

PHOTOSYNTHESIS SIMULATION

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PHOTOSYNTHESIS SIMULATION

SITI SYAHIDAH BINTI ALIAS

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

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
UNIVERSITI TEKNIKAL MALAYSIA MELAKA


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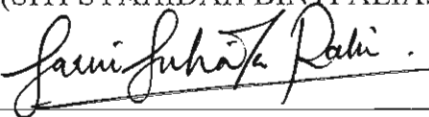
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I hereby declare that this project report entitled

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DEDICATION

In the name of Allah, the most Gracious and the most Merciful. Alhamdulillah my praise to Allah because give opportunity and space for me to express my dedication to person who gives a lot of support to me along the very challenging phase “ Projek Sarjana Muda”. First of all, I would like to wish a big thank you to my beloved family on their fully support in terms of their encouraging words, money and others. Special dedication to my soul mate Mohammad Rozuwan who never fails to advise me, give moral support and always lend me his ears in sharing my problems during my up and down especially during completion of this project. Never be forgotten my lovely coursemates, 3 BITM who always share their opinions and knowledge to ensure that everybody successfully completed Projek Sarjana Muda. Last but not least, special thanks I devoted to my beloved supervisor Miss Sarni Suhaila Rahim who never fails to assist me by giving support, opinions and guidance all through this semester.

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ABSTRACT

The main objective of this project is to develop a simulation of photosynthesis for Biology student from matriculation in 3D environment and create better visualization of photosynthesis process and as educational aids. Commonly, base on conventional methods, Biology lecturer uses slide presentation, transparency, text book or other material to describe the whole process to their students. Unfortunately, not everybody have the ability to imagine or visualize the process. It is due to students who have weak imagination to imagine the complex process. Hopefully, this simulation can help student to understand the process easily. Multimedia Production Process used as a methodology to build this simulation because it has three stages which are Pre-Production, Production and Post-Production. Furthermore, this 3D simulation includes all multimedia elements for example text, video, audio, animation and graphic. In this project, hardware and software requirement are also will be explained. Once project being implemented, the testing will be conducted to get the feedback from the user.

ABSTRAK

Tujuan utama projek ini adalah untuk membina simulasi bagi proses fotosintesis untuk pelajar Biologi dari matrikulasi dalam suasana tiga dimensi dan menghasilkan visual yang lebih baik dan juga sebagai alat bantu mengajar. Biasanya, proses pengajaran dilakukan dengan menggunakan *slide presentation*, transparenasi, buku kerja dan bahan lain untuk mengajar. Tetapi tidak semua pelajar mempunyai kelebihan berimajinasi tentang proses yang kompleks. Dengan adanya simulasi ini harap dapat membantu pelajar untuk memahaminya dengan mudah. Proses Produksi Multimedia adalah sebagai suatu metodologi untuk membangunkan simulasi ini kerana ia mempunyai tiga tahap iaitu Pra-Produksi, Produksi dan Pasca Produksi. Selanjutnya, simulasi 3D ini mengaplikasikan kesemua elemen multimedia misalnya, teks, video, audio, animasi dan grafik. Dalam projek ini, keperluan perkakasan dan perisian juga akan diterangkan secara terperinci. Setelah projek dilaksanakan, ujian akan dijalankan untuk mendapatkan maklum balas daripada pengguna.

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CHAPTER I

INTRODUCTION

1.1 Project Background

This project simulates the process of photosynthesis in a 3D environment in order to facilitate students in understanding the concept of photosynthesis. In Biology matriculation syllabus, this topic is quite complex because it covers till depth. The process of photosynthesis is a complex process thus it is essential to give better visualization to life students. The components involved in photosynthesis were modeled in 3D environment. However, the component may not exactly the same in real life. It's just a symbol of the component.

Soon Ching and Shee Leong [1] with the reference book "EXCEL in Biology for Matriculation semester 1" mentioned that photosynthesis is the formation of organic nutrients in an organism using inorganic raw material and energy from sunlight. The 3D simulation explains each of the stages in plant photosynthesis. Photosynthesis generally consists of two main processes. The first process is called the Light Dependent Process (Light Reactions) and the second stage is called the Light Independent Process (Dark Reactions).

The current methods of teaching this particular area are through slide presentation, OHP transparency, text book and other material. This can be the problem to some of the students especially to visualize or imagine the whole process. So, basically the education field will use this product as their teaching aid in matriculation or maybe tuition center. Based on observations and research done for examples from YouTube, there are lots of simulations of this topic but it covers too general and not really suitable for students.

1.2 Problem Statement

Photosynthesis is one of the sub topics in the lesson plan for Biology Matriculation. These two stages of process which are Light Dependent Process (Light Reactions) and Light Independent Process (Dark Reactions) occur in different place and the mechanism of each stage is totally different too. There are many components involved in the two stages. This topic at matriculation level is much complex than secondary level. As we all know, some of the process in this world cannot simply think and imagine with naked eyes and mind. Perhaps some of students have great imagination about something but may be others are not. Students who are really hard to imagine about the process of something, they need additional teaching aids to help them for better understanding of the topic.

The current teaching methods for example slide presentations, transparencies or text books are not really efficient for student to have better understanding about the process. As mentioned above not all students have the ability to imagine the things that they cannot see. One of the methods to give better visualization about the process is through animation. There are a lot of video of animation that describe about the photosynthesis process, unfortunately the video is not suitable for student who taking this topic. It is because it shows general concept of photosynthesis process. It is hope that through this simulation it can help students to easy their learning process about the topic.

1.3 Objective

The objectives of this project are:

- i. To develop a simulation of photosynthesis for Biology student from matriculation in 3D.
- ii. To create better visualization of photosynthesis process and as an educational aids.
- iii. To produce a simulation application that is standalone.

1.4 Scope

Photosynthesis topic for matriculation level is more details and process compared to photosynthesis process for secondary level. Hence, this project is developing to make the process learning simpler. Photosynthesis has two stage processes. The first process is the Light Dependent Process (Light Reactions), requires the direct energy of light to make energy carrier molecules that are used in the second process. The Light Independent Process (Dark Reactions) occurs when the products of the Light Reaction are used to form C-C covalent bonds of carbohydrates. The Dark Reactions can usually occur in the dark, if the energy carriers from the light process are present. However, this project will focus Light Dependent Process (Light Reactions) which consists of non-cyclic photophosphorylation and cyclic photophosphorylation.

This project was developed to simplify the learning process. There are two groups of target user for this project. Primary user is for Biology students and Biology lecturers in matriculation programme who are learning photosynthesis topic in the Biology subject and secondary user is for people who may have general knowledge about photosynthesis process and eager to know more about the process. The simulation covers explanation of each stage in plant photosynthesis specifically for Light Dependent Process which consists of non-cyclic photophosphorylation and cyclic photophosphorylation.

The main platform of this project uses Autodesk Maya 2010 to model the components involved in the photosynthesis process and later was animate using the combination of 2D animation, sound and effect from Adobe After Effect software.

1.5 Project Significance

The significance of this project is to help Biology students in matriculation to have better understanding about the whole process of photosynthesis. Moreover, the lecturer also can use this product as their teaching aids to make the learning process easier, fun and efficient. Besides, people who are eager to have additional knowledge about the process also can use this product.

1.6 Conclusion

From the project, it will assists Biology students of matriculation to gain better understanding, have better visualization and make the learning process become interesting through this simulation. Besides, they are not only acquiring knowledge but also gain exposure to the current 3D technology, which they may not realize. It was felt that the need of additional learning tool such as visual simulation is required in order to able more understanding especially when involving complex process.

Basically, the chapter explains the purpose of this project, project background, the current problems, and the advantage of product that benefit users. The next chapter covers literature review and project methodology which will explain detail about research on existing system and comparison of existing system to see the approach and related topic with past research. Project methodology is the guideline used in developing this project. Other topic explains about the software and hardware requirement for developing the end product.

CHAPTER II

LITERATURE REVIEW & PROJECT METHODOLOGY

2.1 Introduction

Literature is a term used to describe written or spoken material. Generally speaking, "literature" is used to describe anything from creative writing to more technical or scientific works, but the term is most commonly used to refer to works of the creative imagination, including works of poetry, drama, fiction, and nonfiction [2]. Methodology is a set or system of methods, principles, and rules for regulating a given discipline, as in the arts or sciences. The word methodology is also can be defined as a system which comprises the principles, practices and procedures which are applied to a specific branch of knowledge. Methodology includes the methods, techniques and procedures which are used to collect and analyze information [3].

Other than that, this chapter explains the research of existing system and identify about the software and hardware requirement that will to develop the project use in order to develop this project. This chapter also describes the details of the project methodology used in this project and explanations on every activity or stage.

2.2 Domain

The domain of this project is a 3D simulation by modeling the components involve in the photosynthesis process. Simulation can be a powerful tool if understood and used properly. Simulation can be an extremely useful instructional aid. The programmer can choose what to focus on, build up complexity, and control the environment. The programmer can also introduce components that are purely virtual, concepts that cannot be easily realized, but still useful for learning.

Simulation, according to Robert E. Shannon (1975), is “the process of designing a model of a real system and conducting experiments with this model for the purpose either of understanding the behavior of the system or of evaluating various strategies (within the limits imposed by a criterion or set of criteria) for the operation of the system.” [4]

Simulation gives lot of benefit. The list below is the benefit of simulation [5]:

- i. Low Barrier to Entry

Simulation enables individuals using a personal computer to develop very interesting robots or robot swarms with the primary limiting factors being time and imagination. At the same time, it constrains them in ways similar to physical robots so they can focus efforts in something that can be realized.

ii. Prototyping

Physical models for a robot and the simulation services that use them can be developed concurrently by many individuals, and just like many software development communities, create a platform that many can use and modify without worrying about breaking expensive, unique robots.

iii. Education

Simulation can be an extremely useful instructional aid. The programmer can choose what to focus on, build up complexity, and control the environment. The programmer can also introduce components that are purely virtual, concepts that cannot be easily realized, but still useful for learning.

iv. Learning System

Another interesting aspect of simulation is that it can be used while the robot is running, as a predictive tool or supervised learning module. For quite some time, developers have used simulation running concurrently with an active robot to try things out in the simulation world that is updated real-time with sensory data. Then the simulation can tell them, probabilistically, if something is a good idea.

2.3 Existing System

i. A 3D Robot Simulation for Education

A visual 3D vehicle robot, equipped with a monocular camera navigates in a physics based 3D environment, with some artificial intelligence capabilities. Students can interact with the robot, add new objects and set the robot various tasks. This multimedia tool is designed for students with very little experience with robotics, and aims at giving students unlimited access to a relatively sophisticated robotic system, incorporating artificial intelligence, with an extremely low cost compared to using real robot systems. Our current version of the simulation software has been designed to perform three main tasks, *play soccer*, *avoid object*, and *wander*. The simulation is being designed to closely resemble its real-world counterparts, and we hope, will ultimately become a powerful research and development tool.

ii. Photosynthesis (Light Reactions)

The NDSU Virtual Cell Animation Project presents 'Photosynthesis - The Light Reactions'. Virtual Cell Animation Photosynthesis is the means by which plants make use of chlorophyll and light to produce energy. This section covers the basic stages of the light reactions in the photosynthetic electron transport chain. This project is an initiative of the North Dakota State University (NDSU) World Wide Web Instructional Committee (WWWIC). WWWWIC is a multi-disciplinary faculty group engaged in developing science education tools that communicate both discipline-specific content and the scientific method. Principal among these are role-based, goal-oriented, learner-oriented, immersive, and exploratory virtual/visual educational environments.

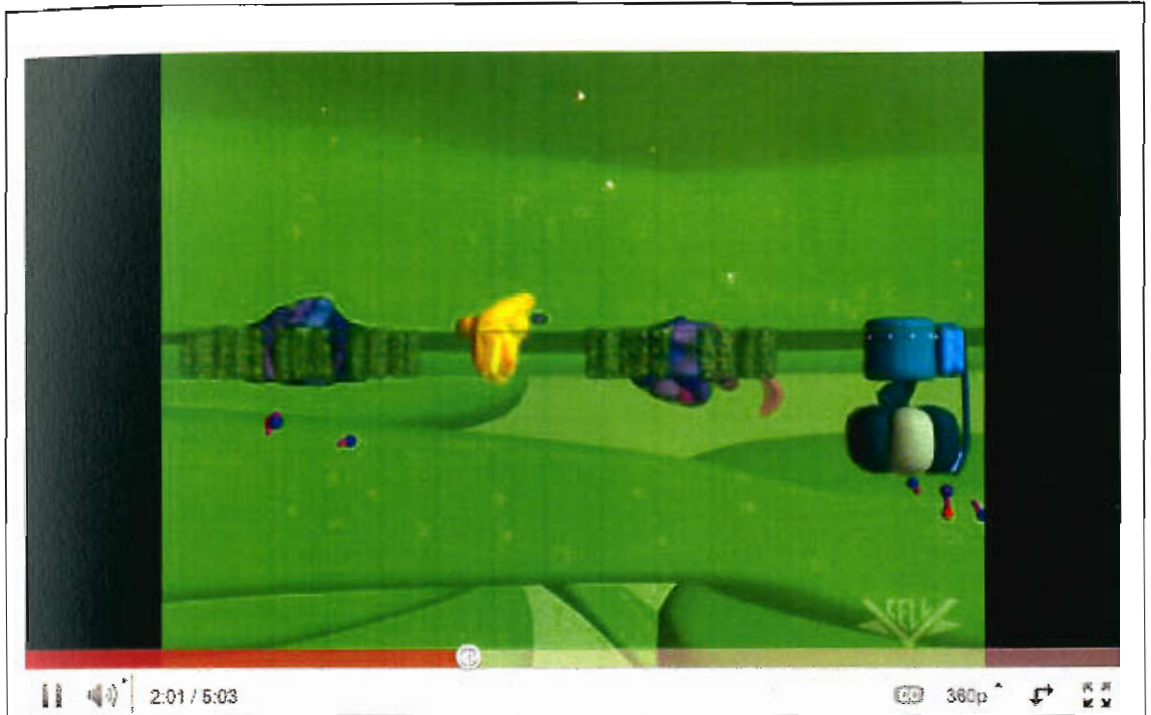


Figure 2.1: Simulation of photosynthesis by Virtual Cell Animation

iii. Orbital Flight - Rendezvous and Docking

This simulation will test user ability to maneuver in space, align the spacecraft and dock. User can choose the descent scenario that starts CSM docked with the CSM. Or, they can fly the ascent stage as it tracks the CSM from about a mile away. User can use attitude and translation RCS commands to position dock the LM with the CSM. In the meantime user can sightsee with an earthrise while the lunar surface rotates 60miles beneath you.