

**LEARNING SAINS (JIRIM) USING AUGMENTED REALITY (AR)
TECHNOLOGY FOR CONCRETE VISUALIZATION OF
CHARACTERISTIC AND CONCEPTS OF JIRIM**



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN

JUDUL: **LEARNING SAINS (JIRIM) USING AUGMENTED REALITY TECHNOLOGY FOR CONCRETE VISUALIZATION OF CHARACTERISTIC AND CONCEPTS OF JIRIM**

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**LEARNING SAINS (JIRIM) USING AUGMENTED REALITY (AR)
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This report is submitted in partial fulfillment of the requirements for the
Bachelor of [Computer Science (Interactive Media)] with Honours.

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2020/2021

DECLARATION

I hereby declare that this project report entitled
**LEARNING SAINS (JIRIM) USING AUGMENTED REALITY (AR) TECHNOLOGY
FOR CONCRETE VISUALIZATION OF CHARACTERISTIC AND CONCEPTS OF
JIRIM**

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I hereby declare that I have read this project report and found
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SUPERVISOR

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Date : 22 JUN 2021

DEDICATION



ACKNOWLEDGEMENTS

Firstly, I would like to show my gratefulness to Allah S.W. T's blessings and giving me strength and healthy body especially during this pandemic season to complete the project development for PSM 1.

I also would like to thank my supervisor, Dr. Ibrahim Bin Ahmad, for guiding and teaching me during the whole project development process. Thank you for being supportive and thoughtful in every progress meeting with me and my friends with all the advice and comments in order to develop this project successfully.

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Thank you.



ABSTRACT

Learning *Sains Jirim* is an Augmented Reality application called AR JIRIM where it helps the target audience which is students who is taking the KSSM Science subject enhance their understanding about the *Jirim* topic. For your information, *Jirim* is a topic where student need to learn and understand things that makes up the universe. All things in the universe is basically made up from tiny little particle called atom. Atoms cannot be seen by a normal human's naked eye and need a technology or machine to help human study about it. Thus, for primary and high school level, student will only be teaching the abstract concepts about *Jirim* with the helps of 2D graphical representation such as images or videos to help them understand and visualize how is *Jirim* is. The problem statement from this project is, some student having difficulties to visualize the abstract concepts that related to characteristic and concepts of *Jirim*. In order to fully understand the topic, student need to visualize the processes happened in *Jirim*, the movement of particles in *Jirim* and the simulation if heat is applied to *Jirim*. This project purpose is create an augmented reality application that can show all the process happened and concepts of *Jirim* in the form of 3D model animation. Project methodology that being used for this project development is the Instructional ADDIE model which is describe the stages involve in developing an application for learning or training from analysis for requirements to evaluation of effectiveness of application. The evaluation phase also would review if the user requirements and project goals have been achieving or not. The result of the evaluation has been made that this AR JIRIM is effective for enhancing student's understanding about *Jirim* topic. As a conclusion, learning *Jirim* topic with the use of augmented reality technology really can help enhance student's understanding yet enjoyable for teaching and learning session.

ABSTRAK

Belajar Sains Jirim ialah sebuah aplikasi *Augmented Reality* yang dinamakan AR JIRIM dimana ia membantu target pengguna iaitu pelajar yang mengambil aliran sains melalui subjek KSSM Sains untuk meningkatkan pemahaman mereka mengenai topik Jirim. Untuk pengetahuan, Jirim ialah topik yang memerlukan pelajar untuk belajar dan faham mengenai benda yang menghasilkan alam semesta. Semua objek di alam semesta ini diperbuat daripada benda kecil yang dipanggil Zarah. Zarah tidak boleh dilihat oleh mata kasar manusia normal dan memerlukan teknologi dan mesin canggih untuk membantu manusia belajar tentang perkara tersebut. Walaupun begitu, untuk peringkat rendah dan sekolah menengah, pelajar hanya akan belajar mengenai konsep abstrak Jirim dengan hanya bantuan grafik 2D seperti gambar dan video untuk membantu mereka membayangkan bagaimana keadaan Jirim tersebut. Pernyataan masalah yang didapati daripada pembangunan projek ini ialah ada sebahagian pelajar yang mengalami kesukaran untuk membayangkan konsep abstrak berkaitan dengan ciri-ciri dan konsep Jirim. Bagi memahami keseluruhan topik, pelajar semestinya perlu boleh membayangkan proses yang berlaku dalam Jirim, pergerakan partikel dalam Jirim dan simulasi jika Jirim diaplikasikan dengan haba. Tujuan projek ini ialah untuk menghasilkan aplikasi *Augmented Reality* yang dapat menunjukkan proses yang berlaku dan konsep jirim dalam bentuk animasi 3D model. Metodologi projek yang digunakan bagi pembangunan projek ini ialah model ADDIE yang menjelaskan setiap fasa yang terlibat dalam pembangunan aplikasi untuk pembelajaran atau latihan daripada fasa analisis keperluan ke fasa penilaian keberkesanan aplikasi. Fasa penilaian juga akan mengkaji adakah keperluan pengguna dan gol projek telah dicapai atau tidak. Keputusan penilaian telah dibuat bahawa aplikasi AR JIRIM ini berkesan bagi meningkatkan pemahaman pelajar mengenai topik Jirim. Sebagai kesimpulan, pembelajaran topik Jirim menggunakan teknologi *Augmented Reality* sangat membantu meningkatkan pemahaman pelajar namun masih menyenangkan untuk sesi pengajaran dan pembelajaran.

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LIST OF ABBREVIATIONS

FYP	-	Final Year Project
AR	-	Augmented Reality
VR	-	Virtual Reality
MR	-	Mixed Reality
ADDIE	-	Addie, Design, Development, Implementation, Evaluation
3D	-	3-Dimensional
SDK	-	Software Development Kit

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CHAPTER 1: INTRODUCTION

1.1 Introduction

Align with the 21st century trends, the uses of interactive multimedia module also be implemented in teaching and learning process and still be developing until now with many advanced technological approaches. These technologies are often used for subject that require students to understand a lot of abstract theories which would be difficult to just visualize and imagine them without concrete visuals. According to John K. Gilbert (2005), visualization means the perception of an object that is seen or touched. Thus, one of the technological tools that at-present rapidly developed and helps in visualization is the Augmented Reality Technology or AR Technology.

Augmented Reality is a technology that help user experience enhanced parts of user's physical world with computer-generated input. Different from Virtual Reality (VR) and Mixed Reality (MR) technology, AR technology is designed for digital elements to appear over real-world view and sometimes with interactivity between users and the digital elements. The digital elements including 3D model, sound to video, images and 3D animations are combined into digital content which responds in real time to changes based on the user's environment that can give a great concrete visual to users via android device or known as Android's ARCore.

In relation between visualization and education, it is particularly necessary in science subject which seeks causal explanation for all the phenomena that happened in the world that make visualization plays an important role in science education, especially in Chemistry. External representations such as diagrams, pictures, graph, and concrete models have always been valuable tools for science teacher but since nowadays, the uses of personal computers and well-known software has expanded into the areas of animation and extended reality, and students are now engaged with the

uses of technological devices, it would be more interesting if we apply the technologies to the science topic to make them understand better.

Jirim or ‘Matter’ is one of the subtopics under KSSM Science syllabus where student will be exposed and learn about the “stuff” that makes up the universe. *Jirim* means everything that has mass and volume which takes up space and is made up of tiny little particles called atoms. In normal science class, student will be learning about the physical and chemical characteristic of *Jirim* and the process occurs when heat are absorbed or released by atoms such as changes of form from solid to liquid, liquid to gas and so on. Unfortunately, since atoms cannot be seen by a normal human’s naked eyes because it is too small, students need to imagine and visualize themselves or refer to the 2D infographic images in order to fully understands the topic especially in the Kinetic Theory of *Jirim* topic where it will explain about the movement of atoms.

Thus, the main purpose of this PSM project is to develop an AR experience using augmented reality application called AR JIRIM that let students learn *Jirim* subtopic using Augmented Reality (AR) Technology for concrete visualization of characteristic and concepts of *Jirim* including the Kinetic theory of *Jirim*.

1.2 Problem Statement

Below are the problem statements of project for the AR JIRIM application development.

- (a) Students have difficulties in visualizing the abstract concepts and processes for the science topic *Jirim*.

There are some subtopics in *Jirim* such as the Characteristic of *Jirim* and Kinetic Theory of *Jirim* where student learn it theoretically and find it difficult to visualize it concretely to fully understand the topic such as what is behind ‘Solid’, ‘Liquid’ or ‘Gas’ and the transformation of matter during process of Boiling, Freezing etc.

Student: This AR JIRIM application is intended to help student especially science stream students who are taking and following the KSSM Science subject syllabus to help them enhance their understanding for the topic *Jirim*.

Teacher: Teachers especially the one who is teaching science subject can use this AR JIRIM application to help their student visualize the abstract concepts that they deliver for the topic *Jirim*.

1.4.2 Contents

Contents to be developed:

1. Video Introduction (Brief introduction for the topic *Jirim*)

2. Solid 3D Model

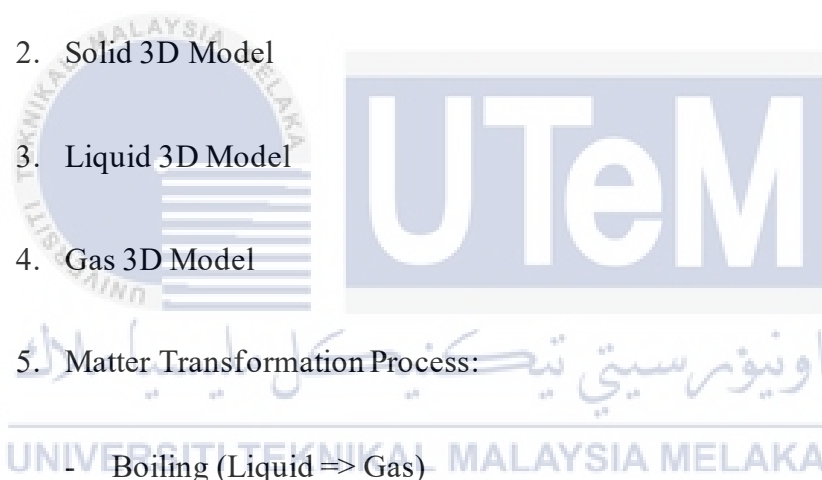
3. Liquid 3D Model

4. Gas 3D Model

5. Matter Transformation Process:

- Boiling (Liquid \Rightarrow Gas)
- Freezing (Liquid \Rightarrow Solid)
- Melting (Solid \Rightarrow Liquid)
- Condensation (Gas \Rightarrow Liquid)
- Evaporation (Liquid \Rightarrow Gas)
- Sublimation (Solid \Leftrightarrow Gas)

6. AR JIRIM Booklet (for target images)



1.3 Objective

Below are the objectives of project for the AR JIRIM application development:

- (a) To identify the elements and requirements of AR application for abstract concept and processes in *Jirim* topic that can be visualize into concrete visuals.

Making sure that abstract concepts from the topic can be fully understand by students.

- (b) To develop AR application using Unity3D and Vuforia that can help visualize the concepts and processes related to *Jirim* topic.

Unity3D and Vuforia software are used for the 3D model development and database for image target marker.

- (c) To evaluate the effectiveness of AR JIRIM application through student's achievement about *Jirim* topic.

A few questions will be asked to the students related to *Jirim* topic to evaluate the effectiveness of AR JIRIM application.

1.4 Scope

Below is the scope involved in this project for the AR JIRIM application development.

1.4.1 Users

As this AR JIRIM application is one of the materials that can help in the KSSM Science subject learning and teaching process, the end user that will be using this application would consist of students and teachers.