THE DEVELOPMENT OF 3D ELECTROLYSIS USING AUGMENTED REALITY

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This report is submitted in partial fulfillment of the requirements for the Bachelor of Computer Science (Interactive Media) with Honours.

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2021

DECLARATION

I hereby declare that this project report entitled

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SUPERVISOR : _____ Date : 08/09/2021

(TS DR IBRAHIM BIN AHMAD)

DEDICATION

This report is dedicated foremost to my beloved family and my supervisor who has guided and motivated me throughout the project.

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ABSTRACT

In the era of science and technology, augmented reality (AR) has become one of the faster-growing fields of technology. As a result of its expansion, it is now used in a variety of human activities. AR make life's activities easy and fun. Education is one of the fields where AR has a huge impact. There are some students are hard to understand and imagine the theory by themselves, especially in chemistry. Hence, this project is developed to help student more understand the theory. The target audience in this project is the students, who take chemistry subject in school. The development of 3D electrolysis using AR is a system that implemented to help the students to have a better understanding of the topic. The interesting 3D model in AR will attract student's attention and make them more focused in class. AR in education can help teachers to make the lessons more interactive and easier for students to understand. The objectives of this to study augmented reality requirement and technique in 3D electrolysis application and develop a prototype of AR based on 3D electrolysis. The expected outcome of the project is that the target audience might have a better understanding. The users can scan the marker on the card and the 3D electrolysis model will be visualized. This will help the audience to understand the movement of ions in the electrolysis process.

ABSTRAK

Dalam era sains dan teknologi, *augmented reality* (AR) telah menjadi salah satu bidang teknologi yang berkembang pesat. Perkembangan ini telah mendorong penggunaannya dalam pelbagai bidang aktiviti manusia. AR menjadikan aktiviti hidup lebih mudah dan menarik. Pendidikan adalah salah satu bidang di mana AR mempunyai kesan yang besar. Terdapat sebilangan pelajar sukar memahami dan membayangkan teori itu sendiri, terutamanya dalam bidang kimia. Oleh itu, projek ini dibangunkan untuk membantu pelajar lebih memahami teori. Sasaran audiens dalam projek ini adalah pelajar yang mengambil subjek kimia di sekolah. Perkembangan elektrolisis 3D menggunakan AR adalah sistem yang dilaksanakan untuk membantu para pelajar untuk lebih memahami topik tersebut. Model 3D yang menarik dalam AR akan menarik perhatian pelajar dan menjadikan mereka lebih fokus dalam kelas. AR dalam pendidikan dapat membantu guru menjadikan pelajaran lebih interaktif dan lebih mudah difahami oleh pelajar. Objektif ini untuk mengkaji keperluan dan teknik augmented reality dalam aplikasi elektrolisis 3D dan mengembangkan prototaip AR berdasarkan elektrolisis 3D. Hasil yang diharapkan dari projek ini adalah bahawa khalayak sasaran mungkin mempunyai pemahaman yang lebih baik. Pengguna boleh mengimbas penanda pada kad dan model elektrolisis 3D akan dapat dilihat. Ini akan membantu penonton memahami pergerakan ion dalam proses elektrolisis.

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LIST OF ABBREVIATIONS

3D	**-**	**3 Dimension**
2D	**-**	**2 Dimension**
AR	**-**	**Augmented Reality**
VR	**-**	**Virtual Reality**
STEM	**-**	**Science, Technology, Engineering and Mathematic**
CER	**-**	**Chemistry Education Research**
ICT	**-**	**Information Communication Technology**
IT	**-**	**Information Technology**
SME	**-**	**Subject-Matter Expert**
SD	**-**	**Standard Deviation**

LIST OF ATTACHMENTS

CHAPTER 1: INTRODUCTION

1.1 Introduction

In the 21st century, computer science is becoming increasingly relevant in this age of information technology. Augmented Reality (AR) is a part of computer science and is one of the biggest technology trends nowadays. AR is a technology that combines real-world objects with computer-generated objects. The usage of augmented reality is not restricted to a specific subject, age group or educational level. Education is one of the fields where AR has a huge impact. As AR technology is integrated with educational material, it provides a new form of automated application that improves the efficiency and attractiveness of teaching and learning for students in real life. (Singaravelu, 2020) Augmented reality can make classes more engaging and allow students to concentrate on experience rather than theory. Some educational materials are quite costly, and not all schools or educational institutions can afford to purchase and retain them. Students only need mobile devices and AR applications to use AR for learning.

The development of 3D electrolysis using augmented reality (AR) is an application that is implemented to help the students to have a better understanding of the electrochemistry topic. The interesting 3D model in AR will attract student's attention and make them more focused in class. AR in education can help teachers to make the lessons more interactive and easier for students to understand. The electrochemistry topic is uneasy to understand by only read the theory in the textbook. (Muzammila Akram, Johari Bin Surif & Murad Ali, 2014) Not every school provide the opportunity for students to do experiments. Thus, The Development of 3D

Electrolysis using AR is an Electrolysis AR application built to help high school students who study chemistry subjects. There are 3D models, electrolysis simulations and simple quizzes produced in the application. Therefore, with the existence of the development of 3D electrolysis using AR, students can observe the process and the movement of the ion during electrolysis without experimenting.

1.2 Problem Statement

In any field of study, a textbook gives instructions or information. However, it fails to capture the attention of the majority of the new generation students. Some students have a poor command of languages. It would be difficult for them to understand topics learned as they are not able to get a clear image or picture of the topic that they are learning by just reading the words inside the textbook. Low operation, interest and student's chemistry results are caused by general difficulties in solving problems related to chemical reactions and chemical counting (Sunyono, 2005). This indicates that chemistry is difficult to learn for a variety of reasons, one of the reasons is that most chemical concepts are abstract. Hence, students are unable to imagine the molecular structure clearly. Besides, the chemical experiment in schools cannot be achieved optimally because it takes time for preparation within a limited period and resulting in inefficient use of student learning time. Therefore, secondary school students will anxiety to learn chemistry. According to the study by Jegede (2007), the causes of student's concerns are a broad syllabus, their teacher's teaching approaches and a lack of teaching materials and laboratories.

1.3 Objective

This project embarks on the following objectives:

- To identify augmented reality requirements and techniques in 3D electrolysis application
- To develop a prototype of marker-based AR on 3D electrolysis
- To evaluate the effectiveness of the prototype in 3D electrolysis topic

1.4 Scope

The marker-based AR of 3D electrolysis is developed for form 4 students in secondary school. They can learn basic electrolysis concepts through the development of 3D electrolysis using AR. This project uses a marker-based AR approach to deliver content using a booklet as a medium. The target is recognized and tracked using the Vuforia Augmented Reality SDK. Blender and Unity were used to create 3D models and build up the scene. The Android platform will be the focus of this project. This project's modules involve scanning target images in the booklet and displaying AR contents with animations, images, video and audio. Displaying 3D objects through the booklet and a simple quiz activity to track user's knowledge and understanding.

1.5 Project Significance

The development of 3D electrolysis using AR will help students who take chemistry subjects in secondary school to learn chemistry interesting. This AR project provides 3D objects instead of 2D pictures, which will help students to achieve better results through visualization and full immersion in the subject. A simulation of ion movement during electrolysis will develop using AR in this project. This enables students to observe the process and the movement of the ion during electrolysis. Therefore, they will have a better understanding of the electrolysis topic.

1.6 Conclusion

This chapter is briefly explained the background and purpose of the project that will be carried out. These are to ensure that the development of AR runs smoothly and any development planning can be completed on time. The expected outcome will be the prototype of marker-based AR of 3D electrolysis. The users can scan the marker on the card and the 3D electrolysis model will appear on the screen. This prototype will help the user to understand the movement of ions in the electrolysis process. It will be very useful for students who do not understand the electrolysis topic. This project is also able to make the user have a better understanding of what is augmented reality. Next, this project will be continued with the literature review and project methodology that has been chosen to ease the completion of this project.

CHAPTER 2: LITERATURE REVIEW AND PROJECT METHODOLOGY

2.1 Introduction

This chapter focus on the review of similar studies by other researchers. This will help in the generation of ideas on how to carry out this project. A methodology is the combination of logically related methods and step by step techniques for the successful planning, control and delivery of the project. It is a scientifically proven, systematic and disciplined approach to project development and implementation. This chapter will also determine the project methodology that use to develop and the project requirement. The software and hardware requirements are defined in the early stage of development plans.

2.2 Domain

2.2.1 Augmented Reality

Augmented reality is an immersive experience of a real-world environment in which computer-generated perceptual information enhances the objects in the real world. AR allows for seamless overlaying of digital content, and views of the physical world are mixed. VR simulates the real world, while augmented reality takes everything from the real world and incorporates it into a video or architecture. The fundamental principles of augmented reality have been used in many movies and science fiction stories. The real-time use of information in the form of text, graphics, audio and other virtual enhancements combined with real-world objects is known as augmented reality.

2.2.2 Augmented Reality in Education

AR is the technology that has the most potential to captivate student's interest in learning. These days, AR is gaining popularity in schools all around the world. In education, AR can be used for a variety of purposes. It helps students in quickly acquiring, processing and remembering knowledge. Besides, AR makes learning more interesting and enjoyable. Educators can use AR to enhance learning outcomes by increasing interaction and interactivity. AR has been accepted as an effective learning tool, especially in chemistry. AR has been found to have a lot of potential for making learning more dynamic, effective and engaging (Nor Farhan Saidin & NoorDayana Abd Halim, 2015). Students can learn abstract concepts including chemical elements, compounds and reactions by using the AR application. An AR application allows computer-generated objects to appear and coexist in the same space as the real world. This characteristic of AR is hypothesized to be able to provide an interactive learning experience and captivate student's interest in learning better than dull traditional textbooks. Images and 3D models created by using AR technology allow students to learn and understand more of a topic in a certain field of study because students are able to watch and learn from the images and models instead of imagining it based on the words in the textbooks. One of the benefits of AR technology for learning is that it can provide 3D visualization and can be employed in a variety of Android-based devices used by students (Irwansyah, Yusof & Farida, 2017).

2.2.3 Chemistry Education

The study of teaching and studying chemistry is known as chemistry education. It is a subset of STEM education. Understanding how students learn chemistry and deciding the most effective teaching methods are two topics in chemistry education. Based on the results of CER, there is a persistent need to develop chemistry curricula and learning outcomes. Changes in teaching methods and proper preparation for chemistry teachers can enhance chemistry education in a variety of ways, including classroom lectures, presentations, demonstrations and laboratory activities. Chemistry education is important because chemistry is a foundational science of our society. Chemistry is referred to as the "central science" because it connects physical, life, and applied sciences. Food, medicine, manufacturing, the atmosphere, and other fields all