



Faculty of Electrical and Electronic Engineering Technology



**DEVELOPMENT OF INTERACTIVE CHEMISTRY GAME APP FOR
STEM EDUCATION USING MIT APP INVENTOR**

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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**Bachelor of Electronics Engineering Technology (Industrial Electronics) with
Honours**

2021

**DEVELOPMENT OF INTERACTIVE CHEMISTRY GAME APP FOR STEM
EDUCATION USING MIT APP INVENTOR**

NUR FATIN ATHIRAH BINTI SHARUDIN

**A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electronics Engineering Technology (Telecommunications) with Honours**



Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2021

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PROJEK SARJANA MUDA II

Tajuk Projek : Development of Interactive Game App for STEM Education using MIT App Inventor

Sesi Pengajian : Semester 1-2021/20222

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I declare that this project report entitled “Development of Interactive Chemistry Game App for STEM Education using MIT App Inventor” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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DEDICATION

It was specially dedicated to my beloved parents Sharudin bin Darus and Nur Hanisah Binti Mior Shamsudin, who always be my strength throughout this project, support Puan Aziean Binti Mohd Azize, my faithful panels, lectures of FTK and my BEET Cohorts 8 friends who always supported me through ups and downs.



ABSTRACT

Technology creates a modern learning environment in which students have more flexibility, and teachers will help as assistants in an exciting new world of nearly infinite knowledge. It is thought that incorporating technology into the classroom will help students learn more effectively. In this research, the objective is to study the recent technology for STEM education and to create an interactive Chemistry game app for STEM education using a microcontroller and MIT App Inventor. Thus, it can help the student who can be used for teaching and upbringing and transferring learned knowledge and experience. This project particularly utilizes many kinds of hardware and software. Before the project begins, a survey has been made to identify the opinion of people about interactive game apps. After gathering the data, the interactive game app is made. The microcontroller and the interactive game app are connected through a Bluetooth module. The tested result is shown for software and hardware parts. Therefore, an interactive Android game app for STEM education has been constructed. Both the microcontroller and the interactive game app are well functioned after being tested.

ABSTRAK

Teknologi mewujudkan persekitaran pembelajaran moden di mana pelajar mempunyai lebih fleksibiliti, dan guru akan membantu sebagai pembantu dan mengujakan dunia baharu pengetahuan yang hampir tidak terhingga. Adalah difikirkan bahawa menggabungkan teknologi ke dalam bilik darjah akan membantu pelajar belajar dengan lebih berkesan. Dalam penyelidikan ini, objektifnya adalah untuk mengkaji teknologi terkini untuk pendidikan STEM dan untuk mencipta aplikasi permainan Kimia interaktif untuk pendidikan STEM menggunakan mikropengawal dan MIT App Inventor. Oleh itu, ia dapat membantu pelajar yang boleh digunakan untuk mengajar dan mengasuh serta memindahkan pengetahuan dan pengalaman yang dipelajari. Projek ini terutamanya menggunakan pelbagai jenis perkakasan dan perisian. Sebelum projek bermula, tinjauan telah dibuat untuk mengenal pasti pendapat orang ramai tentang aplikasi permainan interaktif. Selepas mengumpulkan data, aplikasi permainan interaktif dibuat. Pengawal mikro dan apl permainan interaktif disambungkan melalui modul Bluetooth. Keputusan yang diuji ditunjukkan untuk bahagian perisian dan perkakasan. Oleh itu, aplikasi permainan android interaktif untuk pendidikan STEM telah dibina. Pengawal mikro dan aplikasi permainan interaktif berfungsi dengan baik selepas diuji.

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ACKNOWLEDGEMENTS

In the first place, I would like to thank my supervisor, Mrs Aziean Binti Mohd Azize, for her valuable guidance, words of wisdom and patience over the entire project.

My heartfelt gratitude goes out to my wonderful parents and family members for their unwavering support and prayers during my studies. Moreover, there are no words to express my appreciation for all of my friends who have lent a helping hand while having difficulties with the project. Without a doubt, their insights, advice, support, and assistance with various problems are pretty valuable.



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LIST OF ABBREVIATIONS

STEM	- Science, Technology, Engineering and Mathematics
MIT	- Massachusetts Institute of Technology
MCO	- Movement Control Order
AR	- Augmented Reality
VR	- Virtual Reality
ICT	- Information and Communication Technology
PC	- Personal Computer
UDL	- Universal Design for Learning
IBS	- Inquiry-Based Science Education
IDE	- Arduino Integrated Development Environment
USB	- Universal Serial Bus
CDG4E	- Create Digital Games for Education
IoT	- Internet of Things
MB	- Monitor Based
AUREL	- Augmented Reality Learning
GCP	- Google Cloud Platform
TPUs	- Tensor Processing Units
3D	- Three Dimensional
LED	- light emission diode
UI	- user interface
g	- gram
amu	- atomic mass unit

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CHAPTER 1

INTRODUCTION

1.1 Background

The technological era has transformed how people live and deal with their daily lives. Similarly, educational aspects have evolved from tangible materials to soft materials such as software and applications. The primary purpose of this project is to attract the students to study Chemistry while enjoying the process. [1] To increase students' interest in learning, it is necessary to provide them with engaging learning media. The result can be improved by using gaming apps as a learning medium.[2] Low-achieving students who fail to understand the material in the classroom can use this method to watch the video and the correct answer to the exercise as often as they need to grasp the topic. Students who do well in class will be given access to more strenuous activities, which may help them stay motivated.

Today's textbooks are dull, oversized, profit-driven, and organized around ancient educational myths. Students in school are most often taught using the conventional approach, in which all notes are taken from textbooks given to them. Chemistry is not an easy subject to be learned. Thus, creating this platform called "Development of Interactive Chemistry Game App for STEM Education using Android Studio" can help to improve the educational process and make lessons more engaging. It also can assist the students in understanding the theory of mole mass in chemistry topics.

1.2 Problem Statement

Chemistry is one of a subject that is compulsory to take for pure science students for two years in form 4 and form 5. It is also a subject that quite tricky for them. Chemistry is a subject that we cannot see using our naked eyes, such as atoms and particles. Therefore, they need to learn using this platform which they can explore more. They can also do self-study. Children and parents can access educational applications and websites no matter where they are or what time it is. With this game app, they can picture the topic.

Next, by learning using books, it is an old school or old-style which nowadays they are more interested in multimedia features such as music, animation and sound. Staying stick to the typical book reading and gathering stuff from notebooks sounds outdated. Carrying gadget from one location to another has been straightforward due to their portability. To overcome this problem, we should create a platform for the student along with technology.

By using books, it will harm the earth. We can help reduce the detrimental effects of manufacturing and transportation on the environment. The material requirements of traditional educational institutions (textbooks, chairs, electricity and buildings) are dramatically decreased. It preserves natural resources and reduces waste. The number of trees needed for school worksheets and books will be enough to cover an entire forest.

1.3 Project Objective

The objective of this project is as follows:

- a) To study the recent technology for STEM education.
- b) To design an app that able to do the calculation on the Chemistry subtopic of mole and mass.
- c) To develop an interactive IoT game app for STEM Education based microcontroller and MIT App Inventor.



1.4 Scope of Project

This project's scope is for the student to learn mole and mass in Chemistry subject in interactive apps. The idea is to attract the student to learn Chemistry while playing games. This project aims to design an open-source game app and easy to use.

This project consists of hardware and software. The requirement for this system is a microcontroller, LED, buzzer and MIT App Inventor. The microcontroller is used as a brain to control the component used in this project. Additionally, App Inventor was used to creating the games by using blocks.

These apps consist of three parts which the user need to choose either notes, calculator or question. For the notes, it will state the definition of mole and mass and the formula. The second part will provide some questions for the user to do with multiple answers to choose from. When the user answers the quiz correctly, the green LED will turn on, while if the user answers the quiz wrongly, the red LED and the buzzer will turn on. For the second part, the calculator, the user needs to choose between two buttons: the first switch is from mass to mole while the other is from mole to mass.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter reviews and describes prior experiment work, similar to the experiments described in this report. Having knowledge and data is another resource in the research and development of projects. Therefore, several literature reviews were done to have a better grasp of the project's studies.

2.2 Previous Research Review

2.2.1 Mileage Learn+: A Mobile Learning App to Aid the Students in the Study of Organic Chemistry

In a scholarly study by [2], education analysis is highly regarded as one of the techniques that should be developed further. Rehearsing has a pedagogical benefit because these games are the same as what students experience in class; they help students consolidate things they have already studied. Amenities encourages handheld devices to be used as educational devices and gives them the benefits of the on-the-the-go classroom method of education. It integrates several teaching methodologies, such as self-regulated instruction, gameplay, and peer review, into a single learning paradigm. By learning from each other, students acquire knowledge and consolidate their own; MILEAGE benefits both. This Uity framework, version 1.7, and PostgreSQL management system are all employed in this application. The creation of the game-specific features, as shown in Figure 2.1, is helpful in the comprehension of various organic chemistry topics. With the help of a mobile application,

it can be applied at any time, including in locations and events. Therefore, on average, the final exam grades are higher than those in this app.

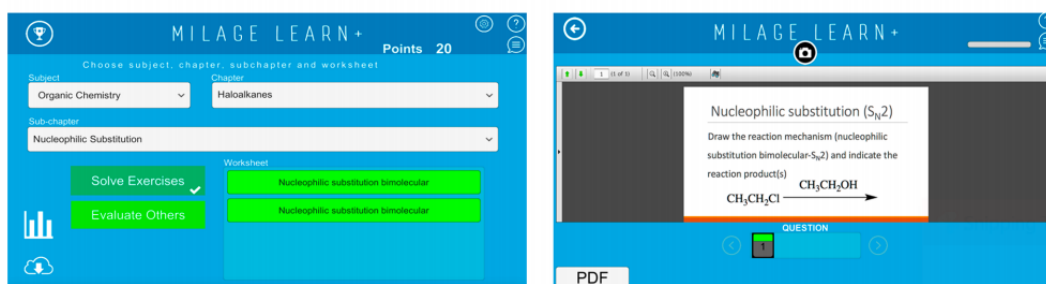


Figure 2.1: The menu of the Milage Learn+.

2.2.2 Using Augmented Reality Technologies for STEM Education Organization

According to [3], modernizing the educational system and employing new learning technologies will boost education. Augmented reality technology results in more excellent individual and group accomplishment while facilitating organization and cooperation. Also, there are several more lectures. Students and the instructor can use free up their creative time to explore Augmented Reality (AR) techniques. PCs, smartphones, and virtual reality (VR) headsets. Augmented reality allows users to understand atomic and molecular structures, perform experiments that could never happen in the real world, and offers the ability to observe chemical reactions, among other features. The use of AR technology and related strategies benefits students in their areas of these three significant pursuits: allowing them to be more innovative, improving their skills in science and research, helping them find their purpose and potential, and incorporating what they have learned in everyday activities. AR applications allow learning the structure of atoms and molecules in the chemistry sphere, perform costly or dangerous experiments in the real world, and observe chemical transformations.

2.2.3 Developing an Android-Based Game for Chemistry Learners and its Usability Assessment

Another research according to [4], Adolescents engage in much gaming daily. Smartphones are utilized for more than simply communication; they are also utilized for gaming and educational purposes. Smartphones are not only convenient and simple to use, but they have also proven to be an adequate substitute for PCs or laptops in terms of functionality and variety in today's world. As a result, gamification of chemistry ideas is becoming increasingly exciting and promising to enhance students' willingness to learn and encourage ICT literacy among university students. While building a good educational game is complex, time-consuming, and challenging, good games will help the instructor achieve the students' learning objectives more rapidly. As a testing tool, the ADDIE model was used to construct the app. The five primary stages of the ADDIE model were research, design, creation, implementation, and evaluation. During the analysis step, they used seven questions to determine the app's needs. According to their research, most pupils spend between 11 and 15 hours a week using their smartphones. This data demonstrates that students and their smartphones have a high level of interaction. As a result, students benefit from a secure and enjoyable learning atmosphere in which they can have a good time, be enthusiastic, and have a tremendous cognitive experience. Android Studio was used to construct the game, CorelDraw was used to produce the graphics, and the content was written in Indonesian.