Faculty of Computer Science and Information Technology

Hazhunt: Augmented Reality App for Gamified Occupational Safety Hazard Training

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Hazhunt: Augmented Reality App for Gamified Occupational Safety Hazard Training

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A thesis submitted

In fulfillment of the requirements for the degree of Bachelor of Computer Science with Honors

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ABSTRACT

The purpose of this project is to develop an augmented content-based app called Hazhunt augmented reality application for the use of Occupational Safety and Health training among the organizational members, which include the students and workers. The objective of this project to use AR technology for practical on-the-spot use to prevent workplace incidents and accidents and assists the user in knowing each of the icons for hazardous material. A recent study shows that the use of augmented reality technology can increase the safety of the worker and student in a dangerous working environment and also provides information in real-time about the hazard or chemical substance. In this report, usability testing has been conducted using the pre-test and post-test and also using the Instructional material motivational survey (IMMS) method. The participants for usability tests were ten university students from non-OSHA graduates (male = 4; female = 6; mean age = 23.5). The results show that Hazhunt AR has offered an excellent way to educate and handle danger to students and to empower them. For the pre-test, the mean and standard deviations are 10.9 and 1.523. The mean and standard deviation figures for post-testing are 14.6 and 1.712. The calculation of satisfaction earned the highest average of 4.8, followed by a relevance value of 4.65, a confidence value of 4.6, and attention. An attention rating with a value of 4.55 is the lowest mean score. The highest standard deviation is a relevance value of 0.590, follow by confidence 0.520, attention 0.510, and satisfaction 0.410. Therefore, it indicates that the students are pleased with the production and use of Hazhunt AR in training and learning.

Keywords: augmented reality, occupational safety, mobile application, gamification, occupational risks, accident prevention

ABSTRAK

Tujuan projek ini adalah untuk mengembangkan aplikasi berasaskan kandungan tambahan yang disebut aplikasi augmented reality Hazhunt untuk penggunaan latihan Keselamatan dan Kesihatan Pekerjaan di kalangan anggota organisasi, yang merangkumi pelajar dan pekerja. Objektif projek ini untuk menggunakan teknologi AR untuk penggunaan praktikal di tempat untuk mengelakkan kejadian dan kemalangan di tempat kerja dan membantu pengguna mengetahui setiap ikon bahan berbahaya. Satu kajian baru-baru ini menunjukkan bahawa penggunaan teknologi augmented reality dapat meningkatkan keselamatan pekerja dan pelajar dalam persekitaran kerja yang berbahaya dan juga memberikan maklumat dalam masa nyata mengenai bahaya atau bahan kimia. Dalam laporan ini, ujian kebolehgunaan telah dilakukan dengan menggunakan ujian pra dan ujian pasca dan juga menggunakan kaedah tinjauan motivasi bahan Instruksional (IMMS). Peserta ujian kebolehgunaan adalah sepuluh pelajar universiti dari lulusan bukan OSHA (lelaki = 4; perempuan = 6). Hasilnya menunjukkan bahawa Hazhunt AR telah menawarkan cara yang sangat baik untuk mendidik dan menangani bahaya kepada pelajar dan memperkasakan mereka . Untuk ujian pra, min dan sisihan piawai adalah 10.9 dan 1.523. Angka min dan sisihan piawai untuk ujian pasca adalah 14.6 dan 1.712. Pengiraan kepuasan memperoleh purata tertinggi 4.8, diikuti dengan nilai relevansi 4.65, nilai keyakinan 4.6, dan perhatian. Peringkat perhatian dengan nilai 4.55 adalah skor min terendah. Sisihan piawai tertinggi adalah nilai relevansi 0,590, diikuti dengan keyakinan 0,520, perhatian 0,510, dan kepuasan 0,410. Oleh itu, menunjukkan bahawa para pelajar berpuas hati dengan penghasilan dan penggunaan Hazhunt AR dalam latihan dan pembelajaran.

Kata kunci: augmented reality, occupational safety, mobile application, gamification, occupational risks, accident prevention

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LIST OF ABBREVIATIONS

IMMS	Instructional material motivational survey
UNIMAS	Universiti Malaysia Sarawak
DDR	Design Development Research
AR	Augmented Reality
OSH	Occupational Safety and Health
VR	Virtual Reality

CHAPTER 1

INTRODUCTION

1.1 Study Background

Technologies development have evolved drastically since the 18th century. New technology has created new applications, and this new technology will be stacked together with other technology to developed into something more significant (Nasir, 2018). Among this new technology is augmented reality (AR). This technology changed our perspective in the real world by adding virtual, augmented information. It is a helpful tool to bring virtual, augmented intelligence in a better way to help the worker to understand chemical and hazardous substances (Carmigniani et al., 2011).

The usage of AR technology in safety control has provided the solution to workers and students to replicate tasks in a complex environment. The benefits of AR technology include improved safety, maintaining availability, reducing working errors, and increasing the supervision of workers who work in a dangerous situation (Alam, Katsikas, Beltramello, & Hadjiefthymiades, 2017). Information that is presented by a virtual object can help the user to collect data in performing the work-related task more accurately. With this technology, workers are more aware of the outcome.

The purpose of this project is to develop an augmented content-based app for the use of Occupational Safety and Health training among the organizational members, which include the students and workers. It will help the workers that are working in a hazardous and dangerous environment. This AR-based app will prevent the accident from occurring and giving prior knowledge to the user. Furthermore, this app will include gamification that

makes it more interactive and user-friendly to ensure it provides a safer training approach and increases authentic augmented practical experiences.

1.2 Problem Statement

Nowadays, the statistic has shown the use of chemical and hazardous material very high, and their usage around the work area can potentially impact the safety of workers, also impact the environmental field. Hence, there an immediate action that needs to be taken to mitigate this problem. The steps need to be made, namely identifying the hazard, assessing the risk, and controlling the chance to ensure a safe and conducive working condition (Hamid & Singh, 2003). Hazardous material has been put on a logo or icon that not all the worker or even a student that work around the dangerous area to know or memorizing the substance and their usage. Furthermore, they are facing difficulties in understanding the details of every hazardous material without harming themselves.

The approach using a traditional method not so convenient to train the organizational members of universities, which include the worker and student, where they have to input the information manually. With this app project, the public also can know the hazard or chemical substance more accessible.

1.3 Research Question

Below is the list of research question in this project:

i. How to improve hazard identification in OSH training at the workplace?
ii. How to measure the motivation of the AR-based app in OSH training among university organizational members, that are the students and worker group?

iii. What is the impact if the AR-based app on the motivation of the user in OSH training?

1.4 Scope

This project mainly focused on developing an AR-based app called Hazhunt. The app will be used to enhance occupational safety and health (OSH) training.

1.5 Aims and Objective

The main objective of this project is:

i. To propose an AR-based app called Hazhunt to improve hazard identification in OSH training.

ii. To measure the motivation and impact of the AR-based app in OSH training among university organizational members, that are the students and worker groups.

1.6 Brief Methodology

This project will use a design and development research (DDR) method, which involves three phases, namely requirement analysis, design and development, and usability analysis. The formulated methodology was based on the purpose nature of design development research (DDR) by Richey & Klien (2007) it highlights that the method of instructional design is like processes for solving scientific problems. The three phases are detailed in the following section (Rejab, Chuprat, & Azmi, 2018).

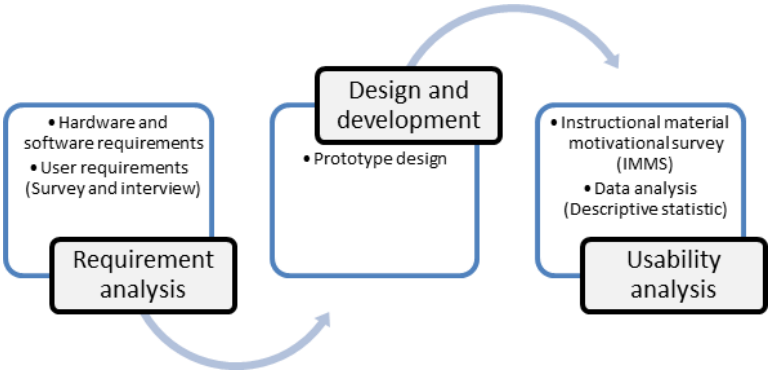

Figure 1.1: DDR Model (adapted from Richey & Klein (2007))

1.6.1 Requirement Analysis

This phase begins with understanding the concept of change management, maintenance of software and hardware, measurement of test effort, and testing of regression. An extensive literature review will be done on the topic. Important information, relevant study, and fundamental research gap and limitation are identified. The main issues that will be focused upon include challenges in OSH training, technology implemented in OSH training, essential elements in AR technology to be developed for Hazhunt, measurement tools for data collection, and suitable quantitative/qualitative analysis technique to achieve the research objective.

1.6.2 Design and development

In the design and development, the making AR-based prototype app Hazhunt is carried out. Using the elements captured from a literature review conducted in the previous phase, the hazard and risk identification training will be integrated into the app. One of the essential functions that are supposed to be included in the app is the input and storing modules, which are applicable for making an authentic example before the OSH training and enabling the trainees to perform real-time hazard and risk identification exercises.