



Faculty of Electrical and Electronic Engineering Technology



**ELECTRONIC EDUCATIONAL BOARD SIMULATOR FOR SEQUENTIAL DIGITAL
CIRCUIT DESIGN WHICH CONSISTS OF FLIP FLOP AND LATCHES**

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

MUHAMMAD SHAHRUL BIN KADID

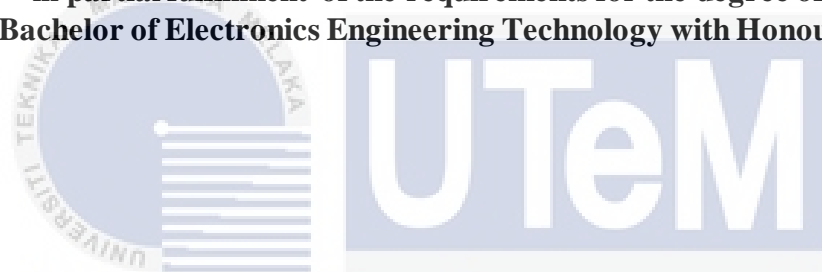
Bachelor of Electronics Engineering Technology with Honours

2023

**ELECTRONIC EDUCATIONAL BOARD SIMULATOR FOR SEQUENTIAL
DIGITAL CIRCUIT DESIGN WHICH CONSISTS OF FLIP FLOP AND
LATCHES**

MUHAMMAD SHAHRUL BIN KADID

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



اونيورسيتي تیکنیکل ملایسا ملاک
Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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**BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II**

Tajuk Projek : Electronic Educational Board Simulator for Sequential Digital Circuit Design Which Consist of Flip flop and Latches

Sesi Pengajian : 2022/2023

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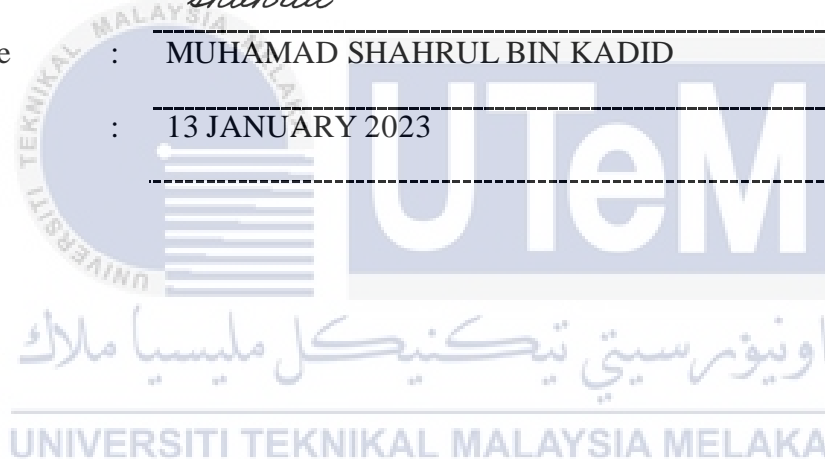
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Universiti Teknikal Malaysia Melaka

DECLARATION

I declare that this project report entitled “Electronic Educational Board Simulator for Sequential Digital Circuit Design Which Consist of Flip flop and Latches” 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.

Signature : *shahrul*
Student Name : MUHAMAD SHAHRUL BIN KADID
Date : 13 JANUARY 2023



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 with Honours.

Signature : 

Supervisor Name : ENCIK AMAR FAIZ BIN ZAINAL ABIDIN

Date : 13 JANUARY 2023



DEDICATION

I dedicate this project to God, the Almighty, the creator of all things, the source of life and inspiration in all its ramifications. He alone has provided us with strength, grace, and guidance we have needed to see this project through to completion and success. Also, to my father Kadid Bin Bangkol, and my mother, Lumat Binti Dadid, always gave me support and taught me to believe in hard work and trust Allah S.W.T. I also dedicate this report to my family member who always supports and help me with their unconditional love that makes me feel motivated and always in high spirit while doing this project. Lastly, this dedication is also dedicated to my supervisor, Enick Amar Faiz Bin Zainal Abidin, who always surrounded me with positive vibes and never let any sadness dominate my heart.



ABSTRACT

For majors in electronic engineering, digital electronics is a significant subject. This course has a lot of credit hours. As a result, students must devote their complete attention to the teaching and learning process. The issue is that pupils require something to keep them in the classroom. The main goal of this project is to develop an electronic-based instructional board simulator capable of simulating sequential digital circuits using flip-flops and latches. Students can build a sequential digital circuit on the board and then simulate it by pressing the push button. The instructional board will then create a timing diagram based on the student's circuit connection and show it on a TFT LCD. The Arduino Mega is used to process the students' input and output important data to the TFT LCD. This project combines hardware and software to simulate sequential digital circuits that include flip-flops and latches. Users can create sequential digital circuit connections on the board, then click the push button to simulate the circuit, and the result will be displayed on a thin-film-transistor liquid crystal display (TFT LCD) in the form of a timing diagram. Furthermore, this initiative must first be declared with the community to see if it is beneficial to the community. A survey is a valuable instrument for gathering information from the public. This survey form will be sent to students and instructors for this project's study. This project will be improved after the data has been analysed.

ABSTRAK

Bagi jurusan kejuruteraan elektronik, elektronik digital adalah subjek penting. Kursus ini mempunyai jam kredit yang banyak. Oleh itu, pelajar harus menumpukan perhatian sepenuhnya terhadap proses pengajaran dan pembelajaran. Isunya ialah murid memerlukan sesuatu untuk menyimpannya di dalam bilik darjah. Matlamat utama projek ini adalah untuk membangunkan simulator papan pengajaran berasaskan elektronik yang mampu mensimulasikan litar digital berjujukan menggunakan flip-flop dan selak. Pelajar boleh membina litar digital berjujukan pada papan dan kemudian mensimulasikannya dengan menekan butang tekan. Papan pengajaran kemudiannya akan membuat gambarajah masa berdasarkan sambungan litar pelajar dan menunjukkannya pada LCD TFT. Arduino Mega digunakan untuk memproses input dan output data penting pelajar ke LCD TFT. Projek ini menggabungkan perkakasan dan perisian untuk mensimulasikan litar digital berjujukan yang termasuk flip-flop dan selak. Pengguna boleh membuat sambungan litar digital berjujukan pada papan, kemudian klik butang tekan untuk mensimulasikan litar, dan hasilnya akan dipaparkan pada paparan kristal cecair transistor filem nipis (TFT LCD) dalam bentuk rajah pemasaan. Tambahan pula, inisiatif ini perlu diisytiharkan terlebih dahulu bersama masyarakat untuk melihat sama ada ia memberi manfaat kepada masyarakat. Tinjauan adalah instrumen berharga untuk mengumpul maklumat daripada orang ramai. Borang kaji selidik ini akan dihantar kepada pelajar dan pengajar untuk kajian projek ini. Projek ini akan ditambah baik selepas data dianalisis.

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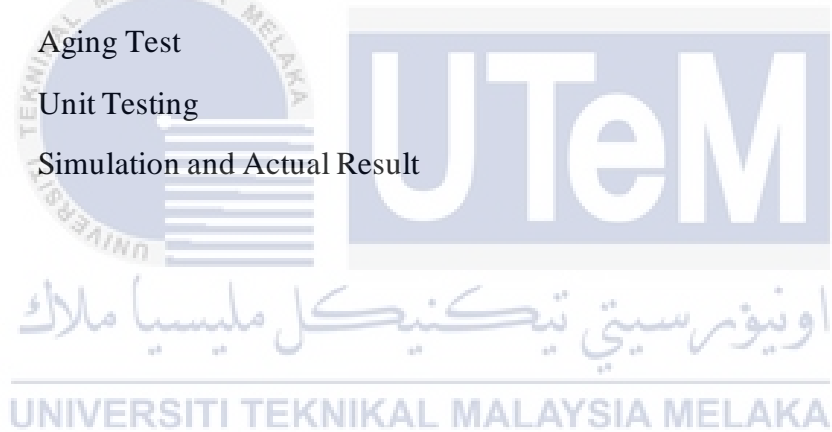
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LIST OF ABBREVIATIONS

IDE	-	Integrated Development Environment
LED	-	Light Emitting Diode
TFT	-	Thin Film Transistor
LCD	-	Liquid Crystal Display
DIP	-	Dual Line Package



CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter aim on creating the framework and introduces the brief idea of the project. It focused on the overview of the project, detailing the objectives, briefly the problem statement, scope and provide outcome of the project.

1.2 Background

Digital systems will be the focus of student electric and electronic engineering at Universiti Teknikal Malaysia Melaka (UTeM). Students will study both theoretically and practically about this subject. Theoretical students will be taught in lectures and tutorials, while practical students will be taught in lab sessions.

The lecture will take place in a huge hall with a significant number of students. The lesson notes for the digital system will be displayed on the projector. The lecturer will theoretically explain the letter to the students. Only a few students will be able to stay focused in class in this manner, while others will become bored and tired. Electrical engineering teachers confront significant challenges while teaching electronics courses using traditional teaching methods that are no longer fitted to the demands of students' professional lives due to the complexity of modern technologies, according to Papadimitriou (2012).

After the chapter has been discussed in class, the lecturer will prepare some questions for the students. All students must respond to all questions, which will be discussed during the tutorial session. The tutorial session's flaw is that not all students would grasp that chapter

because most lecturers choose students at random to answer the questions. Meanwhile, the remainder of the pupils aren't sure what's going on.

During the lab session, students will be given teaching kits in groups. It means that each student must share the educational kit during the experiment, which results in a lack of expertise on the part of the students because the time allotted for the experiment is insufficient to examine any gadgets, such as the educational kit, while also doing the experiment. Furthermore, some students may not fully comprehend what they are learning in the lab.

1.3 Problem Statement

Students majoring in electric and electronic engineering at Universiti Teknikal Malaysia Melaka (UTeM) would be the primary audience for the digital system course. Students will gain knowledge in both the academic and practical aspects of this topic. Those who are interested in theory will study in lectures and tutorials, while students interested in practise will learn in lab sessions. It is sufficient to hold the lecture in a hall with a significant number of pupils present. The lecture notes for the digital system will be shown on the projector when it is used. The lecturer will provide the learner with an explanation of that note by theoretically. In a setting like this, only a select few pupils will be able to maintain their attention, while the other students would experience feelings of boredom and sleepiness. According to Papadimitriou (2012), instructors of electrical engineering face a significant challenge when they are tasked with teaching a course in electronics due to the fact that traditional teaching methods are no longer suitable for the demands of their students' future careers as a result of the complexity of new technologies.

The lecturer will have some questions prepared for the students to answer when the chapter has finished being discussed in the lecture session. Every student is required to provide a response for every question, and those answers will be discussed during the tutorial session.

The majority of lecturers just choose students at random to solve the problems, hence the tutorial session has the inherent flaw that not all students will fully comprehend the material being covered. While that is going on, the other pupils do not necessarily grasp the concept.

During the lab portion of the lesson, instructional kits will be distributed to the students in their respective groups. It indicates that each student will be required to share the educational kit in the course of the experiment. This results in a lack of skill on the part of the students because the duration time of the experiment is not sufficient to explore any devices like the educational kit while also carrying out the experiment. In addition, it's possible that some students won't retain all they learn in the lab.

1.4 Project Objective

The primary objective of this project is to produce an electronic educational board that has the capability of simulating timing diagram of a sequential circuit assemblies by the user that includes 3 flip flops, 2 latches and 4 logic gates.

1. To design an electronic educational board using Proteus for the circuit layout, to design a PCB layout using PCB WIZARD software, to sketch a 3D prototype using Tinker Cad, to construct an electronic educational board simulator with Arduino Mega as the controller, and to program the embedded system using Arduino IDE.
2. To build an electronic educational board simulator that is affordable, portable, and durable for use by students. The price for making the board simulator is RM250, the size of the educational board simulator box is 25cm x 30cm x 20cm. The power supply for the simulator box is a 9V battery. The box can with stand high temperature to 30 degrees Celsius to 4 degrees Celsius and withstand a drop from 1 meter height without any damage.

3. To verify a series of system tests that will be based on a checklist in order to validate the functioning of the electronic educational board simulator. This will be accomplished by testing each of the connection ports on the board simulator individually and examining the findings to see whether or not the electronic board simulator generates the required output.
4. To validate whether the educational board simulator is suitable for educational use at tertiary level by carrying out a survey that consists of sixteen questions. The respondents include of students as well as those who are in lecture.

1.5 Scope of Project

The material used to hold and keep all the components and Arduino Mega is a junction box. Junction boxes are made from quality material and are therefore resistant to corrosion, rotting or rusting. They are also resistant to insect damage and termite attacks, making them extremely durable.

As the board simulator required student to construct the circuit on top of the box, a PCB board consisting of the circuit will be hide inside the box and only the pictures of the flip flop, latches and gate will be put on the top of the box as to hide the complexity of the circuits. The DIP switch, potentiometer, pushbutton, TFT LCD, buzzer, LED and the female header connector are also on top of the box as to control the input and output display.

The PCB board will consists of 8 types of integrated circuit(IC) one for each gates, flip flops and latches. The process of designing the PCB board is using software called PCB WIZARD. This will determine the PCB board layout according to our preferences. Every input and switch will be put a pull up resistor to ensure that a wire is pulled to a high logical level in the absence of an input signal.

There will be many connections from PCB board to Arduino mega. Thus, the Arduino mega will be put inside the junction box. The Arduino mega is coded using Arduino IDE software. The battery pack will also be put inside the junction box as it is to power up the Arduino Mega. Then, the TFT LCD display will be placed on top of the junction box.

In D latch there is an enable pin, the DIP switch will control the enabled input to be displayed on the output display. As for the potentiometer, all the flip flops have a CLK pin so the potentiometer will control the output display for the CLK. The potentiometer will be set 3 different range that will be mark on top of the box and three different pattern in the coding for the output display. There will be two LED lights, one is red the other one is green. If it turns red that means the simulation still running and if green it is on standby mode to run the simulation.

The pushbutton has 2 tasks, that is to continue to the next screen and to reset the output display on TFT LCD. This will be programmed using the Arduino Mega. Female header are placed on top of the box, for the user to make the circuit connection according to their preference. The buzzer will be mounted on the top of the box, as to indicates the sound of the output high or low. In those ways, there will be sound produce when the output goes high or low.

The project's scope is documented to ensure that it will remain within the parameters of the budget. The scope will be operational so that we can ensure that those initiatives are proceeding in the appropriate direction to achieve the objective. The main concern on creating a board simulator is on how relevance it is to student that is undertaking digital electronic subject. This was done with the intention of increasing both inclusiveness and relevance, as the simulator is intended for student that taking digital electronic subject in university. The weight of the educational board simulator is just 2000g, and its dimensions are 20 by 25 centimetres

making it easily portable. The educational board simulator is put through a series of tests to determine how long it will remain functional. These include a drop test from a height of 0.5 meters and 1.0 meters, a temperature test that ranges from -4 degrees Celsius to 30 degrees Celsius, and an ageing test that lasts for 8 hours. The cost to build the board simulator also less than RM250 as it required material and component that is easy to find.

1.6 Project Contribution

The purpose of making this educational electronic circuit board simulator is to introduce timing diagram output display for sequential circuit simulation for student that taking subject digital electronic in university. According to the survey that has been carried out, 25 respondents show their interest in this subject and 50 respondents agree that educational electronic board simulator motivate them toward learning. So by introducing this educational simulator, students will learn on how to construct a sequential circuit that combine gates, flip flops and latches.

In every subject electronic engineering usually consist of theoretical, tutorial and lab session. This educational board simulator provides hands-on experience for students, to build the sequential according to their own knowledge that they have learnt in theoretical class. Besides, with the integration of TFT LCD display as an output display, it will make the learning process more attractive and fun. Students not only will get valuable hands-on learning, but also it will make student easy to understand the concept of sequential electronic circuits. This statement can be proved by referring to the survey that shows 50 respondents believe that educational kit can help student to improve their hands-on skill and it provides difficult things in simple way to understand. Development of this electronic educational board simulator believe it will attract student's interest to learn and understand about Digital Electronic Circuit.

In the lab session students are required to connect the circuit but the only indicator they get as an output is the LED off and on. It also given with a complicated procedure that might make students confused and do not understand. By using this educational electronic board simulator, the student can see thoroughly how the timing diagram work as per the theory that they learn in class.

