Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF INTERACTIVE PHYSICS GAME APP FOR STEM EDUCATION USING MIT APP INVENTOR

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Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

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DEVELOPMENT OF INTERACTIVE PHYSICS GAME APP FOR STEM EDUCATION USING MIT APP INVENTOR

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A project report submitted
in partial fulfillment of the requirements for the degree of
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2021

DECLARATION

I declare that this project report entitled “Development Of Interactive Physics 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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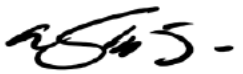
Date : 12 /1/ 2022

APPROVAL

I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electronics Engineering Technology (Telecommunications) with Honours.



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Date : .....

DEDICATION

To My dissertation is dedicated to my family and many friends. My loving parents, Mohd Nizar Yusoff and Madihah Mohd Mohsin, and supportive supervisors, Puan Aziean Mohd Azize, deserve particular thanks. My dedicated panels, FTK lecturers, and my BEET Cohorts 8 classmates who have been extremely supportive along the process

ABSTRACT

In this era of technology, there are many types of instructional games designed specifically for studies in game-based learning to achieve the most successful stage of learning for students in school and university. It is investigated how interactive game apps will support STEM subjects by simulating complex, real-world problems and facilitating higher-order learning. As a result, this analysis aimed to create the most common game feature used in-game apps design that yielded the best results for students learning STEM subjects. The objective of this project is to study recent technology for STEM education and design an app based on Physics subjects and develop apps for STEM with ARDUINO UNO. These game apps used MIT App Inventor and Arduino UNO to create the apps. It will impress the student's curiosity in STEM subjects. This app consists of four functions, Definition button, Notes button, Calculator button and Quiz button. The results of the study are predicted to work on the development of an Android-based mobile application which can link into Arduino UNO using Bluetooth module as a platform to connect software and hardware components. The expected output result for this project is LED and a buzzer to determine whether the answer is correct or wrong using the interactive game apps.

ABSTRAK

Dalam era teknologi ini, terdapat banyak jenis permainan instruksional yang direka khusus untuk pengajian dalam pembelajaran berasaskan permainan bagi mencapai tahap pembelajaran yang paling berjaya untuk pelajar di sekolah dan universiti. Ia disiasat bagaimana aplikasi permainan interaktif akan menyokong subjek STEM dengan mensimulasikan masalah dunia sebenar yang kompleks dan memudahkan pembelajaran aras tinggi. Hasilnya, analisis ini bertujuan untuk mencipta ciri-ciri permainan yang paling biasa digunakan dalam reka bentuk aplikasi dalam permainan untuk menghasilkan keputusan terbaik kepada pelajar yang mempelajari subjek STEM. Objektif projek ini adalah untuk mengkaji teknologi terkini untuk pendidikan STEM dan mereka bentuk aplikasi berdasarkan mata pelajaran Fizik dan membangunkan aplikasi menggunakan MIT App Inventor untuk STEM dengan ARDUINO UNO. Aplikasi permainan ini menggunakan MIT App Inventor dan Arduino UNO untuk mencipta aplikasi tersebut. Ia akan menarik minat pelajar dalam mata pelajaran STEM. Aplikasi ini terdiri daripada empat fungsi, butang Definisi, butang Nota, butang Kalkulator dan butang Kuiz. Hasil kajian diramalkan akan berfungsi pada pembangunan aplikasi mudah alih berasaskan Android yang boleh dipautkan ke Arduino UNO menggunakan modul Bluetooth sebagai platform untuk menyambungkan komponen perisian dan perkakasan. Hasil keluaran yang dijangkakan untuk projek ini ialah LED dan buzzer untuk menentukan sama ada jawapan itu betul atau salah dengan menggunakan aplikasi permainan interaktif.

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First and all, I want to thank my supervisor, Puan Aziean Binti Mohd Azize, for her enthusiasm, patience, insightful remarks, valuable information, practical guidance, and never-ending ideas, which have largely contributed me during my research and this project.

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V	-	Voltage
N	-	Newton
Ns	-	Newton second

LIST OF ABBREVIATIONS

GBL	-	Game-Based Learning
STEM	-	Science, Technology, Engineering and Mathematics
VR	-	Virtual Reality
IT	-	Information Technology
RFID	-	Radio Frequency Identificatiom
NFC	-	Near Field Communication
LED	-	Light Emitted Diode
IDE	-	Integrated Development Environment

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Research Background

Expertise in the twenty-first century always necessitates high-level and cross-disciplinary knowledge, which should be a part of today's educational practices. As a result, educational endeavors should be structured so that students can develop the necessary experience and skills. The current work provides an Arduino-based STEM education resource that focuses on teaching in a non-game setting, a game function. Moreover, learning science with Arduino is a fascinating subject to explore. The Arduino, or microcontroller is a system that can monitor how individual circuit components are attached or detached. According to [1], introducing students to Arduino and open-source applications will expand physics classes beyond conventional book problems and demonstration laboratories. Physics is one of the STEM subjects that students are uncertain about. In addition, students found physics to be one of the most prevalent and difficult topics in the field, resulting in a lack of interest and a pessimistic attitude toward science. The objective test is a method used to determine a student's STEM literacy. For this case, learning impulse and impulsive force through a STEM education approach will pique students' interest in physics, provide intense and substantive learning, and develop student’s thought and practical skills. STEM Instruction is a tool for performing teaching.

1.2 Problem Statement

The project's aim is to create android apps that can be used as a platform for game apps. There are information pages or a website hub where educators can find links to available instructional games. Game-based learning platforms have a range of features when it comes to providing content and desired instructional results. However, the students feel that the old-school teaching methods are unrelieved and hard to learn the physics subject. So, to overcome this problem, an interactive app will be created based on physics subjects. The use of mobile apps will increase the flexibility of classroom practices. The numerous features and functions of the apps in the studying often contribute to the effective transformation of teaching and learning methods. As a result, various senses of students are enabled to use these apps. In addition, students nowadays are already exposed to gadgets, apps, and IT technology. The learning sessions should keep pace with the technology. However, to create an app, it has limited sources to make an interactive game app. It gives only limited access to add buttons, displays, and LCD to create the game apps through Arduino UNO. Therefore, in this project, the game apps will be compact and optimize to make the apps operating smoothly. The lessons in the game apps will increase student engagement and involvement, resulting in more information being learned and retained.

1.3 Project Objective

- To study recent technology for STEM education
- To design an apps based on Physics subject using IoT platform
- To develop apps for STEM using MIT App Inventor with Arduino UNO

1.4 Scope of Project

To accomplish the goals of the project, there are some scopes of work for project. The Physics Game App for STEM Education will be developed for the use of students to improve the education sector. This game app will consist of creating an android game system on the smartphone-based on MIT App inventor and Arduino UNO. In addition, the Arduino UNO will perform as a brain for this project, controlling all the components hardware. Furthermore, the user will be introduced with 4 sections, which is the section for the introduction for the subject and its definition, notes to write infromation, a built-in calculator with the formula to calculate the questions, quiz, and scoreboard to show the mark for the user.

1.5 Thesis Outline

Chapter 1: Introduction

This chapter covers introduction, problem statement, objective, and scope of research.

Chapter 2: Literature Review

This chapter focuses on the research and studies that have been conducted in relation to the project's title.

Chapter 3: Methodology

This chapter outlines the methods of obtaining in which field of study, as well as investigations conducted in accordance with the project's goal.

Chapter 4: Results and Discussion

This chapter outlines the project's predicted output, from the desired outcome to the hardware being created.

Chapter 5: Conclusion

This Chapter focuses on achieve project’s objective, problem statement and future work

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter examines and evaluates previous experiment work that is relevant to this present project. The information and data gathered to provide an additional source of data for the framework in researching and constructing more successful work. A few literature studies were conducted to have a better knowledge of the project's research.

2.2 Research Review

From the article by [2] Students and learners primarily demand the development of an Android-based Quiz application in order to prepare for various tests using their smartphones and tablets. Meanwhile, the software makes them look good so that they may prepare for interviews, admission exams, and other such events in a positive frame of mind. There are several online quiz programmes accessible, but the most of them are designed solely for enjoyment and amusement. Furthermore, if someone is about to take a test or an interview, it takes time to read whole books or articles on certain topics in order to prepare or review their knowledge .TreeKnox Computer Quiz is a quiz system designed to assist and prepare computer science and IT students for any interview, test, or exam in the areas of computer science and IT. Questions with numerous options are shown, and at the conclusion of each question is a button labelled ‘Answer." In the meanwhile, when you click that button, the correct answer is highlighted.

From figure 2.1, the following components make up the proposed framework: Mode selection, Category selection, and Comparison and Scoring. The mode selection

module allows the user to choose a mode from a list of options, such as Time or Categories. For the category picker, the user must provide input by picking any of the available alternatives, and these inputs are then employed in the final result computation. The user is given some life lines to help them play the quiz more effectively. The overall score, acquired score, accuracy, and number of attempts made are all presented here, as well as statements indicating whether the users succeeded or failed the quiz depending on their inputs.

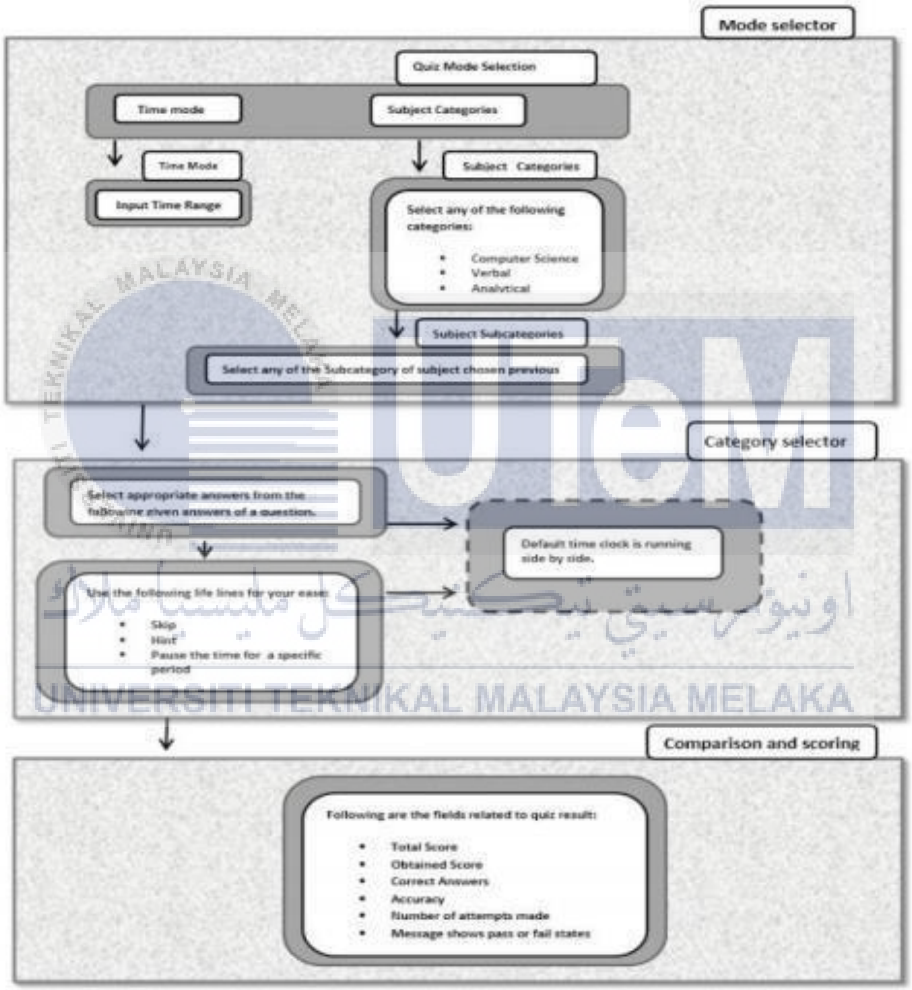

Figure 2.1 system planning of Android Quiz [2]

In addition, research by [3] claimed that for science learning, innovative technologies link a smartphone learning app with the Arduino UNO. The project's target is to build "Electree," an Android smartphone learning framework for junior high school students focused on Arduino projects. Experts assessed the mobile learning application's content,

vocabulary, and media. The findings indicate that the overall mobile learning programme focused on Arduino UNO earned a very strong ranking in each group. None of the mobile learning apps was developed exclusively to help students learn electricity through Arduino UNO experiments. Appropriate, scalable, and testable learning is needed to ensure that students comprehend and apply their skills. Mobile learning is supposed to be a solution for visualising abstract ideas. The using multimedia toolkits such as smartphone apps to educate children about science aids their creation of 21st-century skills such as ICT and knowledge literacy. The elements in the Arduino-based mobile learning application include the topic of electricity, which is included in the Cambridge curriculum and the Indonesian Curriculum 2013. The resources are divided into three categories in this mobile learning application based on Arduino projects: Electrical Quantities, Electrical Components, and Electrical Circuits.

Figure 2.2 shows the flow and display of an Arduino-based mobile learning application. The storyboard was used to create the interface during the design stage. In this method, you'll first gather user requirements, then conceptualise and validate the design. Then, before it can be developed, any issues that occur should be addressed.

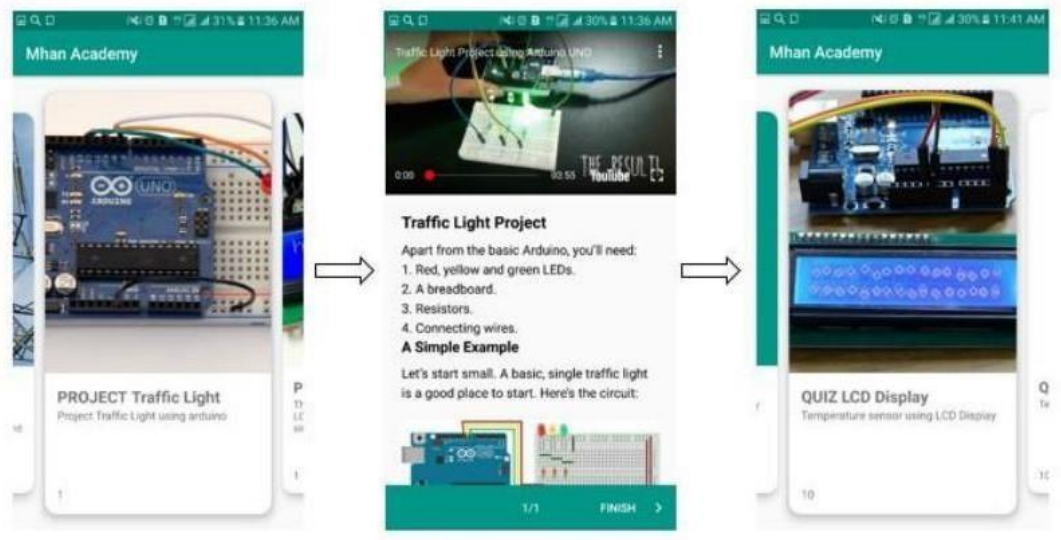

Figure 2.2 "Electree" with Arduino [3]

Nevertheless, [4] stated that STEM (science, technology, engineering, and math) is an interdisciplinary approach that provides a learning environment in which students can apply science, technology, engineering, and math in their everyday lives. The aim of STEM is to teach students how to be STEM literate. STEM Learning was selected as a research technique because it was created using an Android game, a YWRobot, and an Arduino Uno experiment lesson plan and worksheet. Pre-experimental design is one of the experimental research strategies for determining a causal association using only one set of subjects. In other words, when there is no control group or external variables that might affect internal validity, this approach is utilised. The pre-experimental design was utilised to determine the impact of the researcher's STEM Learning methodology on students' STEM Literacy. As a result, the researcher will be able to determine whether any changes happened because of the STEM Learning approach to learning electricity. the Arduino or microcontroller is included as a component of the circuit that the student must construct. The software will programme the Arduino and it will control the light that will turn on in the circuit. In this scenario, the student will be expected to create a traffic light prototype that they may modify themselves.

In figure 2.3, MGames is an Android game. Scientific games include logic puzzles and science games. Mgames is a new approach to study science by playing a science game. It will assist users in learning how to construct a circuit (both series and parallel), determine the effective resistance for a given circuit, and calculate current.

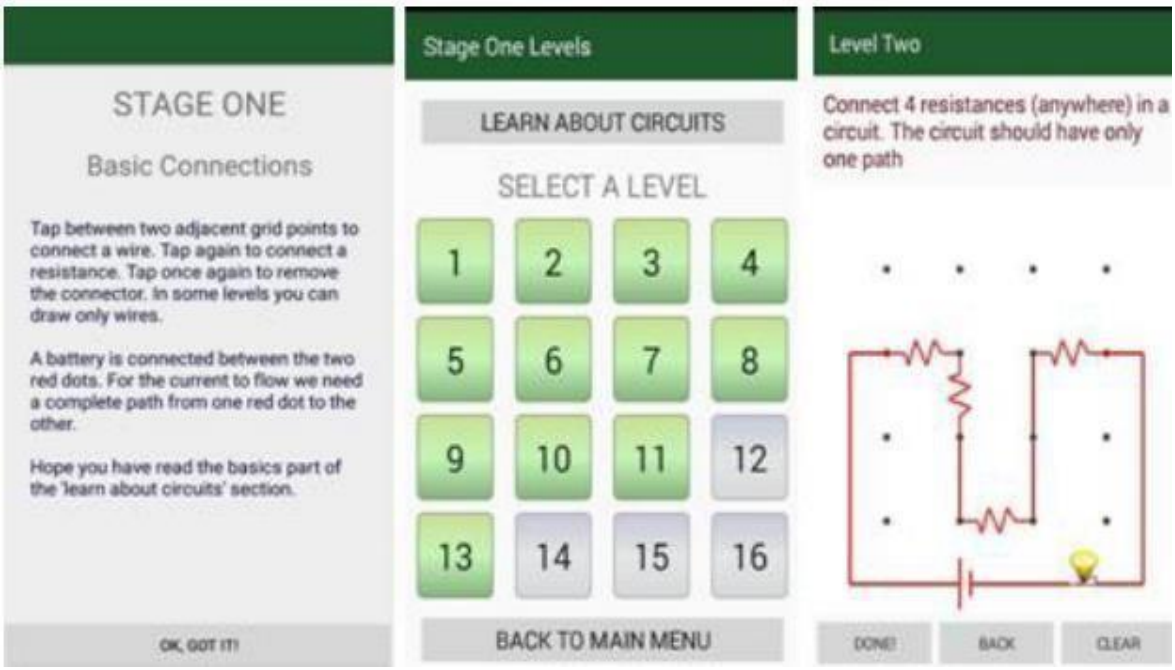

Figure 2.3 Stage one of Android game

Likewise, study by [5], find that the female youngsters who took part in the workshop showed more interest in engineering, more artistic faith, more optimistic views of STEM, higher levels of empathy and pro-social influences, and a more diverse perspective on job opportunities. This research offers objective evidence for the idea that a brief intervention will improve female youths' attitudes toward STEM. In gendered cultures, a creative approach such as design thinking could revitalise education curriculum in ways that inspire female youths' faith and innovation, encouraging them to visualise a future in STEM. Perceptions, interest, and self-efficacy engineering among youngsters improved. This is consistent with the workshop's engineering focus, the kids spent most of their time devising solutions to a problem. As seen by their comments, teenagers' attitudes regarding engineering measures have shifted. Participants' creative confidence grew because of the STEAM design thinking class. In this study, creative confidence is defined as an individual's capacity to work in the face of uncertainty, as well as their willingness to accept feedback and criticism on still-developing ideas .

In addition, [6] claimed that the “Introduction to Programming” course contained an Arduino topic as part of the lecture material. The course is taught to second-year chemical (bioprocess) engineering students at Universiti Teknologi Malaysia's School of Chemical and Energy Engineering, and it focuses on the implementation of basic engineering software and compiled languages. First, there will be a series of lectures on the C programming language. Second, instruction in the use of Microsoft Excel and Microsoft Visio for chemical engineering applications. The lectures on Arduino will be offered in the final step of the course, with topics covered including a general description of Arduino and the advantages of Arduino to chemical (and biochemical) engineers. The lecture (including the introduction of the pause protocol activity) was just 20 minutes long. The game-based learning began shortly after the lecture. Several organizations were created for this reason.

Figure 2.4 shows a circuit schematic and a programmed for running a push button function. Assessments were organized to assess the student on three different aspects, technicalities about Arduino, wiring schematics about online measurements using Arduino, and troubleshooting of errors in coding for Arduino operation in order to evaluate the effectiveness of the Arduino-game based learning method.

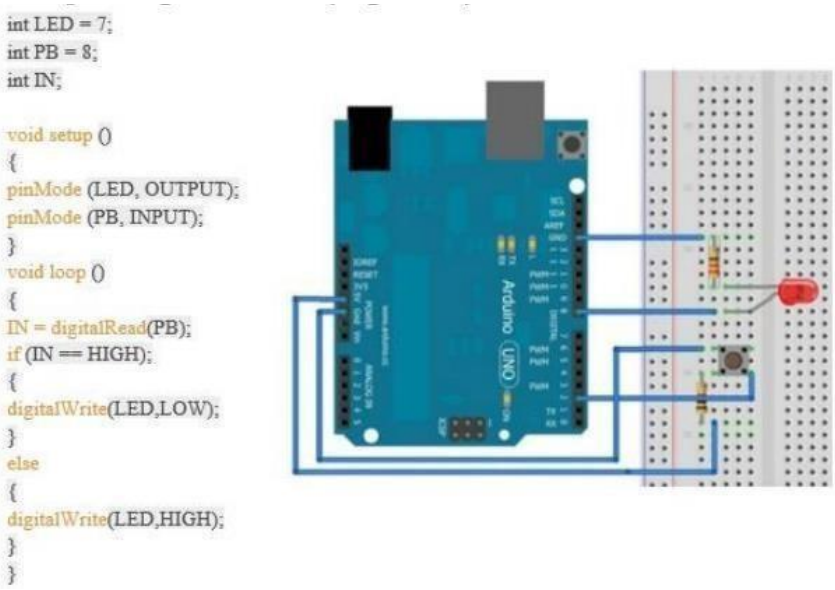

Figure 2.4 schematic and coding ‘push button’[6]

Next, research by [7] claimed that computational reasoning is a skill that is considered important in the problem-solving process in all sciences. The aim of this empirical analysis is to see how a STEM material inquiry base scenario using computational resources and educational games affects computational thought and trust. In order to meet the needs of this study, a didactic scenario was created and applied using computational methods such as the Arduino microcontroller and RGB LEDs, as well as a computational model. The increase in computational thought and trust in using computers was measured using questionnaires that were provided before and after the intervention. The results can be seen in instructional environments where STEM is integrated into the teaching series to help students gain interest in computational experiments. The philosophy of situated cognition, also known as situated learning, was used to develop a model of teaching with implications for classroom experience. They claim that having a contextual understanding of a word or idea allows for a greater understanding and the potential to use that experience in a variety of contexts.

Figure 2.5 shows the depending on the orders for motion directions, the RGB LED emits different colors. A simulation in PixelViewer was used to connect the RGB LED to the pixel's activity.

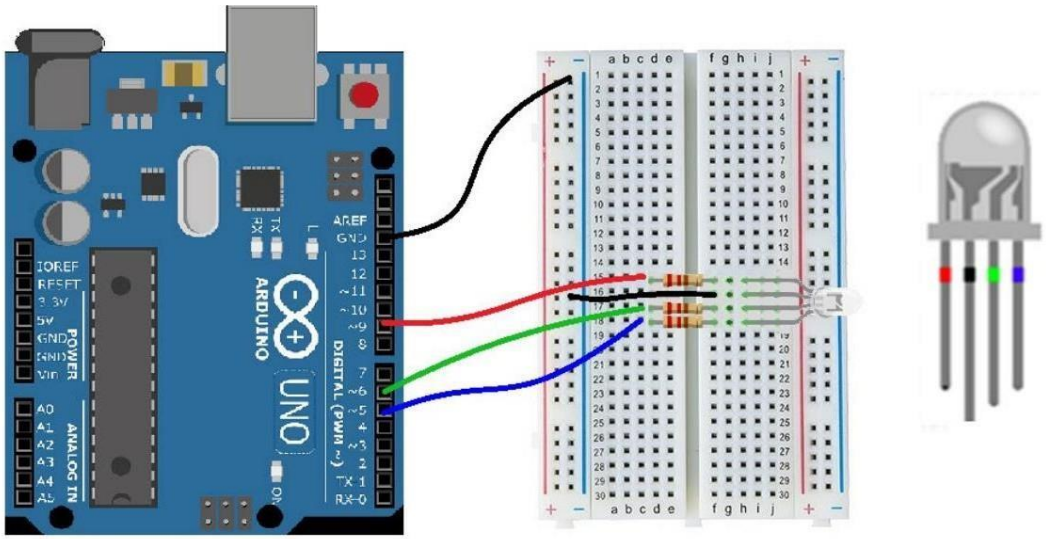

Figure 2.5 Arduino circuit and RGB LED Phase

Next, study by [8] claimed that STEM (Science, Mathematics, Engineering, and Technology) education is the study of material and expertise in the fields of science, mathematics, engineering, and technology. These four cores are the topics that encourage students to read and has a high quality of life in the twenty-first century, a fast-paced, globalized, and technologically advanced age. The four topics are critical for improving economic competitiveness, improving life quality, and ensuring national security. This statement supported by [9] which stated that he required skills for the twenty-first century were developed through the collaboration of academics from various fields. To raise the nation's potential so that it can cope with others by improving the productivity of its population. They also desired for their people to be of high quality and ability in society so that they could adapt to the fast-changing environment. Despite the circumstances and problems that arose, there were still challenges that prevented STEM teaching, learning, and activities from taking place. Due to the numerous aspects that must be incorporated throughout the four courses, it takes a significant amount of time to prepare, schedule, and

coordinate activities for STEM teaching and learning. A case study is presented here froma Lower Secondary Computer class named "Arduino STEM," which is project-based learning.

Figure 2.6 shows the circuit of the project. This project simulates in real life when staying in a house, the scenario is as follows. The temperature outside is higher than the temperature inside. Every time you return home, you must use a manual or remote control to switch on the air conditioner. This condition necessitates the use of automated control. Controlling automated opening and shutting in a variety of ways using computer technology and programming.

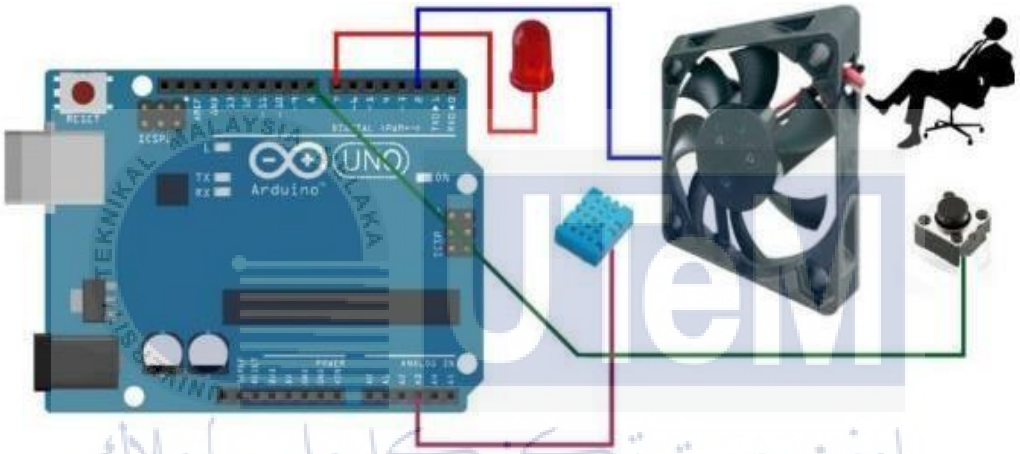

Figure 2.6 Arduino STEM (Automatic Fan) and LED [8]

Hence, [9] claimed that the experience designing, developing, and implementing Game-Based-Learning (GBL) modules based on the new Virtual Reality (VR) technology to enhance STEM education. This thesis is part of a Department of Education-sponsored ongoing programmed. A series of VR game modules, including a VR arrow-shooting game, have been created to incorporate various learning contents for various courses. During tests, students can analyse the corresponding target to determine the correct answer to each question. The teacher can conveniently create tests for various courses by essentially posting questions in this method and answers in the game's accompanying folders, though students will enjoy the exam while playing the game. The effect on the learning experience of

involving STEM courses has been surprisingly positive, according to feedback from both developers and participants. Many students took part in the testing and evaluation of the virtual reality game as an aid to engineering education. The favorable influence of this strategy in motivating and enhancing the learning process of engineering courses has been highly acknowledged by the majority of participants.

In figure 2.7, The student team's primary VR game creation method is demonstrated. The team is currently developing an arrow-shooting VR gaming module to aid in the teaching of engineering courses. Students can utilize the arrow-shooting game to study for the exam.

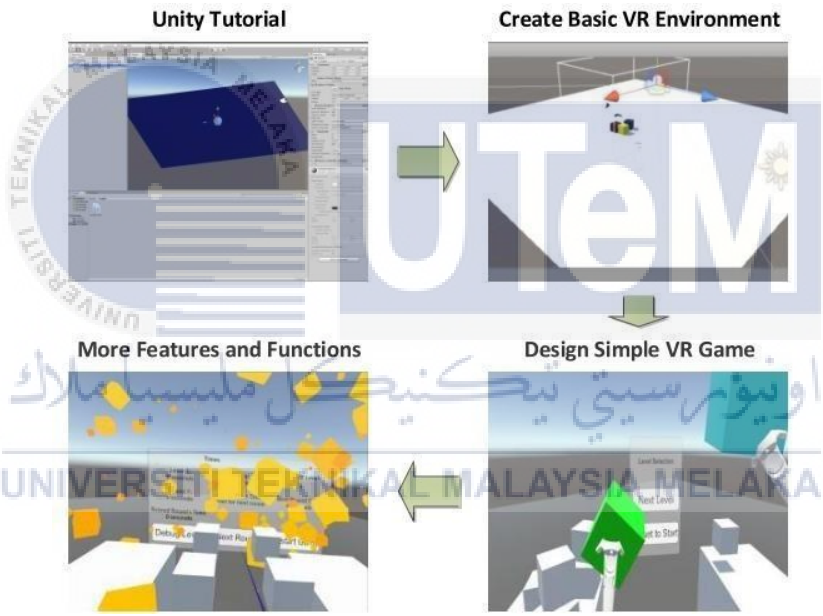

Figure 2.7 The process of VR game

In addition, [10] claimed that in terms of content, gamification level, and fair participation of girls and boys, designing a gender sensitive Science, Technology, Engineering, and Mathematics (STEM) mobile game-based learning solution (mobile GBL) is a challenge. The mobile GBL is a digital framework that uses gameplay to inspire instructional projects and events for teaching and learning purposes. For this study, the design sprint approach was used, which is a five-phase technique that incorporates design thinking concepts. Wise consultations with STEM experts, mind-mapping, prototyping, and

usability checking of the immersive version of the gender sensitive STEM mobile GBL are all part of this approach. The last validation step looked at the students' perspectives and experiences throughout the usability testing sessions. The role models included in the instructional material of the mobile GBL prototype had a favorable influence on the perception of the young students. The role model avatars that accompany students on their learning journey can be a crucial component of a successful gender-responsive STEM education. Students, both girls and boys, must be exposed to both female and male role models to build an understanding of a mentality in which both men and women may study and excel in STEM disciplines.

Moreover, the Artificial Intelligence technologies can, in the not-too-distant future, lead to a reduction in repetitive, template jobs. Like other professions, the toolkit evolves. There is a requirement for an expert to be retrained quickly and to be able to use computer technology. Separate devices and applications have also been developed to address some of the issues that arise in daily life. As a result, STEM education is one of the most in-demand fields in society.[11] The number of professional groups - robotics and programming - has increased rapidly in Ukraine over the last few years. Many of them are novel organizational structures, class types, and target audiences. Examine the current state of the demand for STEM-educational facilities in Ukraine and other countries, as well as the existing technological and methodological support for STEM-education. The experience of creating content for development, a sequence of activities that foster research attraction, and the integration of new technology into the educational process. STEM education is advancing rapidly over the world. This strategy reacts to the increased demand for engineering people and information technology professionals in society. STEM-education strategies such as practical orientation, project activities, teamwork, and research methodologies all contribute to the development of soft skills. As a result, the establishment of institutes for the

advancement of this direction is quite promising. Teachers in the region's districts have the potential to be agents of change.

Next, [12] stated that the first module created is a memory game in which players must match several lab safety-related elements. Our pupils have gotten valuable training in a variety of areas as part of the development process. Students' feedback indicates that the course module has the potential to significantly enhance their learning experience. Furthermore, the GBL module for object matching is an open template that can be readily changed for the learning of a variety of subjects at various levels, such as matching the question in one hand with the answer in the other. In this approach, the latest VR technology may considerably improve the engagement and motivation of learners ranging from elementary school to college. The second step of the VR GBL development will be the creation of a new archery game module in which the player must shoot the correct response to the question shown. This may be used to evaluate various courses. In summary, with the help of rapidly emerging VR technology, STEM students' learning will become increasingly appealing and exciting.

Figure 2.8 show the matching game diagram and the memory game GBL module's purpose is to improve the player's comprehension and awareness of those things by allowing them to interact with them in a virtual reality environment. These things are buried in uniformed cubes in the GBL module. When a cube is picked up and elevated to the necessary height during the game, an object concealed within is revealed for matching.

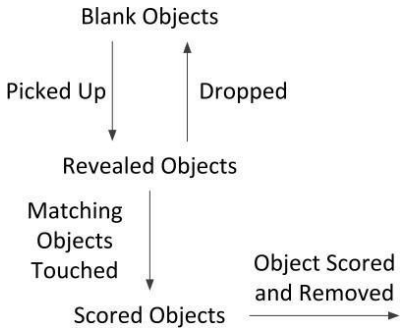

Figure 2.8 Matching game diagram

Moreover, study by [13] claimed that the goal of STEM education, which consists of science and mathematics, which are the sources of scientific data, as well as technology and engineering disciplines, which are their implementation fields, is to combine these four disciplines in order to develop students' problem-solving abilities in a holistic and constructive manner, as well as to allow them to express their ingenuity in order to obtain goods. Only professional educators armed with the requisite expertise will ensure that students achieve the above STEM benefits. Nevertheless, The teachers are less anxious and feel they can trust their supervisors, they are more willing to take chances in different learning opportunities. In fact, teachers benefit each other more by exchanging knowledge and being able to collaborate by assisting one another when they are secure in their colleagues.

Then, design and design thinking are essential for creativity and innovation, and they are becoming particularly relevant in the ongoing push to create and introduce integrated STEM education. It is based on previous studies on design and design thinking, and it discusses how students' learning and design thinking can be enhanced by design practises in not only engineering and technology, but also other disciplines and integrated STEM education.[14] Professional designers and engineers create their identities through specialised training and years of experience, and their design efforts often result in useful end-products. In mathematics and science, well-established information systems and procedures have long been regarded as necessary for students to learn and apply as facts, procedures, and skills.

Furthermore, the transformation of the STEM higher education system to follow a pathways model to a STEM career is essential to increasing the number and variety of individuals entering STEM professions. The (STEM)2 Network accomplishes this by encouraging faculty to change the structure from inside[15]. Though cultural change in

STEM higher education is difficult, the (STEM)2 Network explicitly tackles those obstacles by bridging disciplinary and structural silos and using the existing system's reward framework to help staff as they try to change it. Just 23% of STEM specialists had both of these metrics, compared to 61 percent who had just one and 16 percent who had none. Also, among students who declare an interest in pursuing a STEM degree and thereby seem to be following a pipeline model, less than 40% go on to complete it.

In the same way, [16] found that game learning improves learner interaction, introduce abstract ideas, and explore computational thought through STEM learning games and game design. The reasons for using STEM learning games with teenagers have grown more sophisticated over the time span covered by the articles reviewed. Students from non-dominant groups can display improved interest and potentially better learning outcomes when academic material incorporates linguistic signals, values, and practises from their cultures, according to studies on culturally specific pedagogy [16].

In addition, two methods to improve STEM education, study groups and development and implementation of STEM activities. To assess the improvements in students' science process skills and STEM knowledge, the Scientific Process Ability Test and STEM Awareness Scale were used as a pre-test and post-test.[17] The students' perspectives on STEM activities were gathered through a semi-structured interview form in the study's qualitative component. The convenience-sampling approach was used from purposeful sampling methods to assess the sample group. Status sampling, which is commonly used in qualitative analysis, is simple to use and saves time and money. Each activity lasted two weeks (4 lessons) and included the topics of light diffusion, reflection in mirrors, refraction of light, optics, mirrors, and lens use. Each practice begins with a scenario based on a real-world engineering challenge.

Moreover, the current thesis attempts to resolve the lack of agreement about how STEM learning and teaching can be combined. To do so, researchers conducted a thorough study of emerging literature on learning theories and teaching methods in integrated STEM. Furthermore, a paradigm for teaching methods in integrated STEM was developed based on the findings of the systematic review. Radical constructivism, on the other hand, claims that learning is socially situated, and that understanding is built by contact with others). Students learn by creating personal representations of the universe based on their perceptions and encounters with the environment, according to social constructivism. As a result, cognitivism considers the pupil to be an active participant. A theoretical foundation for the instructional activities in the context is established by first completing a comprehensive study of current literature [18].

Hence, the study by [19] stated that, attendance at educational institutions is a critical factor that is always a source of worry, attendance is used to assess a student's academic performance or commitment to pursuing a degree. As an educational institution, Klabat University, in this case at the Faculty of Computer Science. Attempting to manage attendance as efficiently as possible so that timely, precise, and accurate information may be obtained. At the time of implementation, MIT App Inventor was up and operating. Can develop Android applications for usage on Android smartphones. Google Apps Script may send commands to Google Docs Spreadsheet files directly. The .Apk extension file may be immediately downloaded and installed on an Android smartphone using the MIT App Inventor. Applications can yet be improved for example, as suggested by the author, features such as a login function to determine who oversees scanning and a function to add profile images to the database might be included. Because barcodes are still used, future improvements can rely on RFID or NFC cards to prevent barcode scanning. This is

preferable since there are times when the barcode is difficult to read since the barcode writing on the card begins to fade or is erased, making the scanning procedure more difficult.

Figure 2.9 shows the Android Platform, which includes an operating system, middleware, and apps, is an open-source software architecture supplied by the Open Handset Alliance. In terms of functionality, Android integrates characteristics that can be found on every mobile device platform today, such as reuse of the application framework, an integrated browser, optimized graphics, media support, network technology, and others.

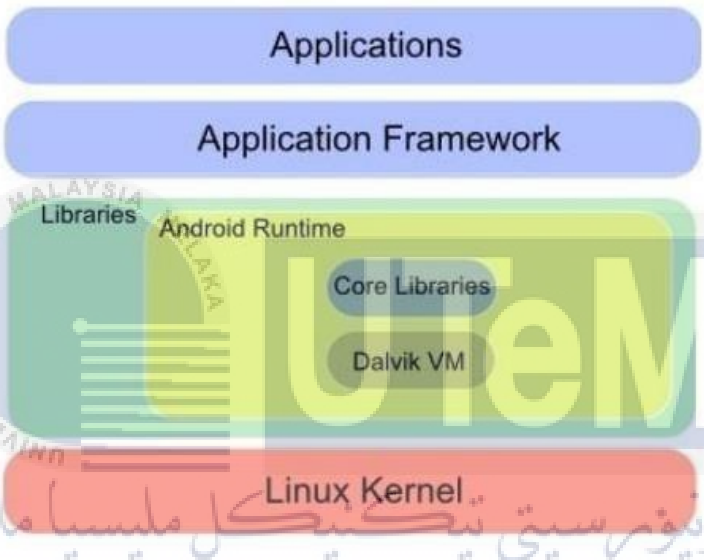

Figure 2.9 The structure of Android application

Next, students giving the opportunity to build during natural and mathematical cycle lessons is one of the most effective ways to improve their enthusiasm and interest in engineering careers. Their creative outputs can be useful in today's world. Due to a variety of factors, it is difficult to implement such programs in conventional physics and mathematics classes [20]. At the intersection of academic disciplines, the most interesting theories and innovations will emerge. Pupils can learn the fundamentals of robotics and computer science, in addition to introductory subjects, through the STEM curriculum. When students build and configure their own robots, they would need to know physics and

mathematics. The students are engaged in the artistic process with the aid of STEM technology, where they discover new information based on previously acquired experience. Furthermore, students should often rely on the teacher's assistance in solving realistic or science problems. As a result of their participation in this project, the student gains new experience.

Moreover, research by [21], stated that the ability to solve problems, in essence, learning to think or learning to reason, namely thought or reasoning, extends newly acquired experience to new problems that have never been experienced. A person will take steps related to the problem-solving method to solve the problem at hand. There are five stages or steps that students must complete in order to solve problems, namely imagine the problem, define the problem in physics, prepare the solution, implement the plan, check and test . Students' physics problem-solving skills are increased by using effective learning methods and techniques, such as problem-based learning models.

2.3 Comparison of the research review

Table 2.1 Comparison of keypoints between articles

No	Title	Authors/Years	Platform	Keypoint
1.	Quizzes: Quiz Application Development Using Android-Based MIT APP Inventor Platform	[2]	MIT APP Inventor	• Focuses on the creation of Quizzes • Allows users to prepare multiple choice questions
2.	'Electree' as Android Mobile Learning Application based on Arduino Project	[3]	Arduino UNO	• Create an Android mobile learning application for junior high school • Educate children about science aids their creation of 21st-century skills
3.	Using design thinking to cultivate the next generation of female STEAM thinkers	[5]	Design thinking	• Female youngsters who took part in the workshop showed increased interest in engineering • Better creative confidence, more favourable opinions of STEM, better levels of empathy and pro- social characteristics

4.	Learning Electricity using Arduino-Android based Game	[4]	YWRobot, Arduino Uno	• Study on the impact of STEM learning implementation on 8th-grade students' STEM literacy
5	Arduino for Chemical Engineering Students via Game-based Learning	[6]	Arduino	• Teach chemical engineering students about Arduino, a gamebased learning strategy
6	The impact of a stem inquiry game learning scenario on computational thinking and computer selfconfidence	[7]	Arduino	• Encourage the use of inquiry-based scenario tools for STEM subjects (Arduino)
7.	Teaching PLC Timers and counters programming using MIT App-Inventor	[22]	MIT App Inventor	• To create Android-based mobile applications for teaching and learning. • Within the programming languages for programmable logic controllers, timers and counters are quite important.
8.	Experience of foundation STEM school	[11]	Arduino, C++ programming	• The youngsters have mastered the programming environment, sensor functioning, structure construction, and can make their own designs.

9.	A Case Study of Mobile Game Based Learning Design for Gender Responsive STEM Education	[10]	Design Sprint	• The educational content was blended with gamification and game features and characteristics (avatar) using the input-process-outcome workflow. • To raise awareness of a mentality that allows both men and women to study and work in STEM disciplines
10.	How to Apply Technology in STEM Education Lesson by Project Based Learning	[8]	Arduino UNO	• Understanding many types of technology • Simulation and the ability to view mathematics as a representation of science
11.	Key-Value Store Implementations for Arduino Microcontrollers	[1]	Arduino	• The IonDB key-value store provides a set of data storage structures that may be simply deployed by a user without requiring knowledge of the storage infrastructure. • The Arduino family of devices' initial key-value storage API.

12.	Design and Develop of Virtual Reality Game based Examination for STEM Education	[9]	Viryual Reality (VR)	• Students have received complete instruction in programming using high-level languages as well as useful experience in software development as a result of the production of the VR game, which has benefited their profession and career growth significantly.
13.	On the exploration of game-based learning in STEM education with the development and application of virtual reality course modules	[12]	Virtual Reality (VR)	• The object matching GBL module, is an open template that can be readily changed for the learning of many disciplines at all levels, such as matching the question in one hand with the answer in the other.
14.	Improving educational process quality in the lessons of natural and mathematical cycle by means of stem-training	[20]	Arduino	• STEM serves as a motivator for engaging learning, with outstanding experiments, colourful guiding demonstrations, and the solution of intriguing scientific and practical challenges.

15.	Implementation of Google Apps and Mit App Inventor on Android Based Real Time Attendance Report Application	[19]	MIT App Inventor, Adobe Photoshop CS6, Microsoft Office 2016, Google Chrome Browser	• In terms of application testing, MIT App Inventor is more user-friendly. It can test using the given default emulator or with alternative options, such as an emulator installed on an Android-based smartphone. • Control, logic, math, text, lists, colours, variables, and procedures are all part of the Block Programming idea.
16.	Integrated STEM Education: A Systematic Review of Instructional Practices in Secondary Education	[18]	systematic review	• It is necessary to conduct a comprehensive study of the impacts of integrated STEM, as applied in this framework, on students' cognitive and emotional learning outcomes.

17.	STEM Learning Games and Game Design in ITEST Projects	[16]	Gamestar Mechanic	• When academic curriculum integrates language clues, values, and traditions from the students' communities, students from non-dominant groups may exhibit enhanced interest and perhaps improved learning results.
18.	Design and Design Thinking in STEM Education	[14]	Design thinking	• Students may learn and develop design thinking through the design of STEM education, and students can benefit from integrated STEM education through design practises. • Higher-order thinking abilities, and the engineering design project activity, it outscored pupils studying the technological education module.

19.	The (STEM)2 Network: a multi-institution, multidisciplinary approach to transforming undergraduate STEM education	[15]	System design	• This transition must incorporate the STEM career pathways concept, which is more practical and inclusive than the old pipeline approach.
20.	The effects of STEM education on scientific process skills and STEM awareness in simulation based inquiry learning environment	[17]	Visualize design	• STEM education might provide a variety of advantages, including developing imagination, raising class interest, giving professional and academic growth, and boosting self-confidence.

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2.4 Summary

This chapter covers different analyses and methods that may be utilized to construct Game-Based Learning. According to the research, there are a variety of software options for developing the game, including MIT App Inventor, C++ programming, and Arduino. These software for developing apps often used at educational area. It is also beneficial to learners to improve their skills and understanding by using game software.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter will describe the system that will be used to raise the proposed proposal. ‘Development of Interactive Physics Game App for STEM Education using Android Studio' is the title of the proposed project. This research is based on specific phases of a venture that were properly conducted to achieve the objectives. For the objective and procedure necessary to ensure that the device functioned properly. The hardware element of this project is compiled of electronic parts, while the software component is constructed of software that would be used to compile the source code. The figure shows how this project through out from selection material, construct product and design project. By reffering to the block diagram, the prototype project will be produced.

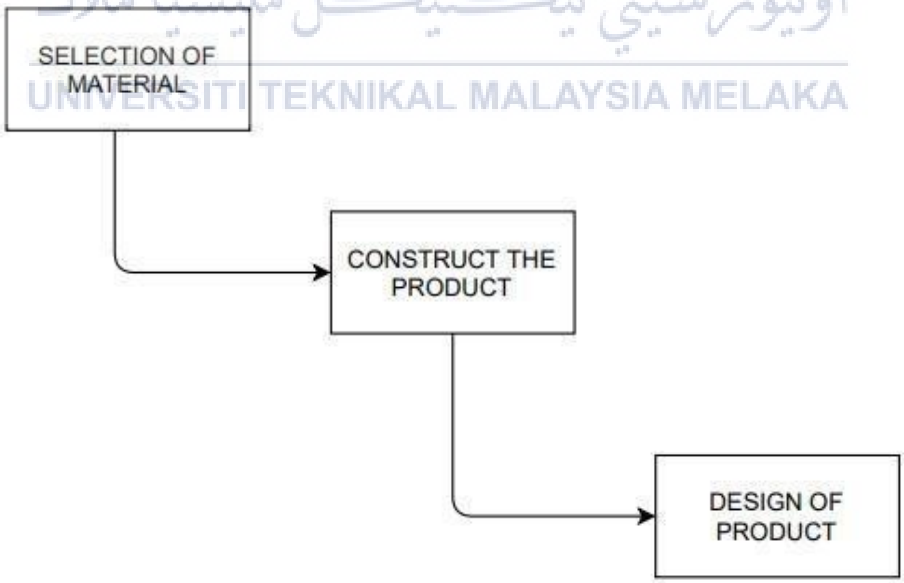

Figure 3.1 flowchart to design the project

3.2 Project Planning

Project planning is a project timetable that includes a thorough procedural plan. The process planning was displayed in a succinct flowchart. As described in figure, with a brief and clear structure of the flowchart. The researcher was able to complete the project without difficulty, and the able to comprehend the flow of the procedure.

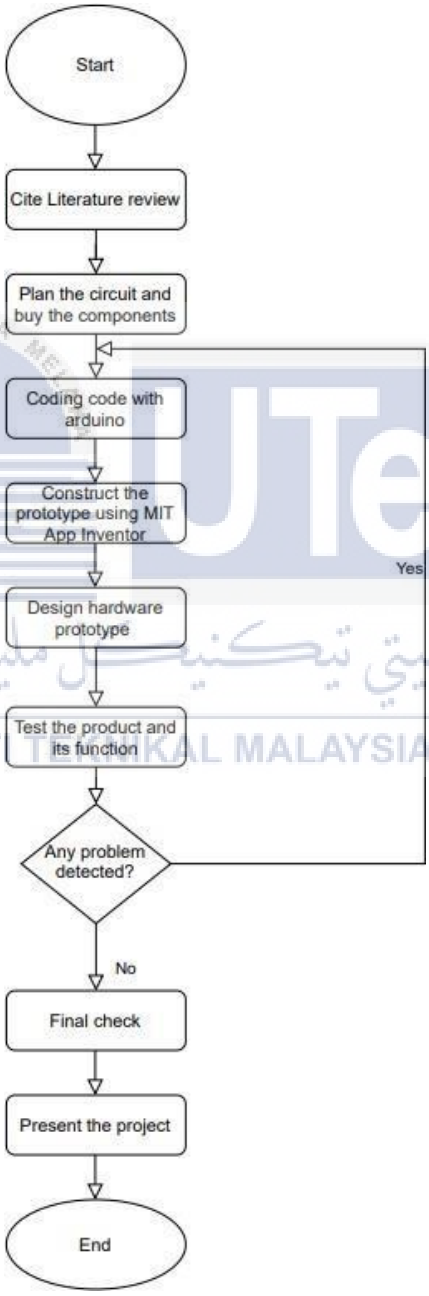

Figure 3.2 project estimation general process flow

3.3 Design of the project

A few similar literature evaluations have been published, as well as approaches for developing the prototype. Aside from that, the project has identified and detailed the system's operating idea. The project's flowchart may be seen below. The hardware and software components of the project's design may be shown on the chart.The project will follow as the flowchart below.

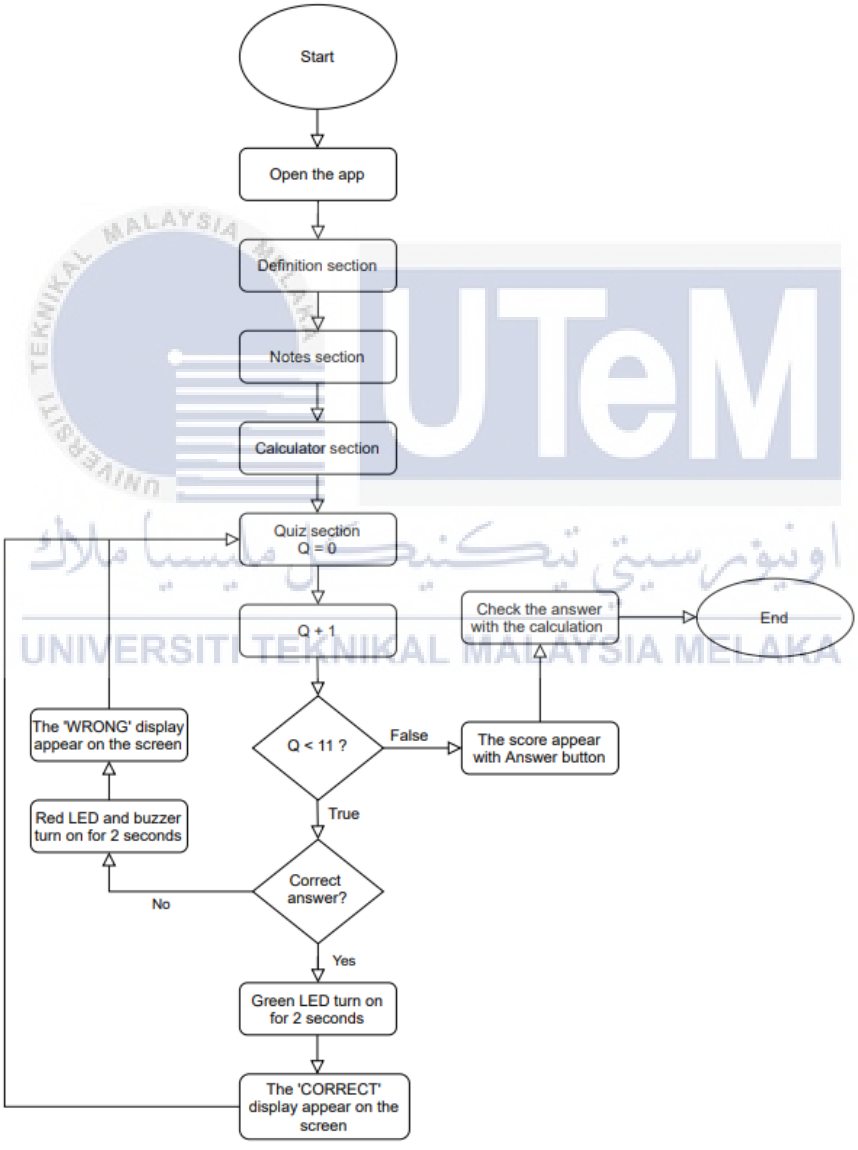

Figure 3.3 Design of the project flowchart

3.4 Hardware Application

Hardware construction is one of the most important aspects of a project's design, since it determines what sort of hardware components will be used. This would be essential for the development of the project's prototype. The hardware, which includes Arduino UNO R3, Light Emitting Diode (LED), Buzzer, Diode, Voltage Regulator, Resistor, Capacitor and HC-05 Bluetooth modulde.

3.4.1 Block diagram for hardware implementation

A block diagram is a graphical description of a system that shows how the system works. The rectangular pieces that make up a block diagram give the diagram its name. It was once used to express processes as well as to describe hardware systems. The answer from MIT App inventor will go into Arduino UNO R3. The Arduino will process the answer and the output from the Arduino will turn on the LED and buzzer within the answer. If the answer is correct, the green LED will turn on and proceed to next answer and if the answer is incorrect, the red LED and the buzzer will turn on.

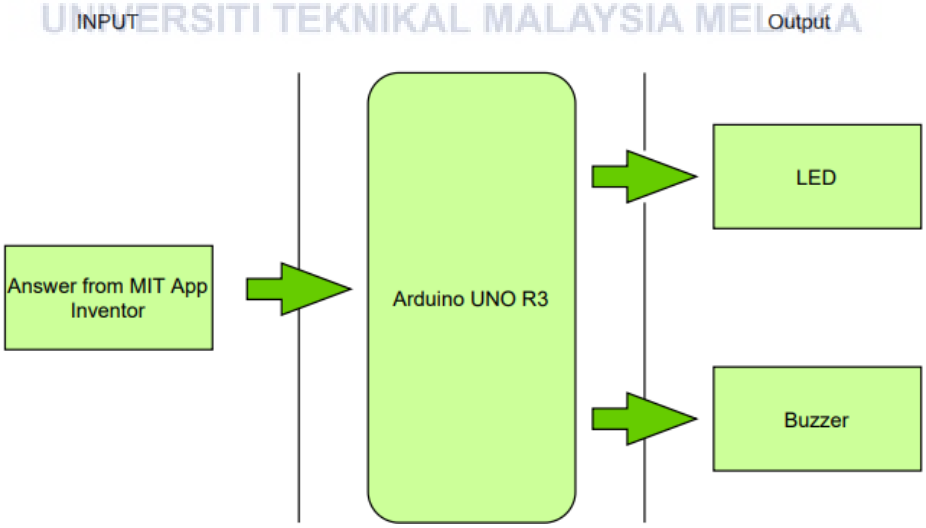

Figure 3.4 Block diagram of hardware implementation

3.4.2 Arduino UNO

The Arduino Uno is a microcontroller board based on the ATmega328P. It comes with everything that need to support the microcontroller. To turn on the Arduino, just plug it into a PC via USB and power it up with an AC-DC adapter or a battery to getstarted. The Arduino Uno R3 is the third and most recent version of the Arduino Uno. The Arduino board and IDE applications are the reference versions of Arduino, which are currently being updated. The Uno-board is the first of a series of USB-Arduino boards, and it is the Arduino platform's reference model. It has 14 I/O pins with 14 digits. 6-pins may be used as PWM outputs from these pins. This board has 14 optical input/output pins, six analogue inputs, a USB connection, a quartz crystal (16 MHz), a battery jack, a USB connection, a resonator (16Mhz), a power jack, an ICSP header, and a RST button. This board's key features include DIP (dual-inline-package) availability, detachability, and an ATmega328 microcontroller. This board's programming can be quickly loaded with an Arduino computer application. This board has a lot of help from the Arduino network, so it will be more easier to get started with embedded electronics and a lot of other stuff.

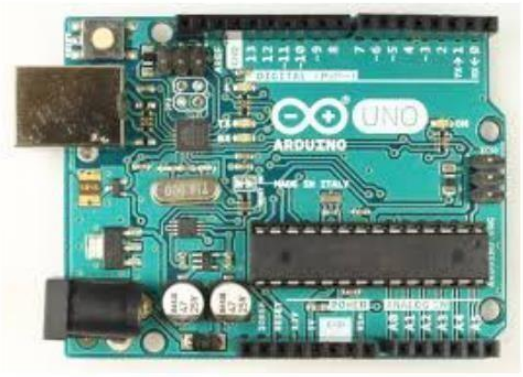

Figure 3.5 Arduino UNO R3

3.4.3 Light Emitting Diode (LED)

Light emitting diode (LED) is used as a prototype, which turns on when the answer is right and turns off when the answer is incorrect. When used for a long time, light emitting diode (LED) uses less power and does not get hot.

Figure 3.6 Light Emitting Diode (LED)

3.4.4 Buzzer

When a voltage is delivered to a buzzer, it produces an audio signal in the circuit. Mechanical, electromechanical, and piezoelectric are only a few of the numerous types of buzzers. The buzzer is made up of an outer shell and two pins that connect it to power and ground. The ceramic disc contracts or expands when electricity is delivered to the buzzer. This causes the discs around it to vibrate.

Figure 3.7 Buzzer

3.4.5 Resistor

A resistor is a passive electrical component that creates resistance in the passage of electricity. They may be found in practically all electrical networks and electronic circuits. In ohms, resistance is measured. When a current of one ampere travels through a resistor with a one volt drop between its terminals, the resistance is measured in ohms. Resistors are utilised in a variety of applications. Delimit electric current, voltage division, heat production, matching and loading circuits, control gain, and establish time constants are only a few examples of resistor.

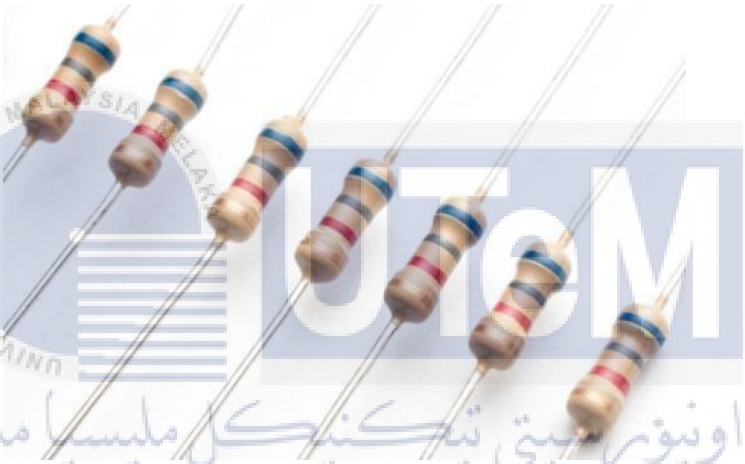

Figure 3.8 Resistor

3.4.6 Diode

A diode is a semiconductor device that functions as a current one-way switch. It permits current to flow freely in one direction while drastically restricting current flow in the other. Because they convert alternating current (ac) to pulsing direct current (dc), diodes are also known as rectifiers (dc). The type, voltage, and current capability of diodes are all rated. Anode (positive lead) and cathode (negative lead) establish the polarity of a diode (negative lead). When positive voltage is given to the anode, most diodes enable current to flow.

Figure 3.9 Diode

3.4.7 Voltage regulator

A voltage regulator that outputs +5 volts is the LM7805 Voltage Regulator. The last two digits of the number are a simple way to recall the voltage output of an LM78XX series of voltage regulators. A LM7805 has a "05" at the end of its name, indicating that it produces 5 volts. The "78" is simply a convention used by chip manufacturers to designate a series of positive voltage regulators. Pin 1 (Input Pin) takes the incoming DC voltage, which is then reduced to 5 volts by the voltage regulator. Pin 2 (Ground) is the pin that connects the regulator to the ground. The controlled 5 volts DC is connected to Pin 3 (Output Pin).

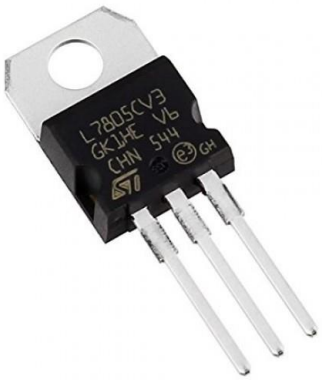

Figure 3.10 Voltage Regulator

3.4.8 Capacitor

A capacitor is an electrical component that stores energy in the form of potential. Positive and negative energy are stored on two distinct plates separated by an insulator in capacitors. A capacitor is made up of two metal plates with an insulator between them. One of the most essential characteristics of a capacitor is its capacity to resist voltage variations. When the voltage applied to a capacitor is abruptly changed, the capacitor's voltage changes more slowly than the applied voltage.

Figure 3.11 Capacitor

3.4.9 HC-05 Bluetooth Module

The HC-05 Bluetooth Module is a simplified Bluetooth SPP (Serial Port Protocol) module that enables the creation of a transparent wireless serial link. It interfaces with a controller or PC through serial transmission, making it simple to integrate. Designed to be used instead of cable connections The HC-05 communicates with the electronics through serial communication. Typically, it is used to transmit files between tiny devices such as mobile phones over a short-range wireless connection. It operates at a frequency of 2.45GHz. The data transfer rate may range from 1Mbps to 10Mbps and is within a 10-meter range. The

HC-05 module may work with a power source of 4-6V. It may also be used in Master-Slave mode, which means it will neither send nor receive data from other sources.

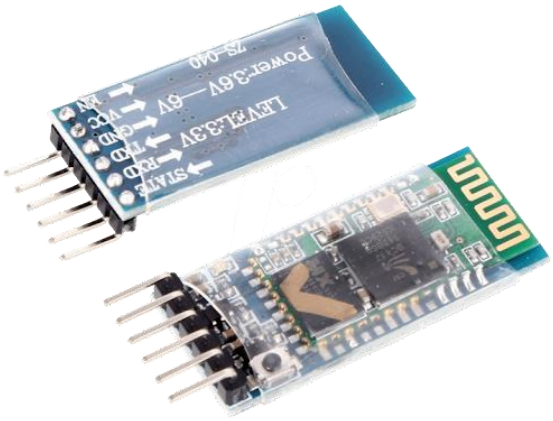

Figure 3.12 HC-05 Bluetooth module

3.5 Software Application

To proceed on with the project, the implementation requires software. The reason for this development is that it provides data for testing the project before it is put into the hardware. There are a few software that are used for this project which is MIT App Inventor, Arduino IDE and Emulator AI2.

3.5.1 Flowchart of software implementation

A flowchart is a graphic representation of a procedure, method, and computer algorithm. From the flowchart, starting from the beginning it will show the menu of the apps. The user will be given 3 options to choose, that is notes section, quiz section and calculator section. The notes section contains definition of the topic with the formula, quiz section contain question about the topic that user can answer and calculator section for user to do some calculation.

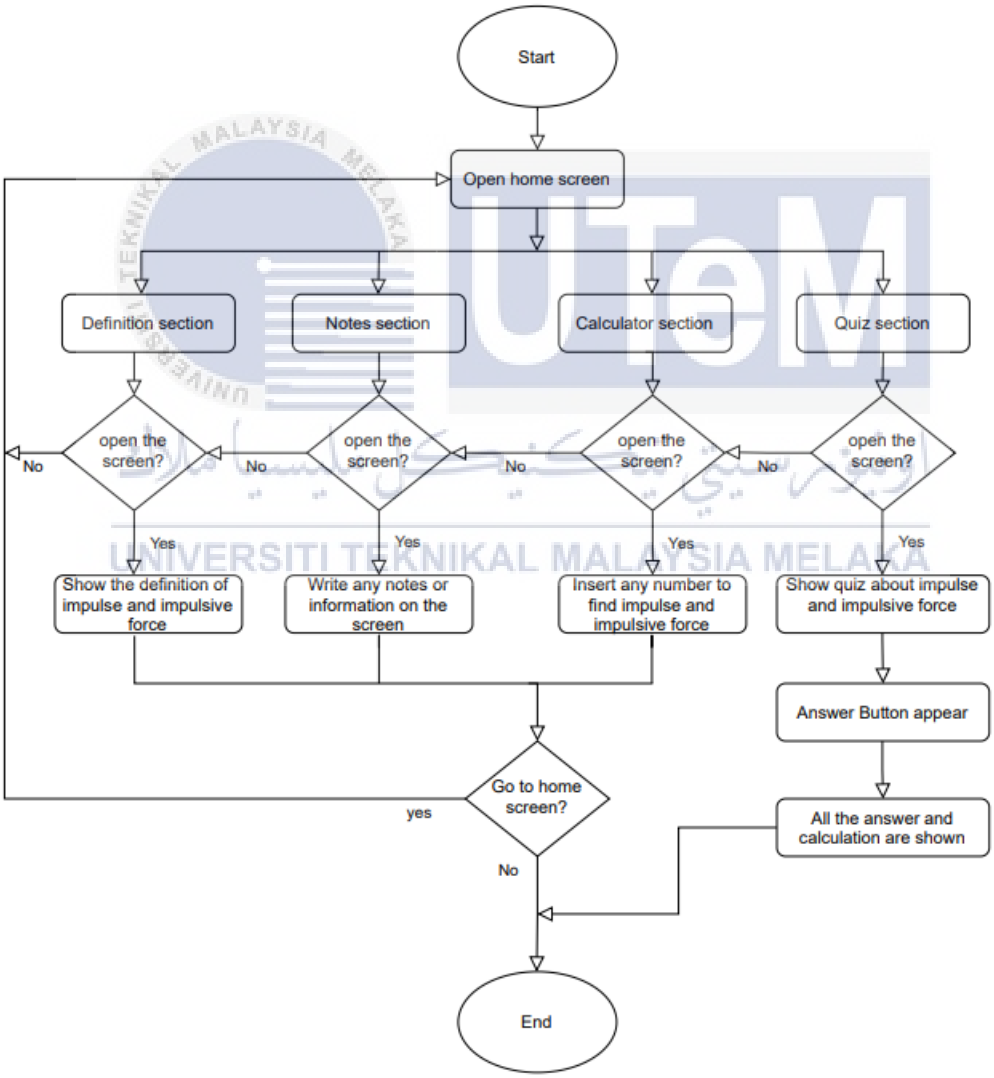

Figure 3.13 Flowchart of the software implementation

3.5.2 MIT App Inventor

MIT App inventor develop applications for Android and IOS phones using a web browser and either a connected phone or emulator. The App Inventor servers store thework and help to keep track of the projects. The App Inventor can be built by the App Inventor Designer and the App Inventor Blocks Editor where it selected the components for the app and where it assembles programme blocks that specify how the components should function. Mac OS X, Linux, and Windows operating systems as well as several popular Android and IOS phone models, are all supported by the App Inventor development environment. App Inventor-created applications can be installed on any Android and IOS devices.

Figure 3.14 MIT App inventor

3.5.3 Arduino Integrated Development Environment (IDE)

The Arduino Software (IDE) includes a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions, and a series of menus. It connects to the Arduino hardware, allowing it to upload and communicate with programmes. Sketches are programmes created with the Arduino Software (IDE). These sketches were created in a text editor and saved with the .ino file extension. Cutting and pasting, as well as

searching and replacing text, are all available in the editor. The message area displays errors and provides feedback while saving and exporting. It can verify and upload programmes, create, open, and save sketches, and open the serial monitor using the toolbar buttons.

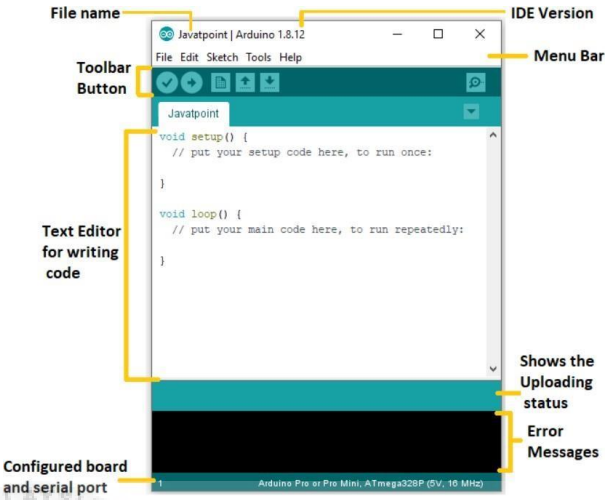

Figure 3.15 The Arduino Software (IDE)

3.5.4 Emulator AI2

App Inventor may be used to create apps even if do not have an Android phone or tablet. App Inventor includes an Android emulator that mimics the functionality of an Android device but displays on your computer screen. As a result, it can be used as an emulator to test the apps while still distributing them to others.

Figure 3.16 Emulator AI2

3.6 Summary

The methods for completing this project are discussed in this chapter. This chapter also covers the software and hardware that have been used to create the application. The flow chart is then used in this chapter to comprehend the system flow. As a result, for Hardware and Software development, comprehensive investigation into the design process was required. Data was collected and analysed, then simulations were run to establish whether the program was successful.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter discusses the overall project result that we observed and obtained from the project. This section is important since it shows if the objectives, hypothesis, courseware effectiveness, and prototype project usability were accomplished or not. Expected outcome, preliminary result, and total result are all covered in the results. Before getting the real outcome, every project will have an expected result. The findings for each area will be reviewed and developed on throughout this chapter.

4.2 Software Result

Software and hardware are used to create this prototype. MIT App Inventor, and Arduino IDE are used to create the software for this project. The game app for this project will be developed in MIT App Inventor, the code programme will be developed in Arduino IDE before being transferred to Arduino UNO. The Result will be shown in the smartphone screen with four sections, the introduction for the subject and its definition, notes to write infromation, a built-in calculator with the formula to calculate the questions, quiz, and scoreboard to show the mark for the user.

Based on the Figure 4.1, it shows the developer mode in MIT App Inventor. The app has been created using this software. Several inputs and outputs were utilised to build this prototype project, which may perform a variety of functions. The app are the system's input, while the speaker and LEDs are the system's output. The system was pre-programmed using the Arduino IDE.

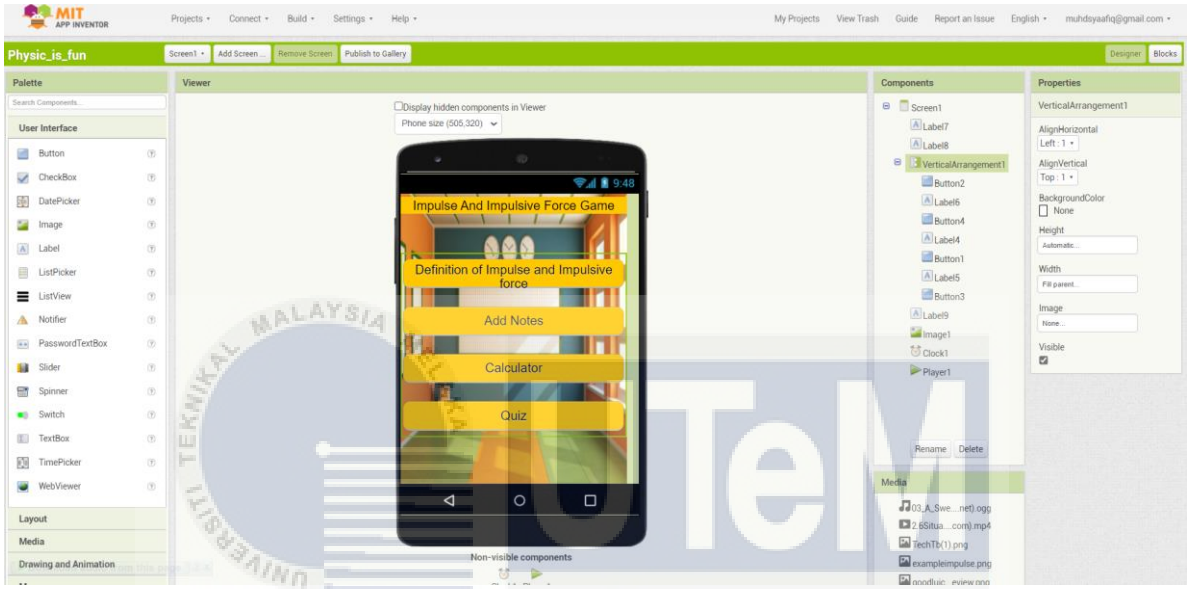

Figure 4.1 Developer mode in MIT App Inventor

Figure 4.2 represents the game app's screen menu, which includes the title of the game app and four buttons, which is the definition of the subject, add notes, quiz, and calculator. Depending on whatever button the user clicks, each button will take them to a different screen.

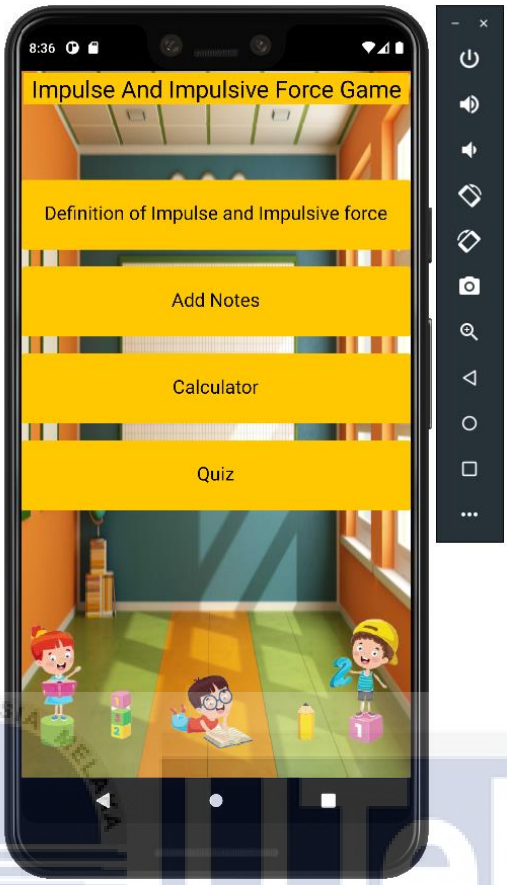

Figure 4.2 Menu screen for application

Figure 4.3 depicts the concept of impulse force, as well as the formula and example questions for the topic. The 'Back button' and the 'To Impulsive Force button' are the only buttons on this screen. The user returns to the menu screen by pressing the Back button. The following screen of impulsive force notes that have the same design, the definition of impulsive force, the formula, and example questions will appear when the user clicks the Impulsive Force button. This screen also includes a video that explains impulse and impulsive force in greater detail.

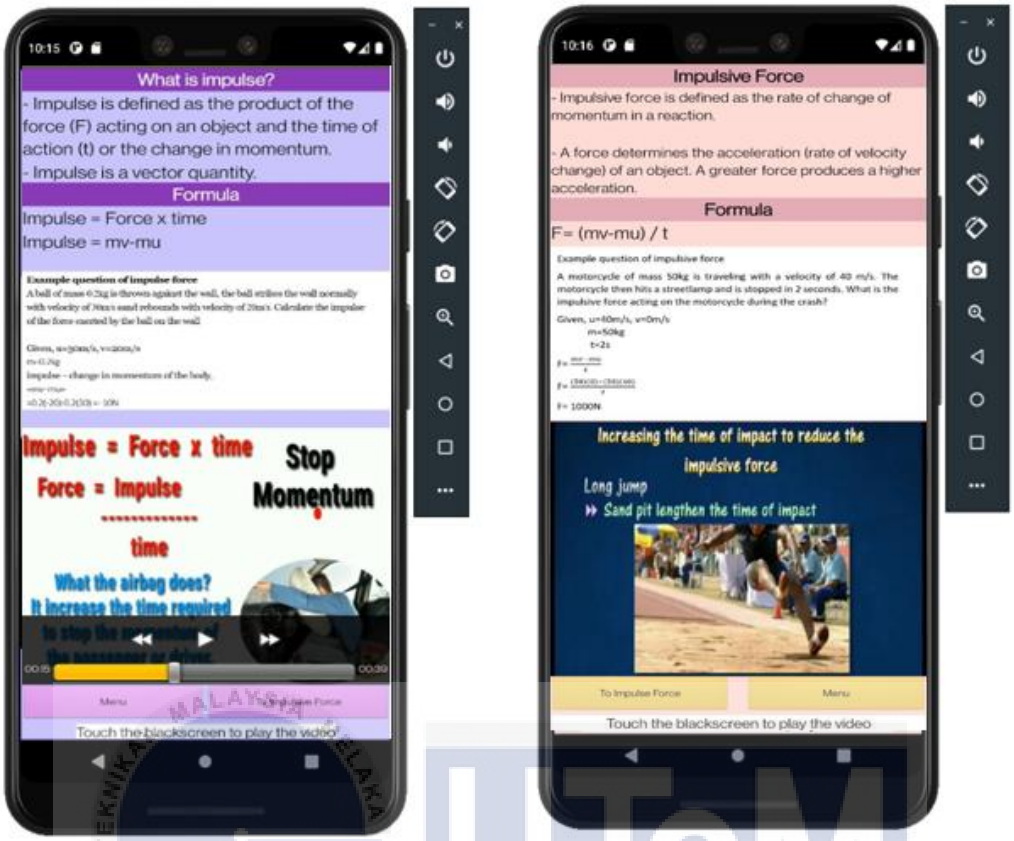

Figure 4.3 Definition of impulse and impulsive force screen

Figure 4.4 shown the notes screen for the game application. This notes section will act as a notepad. To use this notes, user can write anything and it can be stored in the apps by click the Save button. The notes will remain in the app even if the user logs out. The Home Screen button will lead to screen menu.

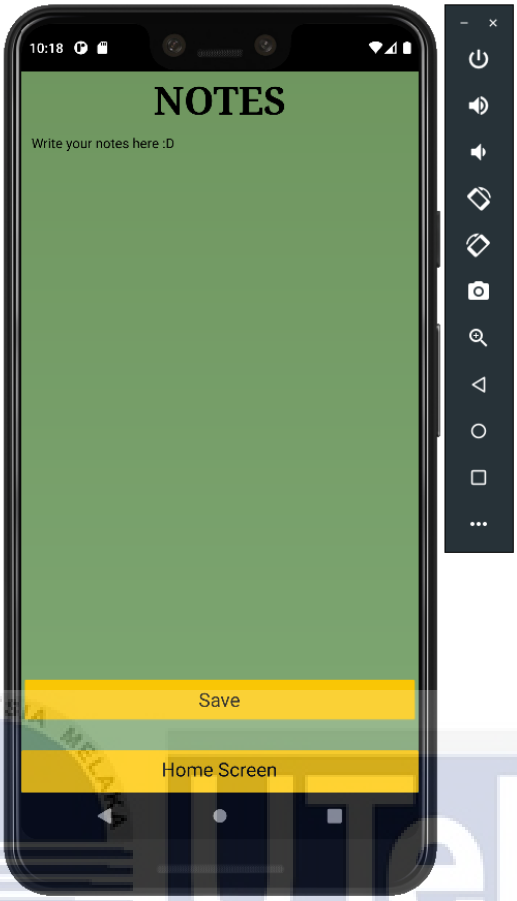

Figure 4.4 Notes screen

Figure 4.5 represents a calculator screen with three different sorts of formulas. Impulsive Force have two formulas and Impulsive Force has one formula. The function of all the calculator screens is to determine the force. The white box includes a suggestion that will assist the user in using this calculator part. To obtain the result, the user must enter the data and then click the Calculate Result button. The SI unit was already present in the solution result to assist the user's understanding of the formula.

Figure 4.5 Calculator screen

The Quiz screen is shown in Figure 4.6. The Bluetooth button, guidance button, submit button, next button, and answer button are among the five buttons on the app. The guidance button will assist the user in navigating the quiz part. The Bluetooth button will link the user to the hardware. The submit button is used to determine if the user entered the correct or incorrect answers. The next button advances to the next question, while the answer button moves to the screen with the answer and calculations on it. The users are given ten questions to answer. The scoreboard and the feedback from the score screen will show when the user has completed the quiz. It will display the marks or score that the user received. The feedback results are shown in table below according to the score mark.

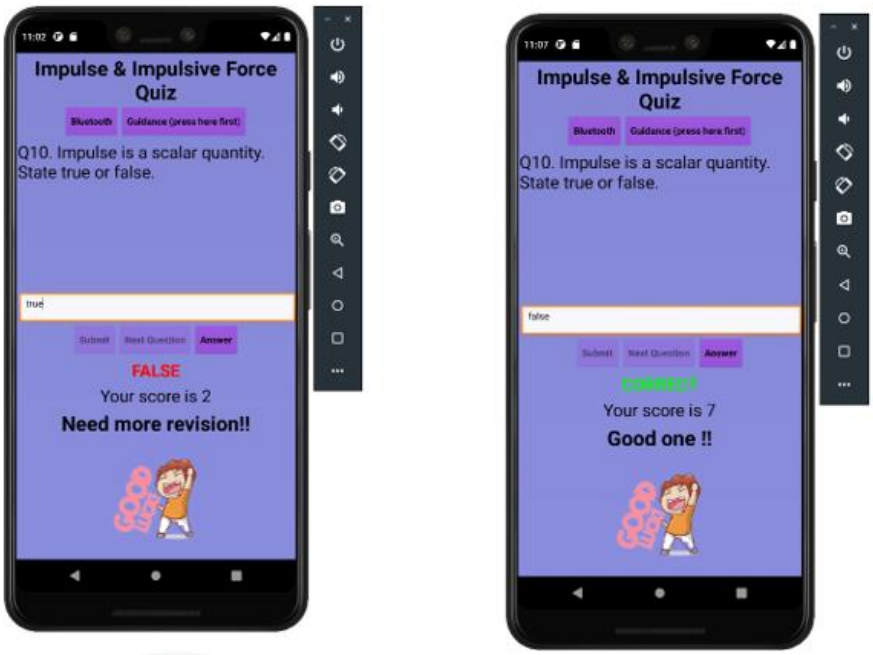

Figure 4.6 Quiz screen

Table 4.1 : Feedback results based on ScoreBoard

ScoreBoard	Feedback
1-2	Need more revision!!
3-5	Try harder!!
6-7	Good one !!
8-10	Excellent!!

The feedback findings based on ScoreBoard are shown in table 4.1. Based on the score between 1-2, 3-5, 6-7, and 8-10, there are 4 different types of feedback. Each score has its own set of feedback for the user. This feedback will appear below the Score mark after users had answered all ten questions.

Figure 4.7 displays the answer screen selected by the user at the quiz screen. There are 10 pictures and three buttons on this screen. The user may use the previous and next buttons to navigate back and forth between the answer and the calculating method. The previous button is being used to view the previous answer, while the next button used to view the next answer.

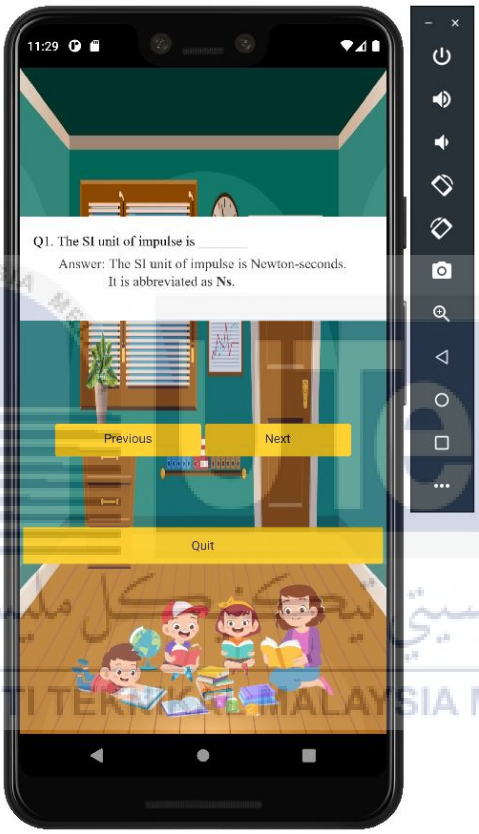

Figure 4.7 Answer screen

4.3 Hardware Results

The hardware project consists of a collection of functions that can display the gaming app's output results. Each function has a different input and output. The circuit was first built on a bread board, and then troubleshooting was carried out. The circuit then was placed onto an Arduino shield board to finish the project.

Based on the figure 4.8, these are the components that attached on the breadboard to testing the prototype. By using HC-05 Bluetooth module, it will be serial communication between the apps and the hardware. A buzzer and two red and green LEDs are included in the Arduino shield, as well as female header pin connections for the Bluetooth module. The power supply used is AC to DC power supply to make the Arduino UNO well performance. A voltage regulator will be used to convert the supplied voltage to 5 volts. The Arduino Uno board is instead powered up as a result of this signal. The power expansion rail's 5V pin can be used to access the 5V generated here. Two capacitors and a ceramic capacitor are used. Bypass capacitors are the name for these capacitors.

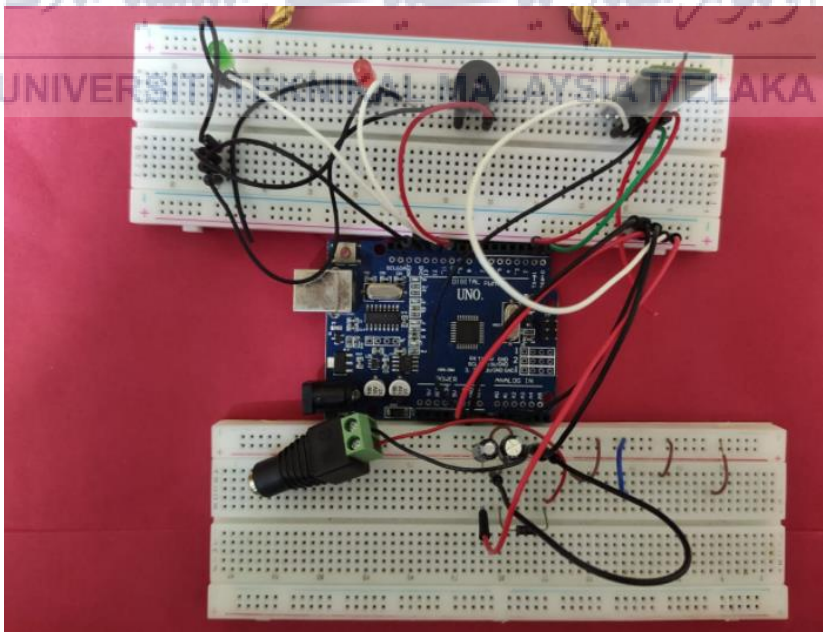

Figure 4.8 Construction components on a breadboard

Figure 4.9 will show the hardware components after solder on the shield board. Several run and testing have been done to prevent the components take damage. This prototype will produce the result output from LED and buzzer.

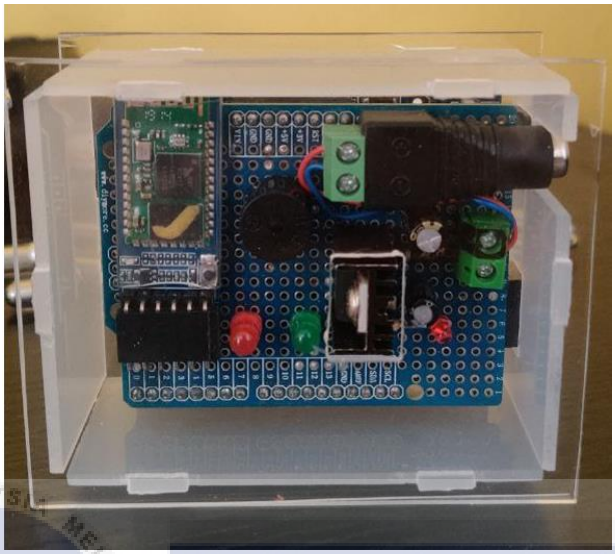

Figure 4.9 Component after solder on shield board

Figure 4.10 shows the prototype result of the project when the correct and wrong answer had been enter at the application. There were 2 different output on the screen,LED and buzzer

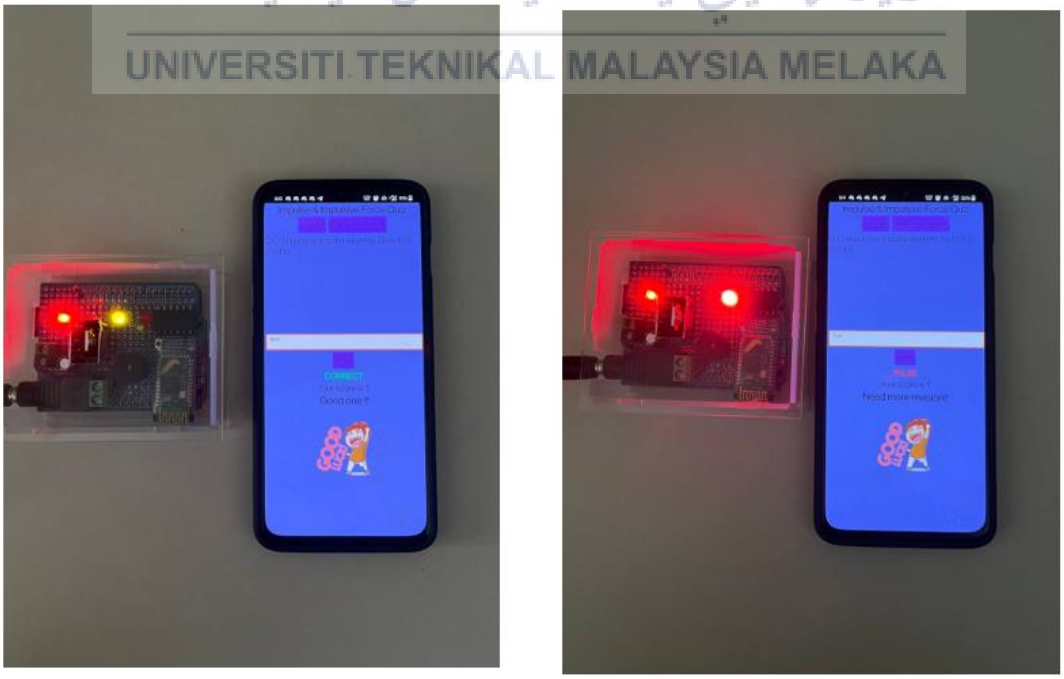

Figure 4.10 Result from the prototype

Table 4.2 The result at the Arduino UNO

Answer in the game app	Colour of the LED lighten up	The sound of the buzzer
True	Green LED	No sound produced
False	Red LED	Produced sound

The summary of this prototype may be provided in Table 4.2. The working concept of Arduino is to convert the result into LED and buzzer is shown in Table 4.2. The Bluetooth device must be connected first to the mobile app to link the result to the Arduino UNO. After that, a few questions from the app will appear and need to be answered by user. When the user enters an incorrect answer, the red LED and the buzzer will turn on. The “WRONG" sentence will be shown on the screen as well. When the user enters correct answer, the green LED will turn on when the word "CORRECT" appears on the screen. It indicates that the user was able to successfully answer the quiz. The LED and buzzer will turn on for 3 seconds before turning off.

4.4 Data and Analysis

This part will be reviewed using a Google form poll with a limit of 100 responses. This section goes through into the application's discovery in further information. The results were obtained using a Physics gaming applicatiom. This survey consists of five questions on the development of a mobile STEM education application.

Figure 4.11 shows the respondents knowledge about STEM education. From 100 respondents, 59 percent understanding the STEM education while 41 percent doesn't know about it. This app will provide information about STEM education. It also met the criteria because this application will help people to learn more about STEM education.

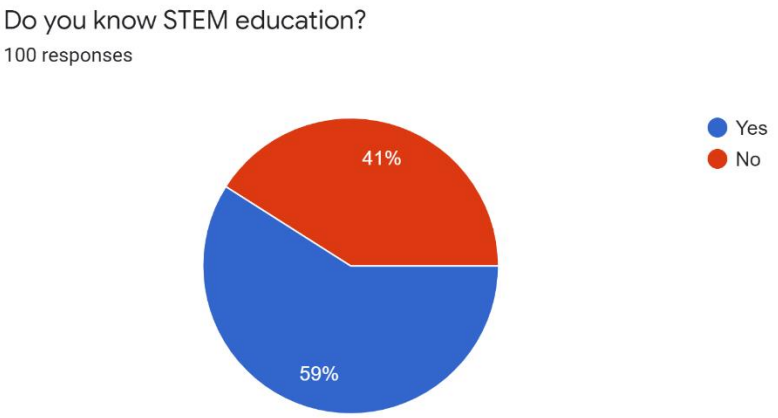

Figure 4.11 Pie chart about STEM education

According to Figure 4.12, The MIT App Inventor software had been known to 42 percent of the 100 respondents, while the remaining 58 percent had never heard of it. The majority of those polled had never heard of the MIT App Inventor before. MIT App Inventor is more of an instructional tool for teaching youngsters how to programme than a professional tool for developing real application. As a result, it's unlikely to be utilised in the development of anything useful.

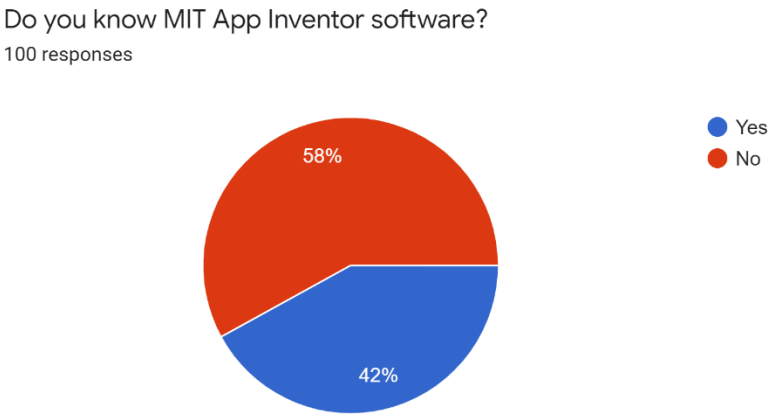

Figure 4.12 Pie chart about MIT App Inventor

Based on figure 4.13, this chart explain is it the app help respondents to increase their understanding about STEM education. About 11 respondents voted very excellent, 47 respondents voted good, 41 respondents voted the app as average while 1 respondent rated the app as very poor to help understanding about STEM education. From the survey, the application succeeds and achieved the objectives for this project.

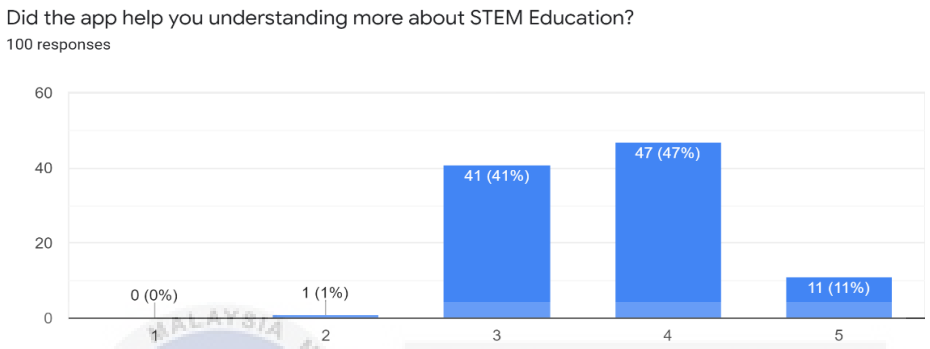

Figure 4.13 Chart responses to understanding more about STEM education

From Figure 4.14, the majority of people considered the application seems to be of good quality, with 11 percent saying it was of really top standard. 66 percent shows that the app is almost good quality when using it. 22 percent received an indifferent rating, indicating that their quality was neither high nor poor, and 1 respondent rated the app as poor. The data showing that the product fulfilled expectations.

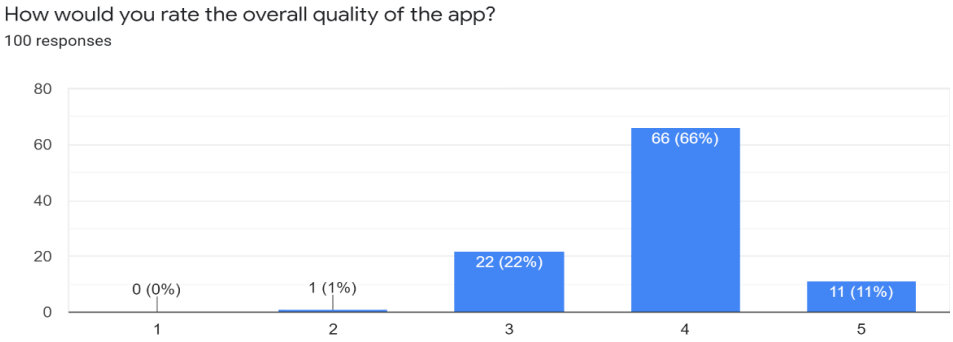

Figure 4.14 Chart responses for overall quality of the app

From Figure 4.15, 98 percent of respondents said they would recommend the app to a friend or coworker. This application offers various benefits to everyone since it is extremely user-friendly. In my opinion, want to recommend the application to their friends or coworkers since it allowed them to understand it quickly. There were just 2 percent of respondents who didn't intend to recommend the product to their friends.

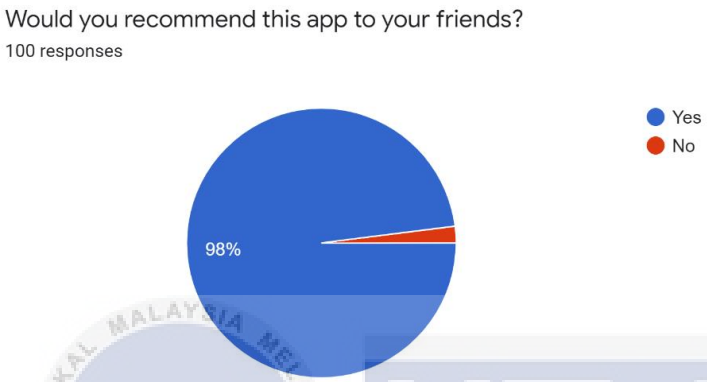

Figure 4.15 Pie chart responses to recommendation to their friends

4.5 Summary

The MIT App Inventor and Arduino UNO are aimed to aid people in the field of STEM education by providing a variety of applications. Each component of this prototype has a unique purpose. The coding was sent to the arduino through IDE software. The Bluetooth module connects the arduino to the prototype. The game apps provide information about the subject with the notes of definitions, calculator and quiz to be answered. The answer from the quiz can be answered after connecting the bluetooth to mobile phone. The prototype component will operate and respond to the answers in the app by turning on the LED and buzzer. While this is carrying on, the phrases 'Wrong' and 'Correct' will display on the screen. Almost all of the questions in the survey corresponded to the project's criteria and objectives.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

To sum up, this chapter concludes based on the research and outcomes acquired. Several improvements for the future should be addressed. STEM education will be presented through an interactive mobile gaming app. Software and hardware are required to develop this project. The hardware component is integrated with the IDE integration platform. The Bluetooth module is used as a wireless component of the device system to connect software and hardware components.

Furthermore, the first objectives of this project are to study recent technology for STEM education. There has been a lot of research and studies done so that all of the functions of the components may be comprehended before they are built into the hardware. Each system built has its own unique way of working whereby it fulfills the objective's requirements. In addition, by using MIT App inventor software, an interactive physics game app had been developed successfully. With the implementation of this game app, the project will be able to give the opportunity to fully supporting students in STEM education, particularly in the topic of physics subject. As a result, the project goal has been fulfilled.

Hence, the performance of a prototype project with multiple output results using MIT App Inventor software was tested based on the analysis. With the assistance of the Bluetooth module, the prototype project able to connect with the game application. The third objectives for this project, which is to develop apps for STEM using MIT App Inventor with Arduino UNO had been achieved.

5.2 Future Works

These are suggestion for improvements that could be made to improve the game app's performance. The current model may be upgraded as a consequence of technological advances by using a Wi-Fi module. Because Wi-Fi provides a quicker connection, a longer range from the base station, and greater wireless security than Bluetooth, it is better suited for running full-scale systems. When the user used this game application, long-range connectivity will be required to connect to the Arduino. Furthermore, MIT App Inventor have limitations. Although the user interface designer has improved, it is still unstable and restrictive, preventing users from creating any user interface. Users cannot make apps with many displays, and handling orientation changes has some difficulties. As a result, a new platform is required to improve performance. Android Studio is the most suitable software maker android to replace MIT App Inventor. Due to its open-source platform, it makes mobile app creation simple. Android Studio is a tool for developing Android apps that is particularly designed to expedite the process. Android Studio is the ideal IDE for stability. Because it is much more expandable, it improves the developer's experience.

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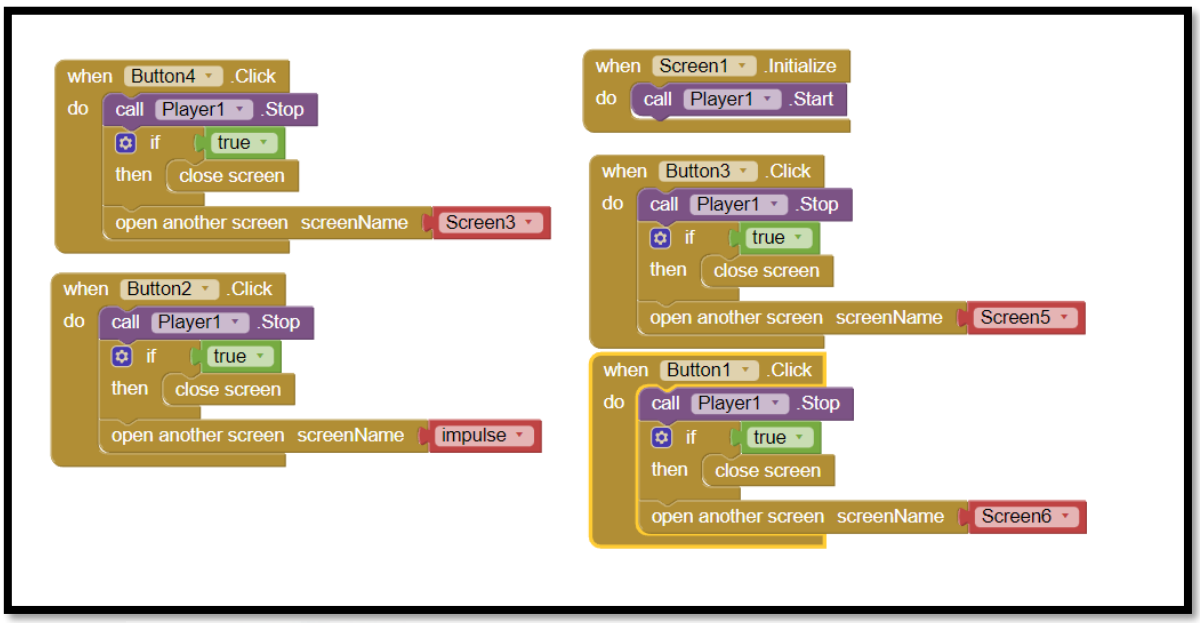
APPENDICES

Appendix A

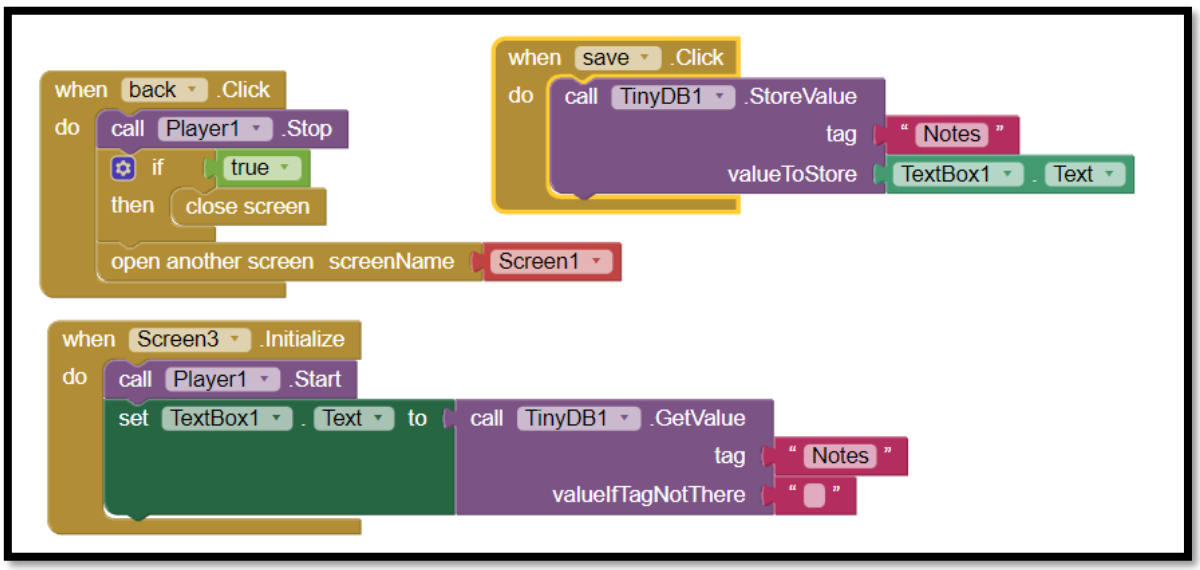
```
-Program: Arduino.exe
-Microcontroller : Arduino UNO
-Function : To shows the correct and wrong answer using LED and Buzzer
char Incoming_value = 0;
int greenLED = 13;
int redLED = 12;
int buzzer = 11;

void setup()
{
  Serial.begin(9600);
  pinMode(13, OUTPUT); //Green LED
  pinMode(12, OUTPUT); //Red LED
  pinMode(11, OUTPUT); // buzzer pin 9


}

void loop()
{
  if(Serial.available() > 0)
  {
    Incoming_value = Serial.read();
    Serial.print(Incoming_value);
    Serial.print("\n");
    if(Incoming_value == '1'){
      digitalWrite(13, HIGH);
      delay (2000);
      noTone(11);
      digitalWrite(13, LOW);
  }
    else if(Incoming_value == '0'){
      digitalWrite(12, HIGH);
      tone (11,200);//freq200Hz
      delay (2000);
      digitalWrite(12, LOW);
      noTone(11);
    }
  }
}
```

Coding Block for Menu screen

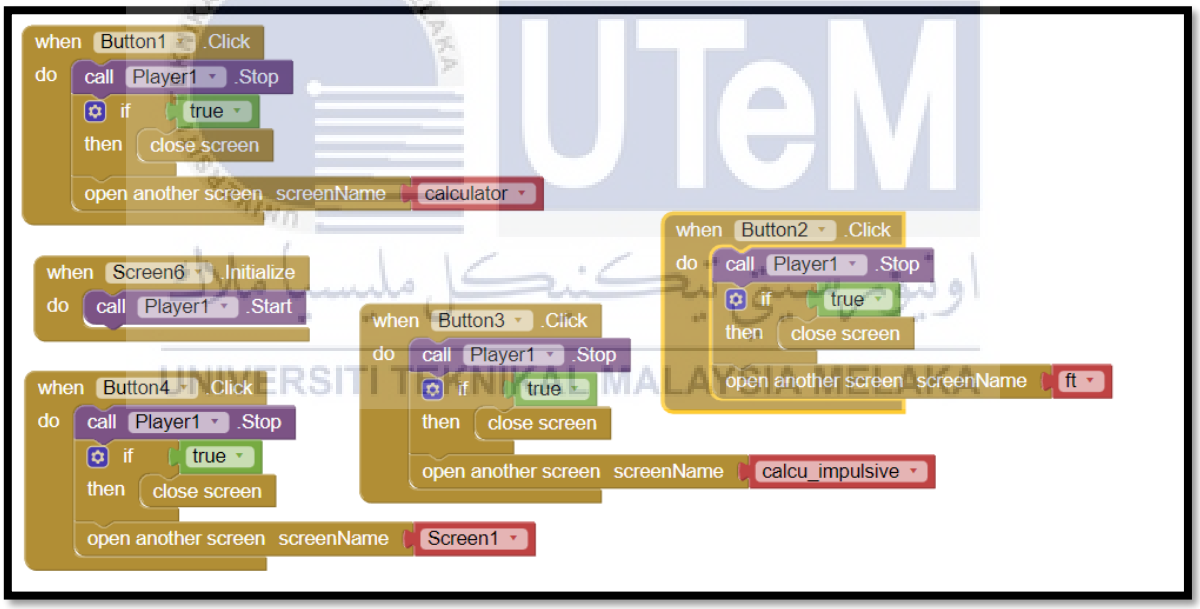


Coding Block for Answer Section

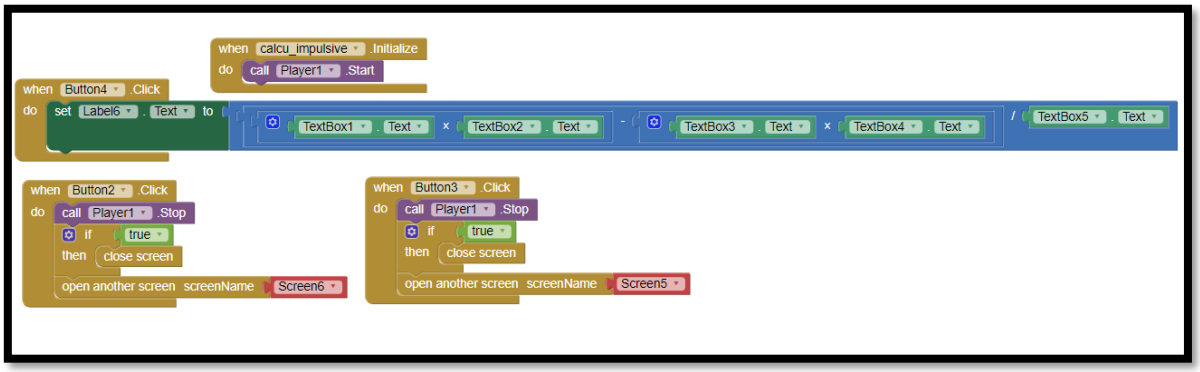
Coding Block for Notes Section

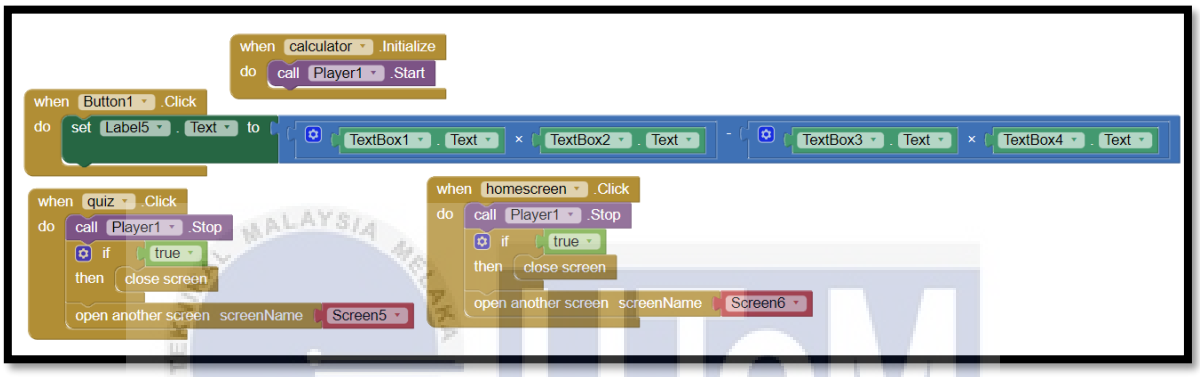


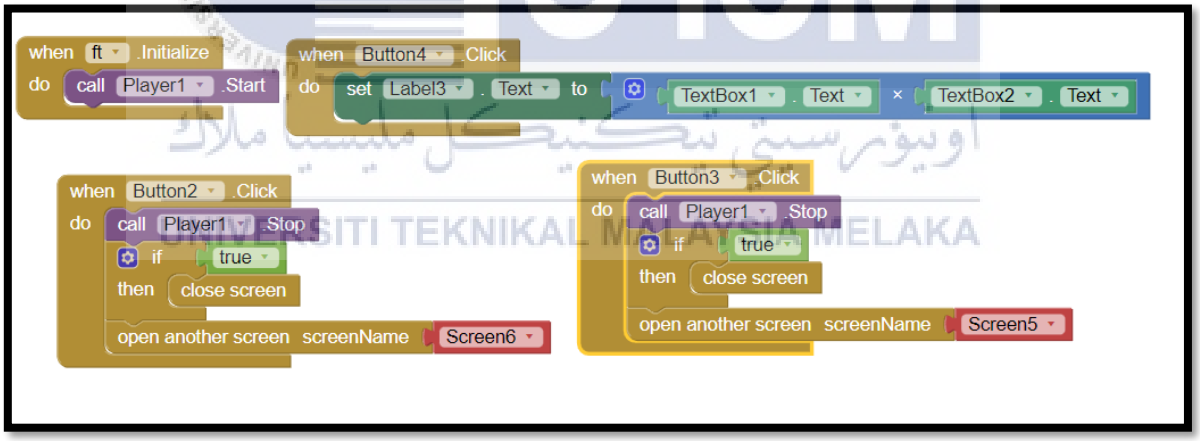
Coding Block for Choosing Calculator Section



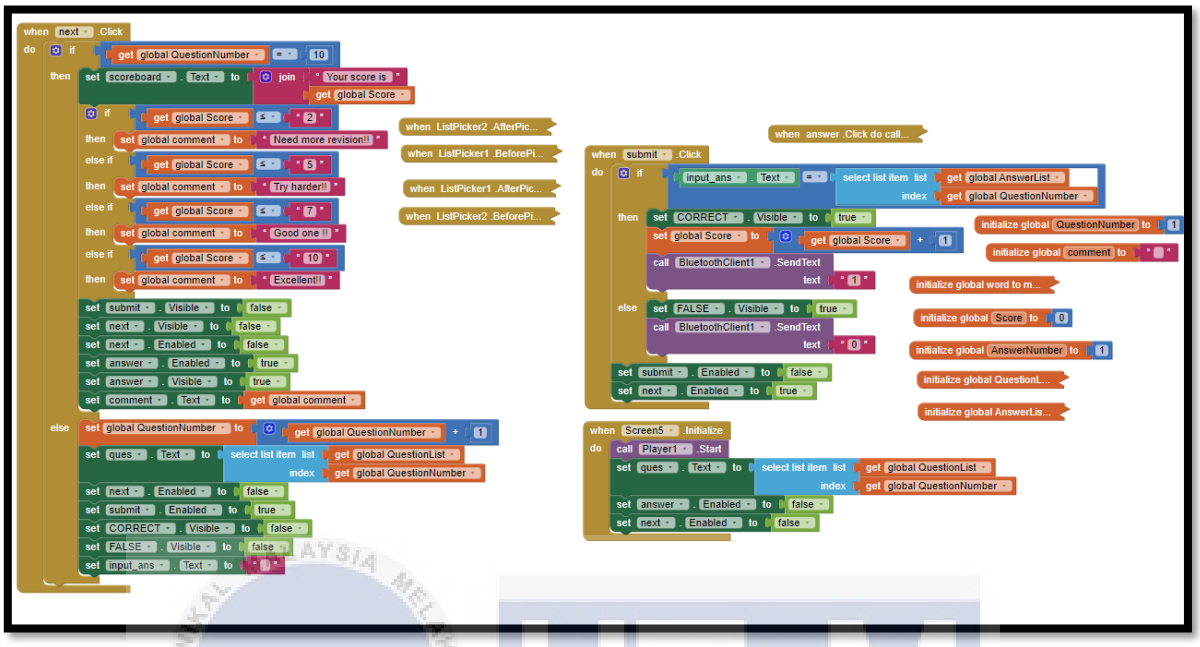
Coding Block Calculator Section



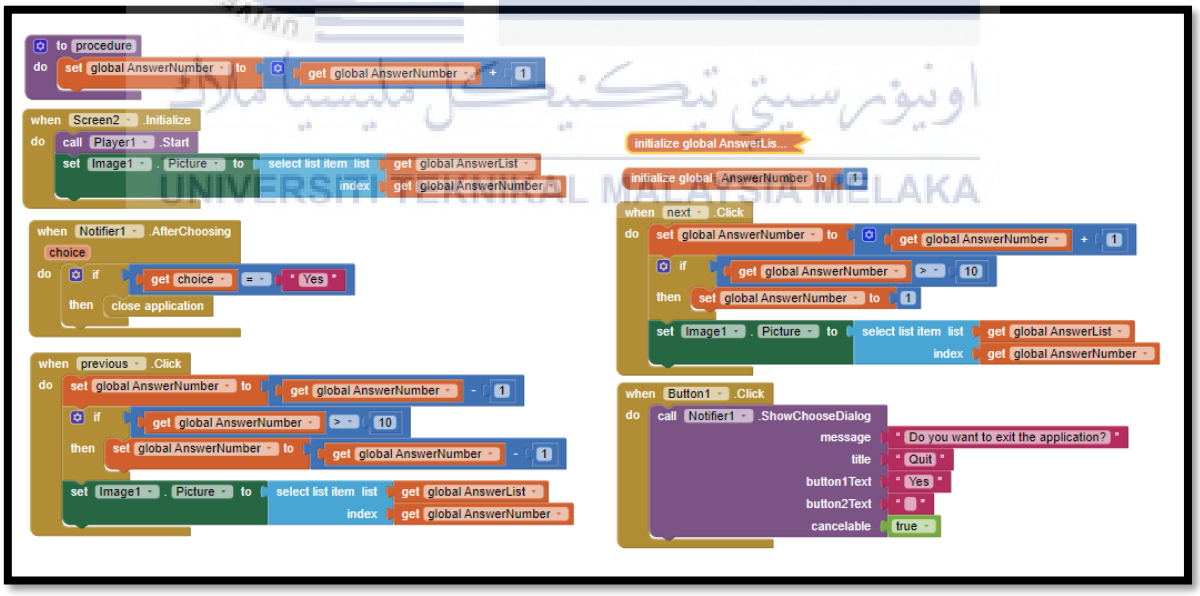




Coding Block for Quiz Section



Coding Block for Answer screen



Appendix B

Survey for feedback application

1. Gender
    - Male
    - Female
2. Races
    - Malay
    - Indian
    - Chinese
    - Others
3. Age
    - 18-23
    - 24-29
    - 30-35
    - 36 and above
4. Do you know STEM education?
    - Yes
    - No
5. Do you know MIT App Inventor software?
    - Yes
    - No
6. What was your first impression of the app?
    - 1 – Very poor
    - 2 – Poor
    - 3 – Normal
    - 4 – Good
    - 5 – Very good
7. Did the app help you understanding more about STEM Education?
    - 1 – Very poor
    - 2 – Poor
    - 3 – Normal
    - 4 – Good
    - 5 – Very good
8. How would you rate the overall quality of the app?
    - 1 – Very poor
    - 2 – Poor
    - 3 – Normal
    - 4 – Good
    - 5 – Very good
9. Would you recommend this app to your friends?
    - Yes
    - No

Appendix C

Gantt Chart for PSM 2021 /2022

Project Activities	SEM 1 2021 /2022															SEM 2 2021 /2022													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Topic Selection																														
Title registration																														
Meeting and with Supervisor																														
Literature Review																														
Project objectives, problem statement, scope project																														
Project Design																														
Methodology for project																														
Testing Prototype																														
Evaluate Analysis																														
Troubleshoot the problem																														
Survey Feedback																														
Collection of Data																														
Final checking for the project																														
Presentation																														
Submit Report																														