a suitable solution for it [10].

This research aims to investigate new ways of interactive learning by immersing AR technology into computer science labs. Applying AR technology to computer hardware labs will allow students to view internal operations as an interactive simulation. This approach, supported by pedagogy, is hypothesized to enhance the student learning experience.

To achieve this aim, the research will be divided into three major phases rounded with a student experience theory as illustrated in Fig. 1:

- Problem diagnosis: An investigative/exploratory study has been carried out to understand the current situation and student needs;
- Technology design: the development of an AR tool based on the investigative study data with the respect to pedagogy and student experience theory;
- Technology evaluation: assessing the augmented reality tools in terms of learning experience and technology acceptance.

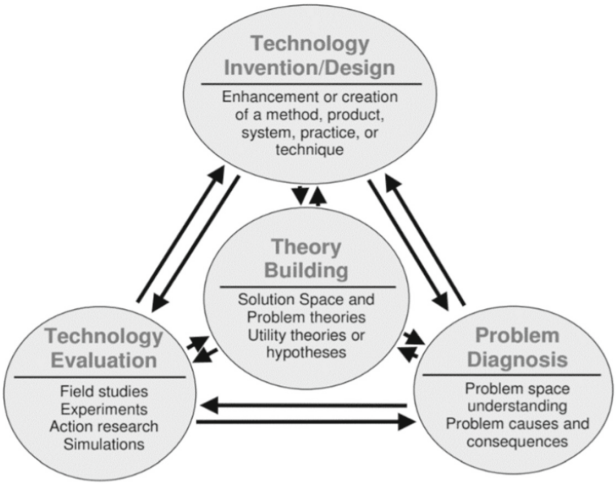

Fig. 1. An activity framework for design science research [11]

4 Results and Future Work

The exploratory study which covers the first phase has been conducted and the data have been collected. The data analysis is in process.

A preliminary analysis of both the qualitative and quantitative data confirms our initial hypothesis that there is a lack of hardware equipment in computing labs and that accessibility is difficult. Data further support acceptance of students to use new education tools, and that AR might be effective.

The future design science steps and phases will be:

- Making a full analysis the data;
- Developing and testing the tools;
- Deploying and evaluating usage of the tool.

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