



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**E-Logic Trainer Kit: Development of an Electronic Educational
Simulator and Quiz Kit for Logic Gate Combinational Circuit
by Using Arduino**

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electronic Engineering Technology (Industrial Electronics) with Honours.

by

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electronic Engineering Technology (Industrial Electronics) with Honours. The member of the supervisory is as follow:

.....
(Amar Faiz Bin Zainal Abidin)

ABSTRAK

Digital Elektrronik adalah subjek yang penting bagi pelajar yang mengambil jurusan kejuruteraan. Subjek ini agak sukar untuk difahami. Oleh itu, pelajar perlu memberi sepenuh perhatian ketika proses pengajaran dan pengajaran. Permasalahannya adalah pelajar memerlukan sesuatu yang dapat menarik minat dan perhatian mereka di dalam kelas. Tujuan utama projek ini dijalankan adalah untuk mereka cipta alat bantuan pengajaran yang boleh menguji pengetahuan pelajar tentang “logic gate” dan menukar gabungan litar dalam bentuk “timing diagram”. Projek ini juga bertujuan untuk mengesahkan keberkesanan penggunaan alat bantuan pengajaran semasa sesi pengajaran dan pembelajaran. Arduino Mega 2560 digunakan sebagai mikro-pengawal kepada E-Logic Trainer Kit. Perisian SolidWork 2013 pula digunakan untuk merekabentuk prototaip untuk E-Logic Trainer Kit. Projek ini berfungsi dengan baik dan kaji selidik telah dijalankan kepada pensyarah dan juga pelajar Fakulti Teknologi Kejuruteraan (FTK) di Universiti Teknikal Malaysia Melaka (UTeM). Merujuk kepada data yang telah dikumpul, E-Logic Trainer Kit sangat sesuai digunakan untuk menarik minat dan perhatian pelajar ketika proses pengajaran dan pembelajaran.

ABSTRACT

Digital Electronic is an important subject for engineering student. This subject very hard to understand. So, student need to focus during class and tutorial session. The problem is during class session or lecture session student need something that can attract them to focus. The aim for this project is to design an electronic educational kit that can test student knowledge about logic gate and to convert the logic gate combinational circuit to timing diagram. This project also to verify the effectiveness of the educational kit during class session. E-Logic Trainer Kit used Arduino Mega 2560 as a microcontroller. SolidWork 2013 software used to design the prototype for E-Logic Trainer Kit. This project function very well and the survey has been done to lecture and student at Universiti Teknikal Malaysia Melaka (UTeM) at Faculty of Technology Engineering. Refer to data that has collect E-Logic Trainer Kit proved that the educational kit very effective to use during class and tutorial session because it can attract student to focus.

DEDICATION

I am grateful to the ALLAH SWT for his grace. Within this report I, Mohammad Zulkurnain Bin Omar (B071410185) of UTeM Malacca was successfully completed the report of final year project during two semesters. “Especially for my beloved mother Mrs. Maziah Binti Ismail and to my family who had given me much support, encouragement and advice to complete this project. And do not forget to all dearest fellow friends and UTeM staffs for helping and cheering my day when I lose the direction on doing my project. Thank you so much, I love u all.

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TABLE OF CONTENT

Abstrak	i
Abstract	ii
Dedication	iii
Acknowledgement	iv
Table of Content	v
List of Tables	viii
List of Figures	ix
List of Abbreviations, Symbols and Nomenclature	xi
CHAPTER 1: INTRODUCTION	1
1.1 Introduction	1
1.2 Background Study	1
1.3 Problem Statement	2
1.4 Objective	3
1.5 Scope of Work	4
1.6 Project Contribution	5
CHAPTER 2: LITERATURE REVIEW	6
2.0 Introduction	6
2.1 Hardware Use	6
2.1.1 Arduino Mega 2560	6
2.1.2 Thin-Film-Transistor Liquid-Crystal Display (TFT LCD)	7
2.1.3 Keypad 4x4	8
2.1.4 Logic Gate Integrated Circuit (IC)	9

2.2	Overview of Existing Product	10
2.2.1	Logic Tutor Board	10
2.2.2	Basic Logic Gates Trainer	11
2.2.3	DB01 Logic Gate	12
2.2.4	Logic Gate Trainer Kit (Dt-1001)	13
2.2.5	Basic Logic Gate Trainer Kit (Dt-1001)	14
2.2.5	Logic Gate Trainer	15
2.2.8	Logic Gate Tutor	16
CHAPTER 3: METHODOLOGY		18
3.0	Introduction	18
3.1	Flow Chart	18
3.2	Project Layout	21
3.3	Block Diagram	21
3.4	Flow of the program	22
3.5	Estimate Cost	28
CHAPTER 4: RESULT & DISCUSSION		29
4.1	Result	29
4.2	Design Casing by Using SOLidWork 2013	29
4.3	Comparison Between Hardware and Software	33
4.3.1	Case 1: Two Inputs and One Gate	33
4.3.2	Case 2: Two Inputs and Two Gates	34
4.3.3	Case 3: Three Inputs and Five Gates	35
4.4	Survey	36
4.4.1	Question 1: During do simulator, is it e-logic trainer kit can give true answer according to connection.	37

4.4.2	Question 2: The questions asked by e-logic trainer kit are suitable for test student knowledge	37
4.4.3	Question 3: E-Logic Trainer kit can be a highly interactive activity during class session.	39
4.4.4	Question 4: E-Logic Trainer kit can help student to improve their hands-on skill.	40
4.4.5	Question 5: Students gained better understanding after answering the entire questions in e-logic trainer kit.	41
4.4.6	Question 6: e-logic trainer kit can be applied during lab session for subject digital electronic	42
4.4.7	Question 7: Students prefer to learn digital electronic subject by using e-logic trainer kit rather than in theoretical way.	43
4.4.8	Question 8: This educational kit can help lecturer to teach easily to student about logic gate	44
4.4.9	Question 9: Students can operate this educational kit without the guidance of educator/ teacher	45
4.4.10	Question 10: Do you think this e-logic trainer kit can marketable in industry?	46
CHAPTER 5: CONCLUSION & RECOMMENDATION		47
5.1	Conclusion	47
5.2	Recommendation	48
REFERENCES		49
APPENDICES		
A	Data Sheet Arduino Mega	
B	Data Sheet TFT LCD	
C	Survey Form	
D	Gannt Chart	

LIST OF TABLES

3.1	Estimate Cost	28
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LIST OF FIGURES

2.1	Arduino Mega	7
2.2	TFT LCD	8
2.3	Keypad 4X4	9
2.4	Pin diagram IC 7400 series	10
2.5	Logic Tutor Board	11
2.6	Basic Logic Gates Trainer	12
2.7	DB01 Logic Gates	13
2.8	Logic Gate Trainer Kit	14
2.9	Basic Logic Gate Trainer Kit (DT-1001)	15
2.10	Logic Gate Trainer	16
2.11	Logic Gate Tutor	17
3.1	FYP 1 flow chart	19
3.2	FYP 2 flow chart	20
3.3	Project Layout	21
3.4	E-Logic Kit Block Diagram	22
3.5	Flow chart of program	23
3.6	Flow chart of program	24
3.7	Flow chart of program	25
3.8	Flow chart of program	26
3.9	Flow chart of program	27
4.1	Drawing 4X4 Keypad In 3D	29
4.2	Drawing Logic Gate IC In 3D	30
4.3	Main Box In 3D	30
4.4	Top View	31
4.5	Side View	31
4.6	Front View	32
4.7	Top View With Dimension	32

4.8	Simulation AND Gate In Multisim	33
4.9	Simulation AND Gate In E-Logic Trainer Kit	34
4.10	Combinational Circuit Simulation In Multisim	34
4.11	Circuit Simulation In E-Logic Trainer Kit	35
4.12	Combinational Circuit In Simulation	35
4.13	Combinational Circuit In E-Logic Trainer Kit	36
4.14	Data From Respondent For Question 1	37
4.15	Data From Respondent For Question 2	38
4.16	Data From Respondent For Question 3	39
4.17	Data From Respondent For Question 4	40
4.18	Data From Respondent For Question 5	41
4.19	Data From Respondent For Question 6	42
4.20	Data From Respondent For Question 7	43
4.21	Data From Respondent For Question 8	44
4.22	Data From Respondent For Question 9	45
4.23	Data From Respondent For Question 10	46

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

AND	-	Logic AND
FTK	-	Faculty of Technology Engineering
IC	-	Integrated Circuit
IDE	-	Integrated Development Environment
IoT	-	Internet of Thing
K-map	-	Karnaugh Map
LCD	-	Liquid-Crystal Display
LED	-	Light-emitting diode
NOT	-	Logic NOT
OR	-	Logic OR
PIO	-	Peripheral Input and Output
POS	-	Product of Sum
PWM	-	Pulse Width Modulation
SLT	-	Supreme Light Technology
SOP	-	Sum of Product
TFT LCD	-	Thin-Film-Transistor Liquid-Crystal Display
UART	-	Universal Asynchronous Receiver-Transmitter
UTeM	-	Universiti Teknikal Malaysia Melaka
XOR	-	Exclusive OR gate
3D	-	Three-dimension

CHAPTER 1

INTRODUCTION

1.1 Introduction

In this introduction chapter contained detailed of an electronic educational simulator kit that convert digital system logic gate combinational kit to equivalent timing diagram. This trainer kit is very important to help student easily understand digital system subject.

1.2 Background Study

Base on Ashaari (1999) “educational kit is one of example that lecturer or teacher used to teach student. This alternative will help student understand topic easily”. Development of educational kit based on objective for every subject can help teacher and lecturer. When educational kit has more function, it can attract student to learn that subject.

According to Tocci (2007) digital system is a word become a vocabulary in our day because digital circuit and digital techniques have become widely used in our daily life. Example of digital system application such as computer, automation, entertainment and robot. In Universiti Teknikal Malaysia Melaka (UTeM), digital system subject will focus to student electric and electronic engineering. For this subject student will learn in theoretically and practically. For theoretical student will learn in lecture and tutorial but for practical student will learn in lab session.

E-Logic Trainer Kit is a trainer kit that test student understanding in Digital System subject but just focus in logic gate. This trainer kit will convert the connection that do in this trainer kit to timing diagram high (1) or low (0). Student is required to do connection on trainer kit. Once the connection completes the trainer kit will display the output timing diagram.

1.3 Problem Statement

In Universiti Teknikal Malaysia Melaka (UTeM), digital system subject will focus to student electric and electronic engineering. For this subject student will learn in theoretically and practically. For theoretical student will learn in lecture and tutorial but for practical student will learn in lab session.

Lecture session will do in a hall with a large group of students. The projector will use to display the lecture note for digital system. Lecturer will explain that note to student by theoretically. Just a few students can stay focus in class like this, but another student will feel bored and sleepy.

After chapter finish covered in lecture session, lecturer will have prepared some question for student. All student need to answer all questions and will discuss during tutorial session. Weakness of tutorial session is not all student will understand that chapter because majority lecturer only calls one student to solve one of the question and another student to solve another question. Additionally, student just understand theoretical but do not know application for that chapter.

During the lab session lab sheet will provide to guide student doing that experimental. Moreover, lab session only can conduct with lecturer guide. If lecturer take emergency leave the lab session cannot be conduct. So, the weakness of this lab session is student need the procedure to do that lab assessment. It cannot be done if that lab assessment does not have the procedure. Students also need a lecturer to guide them to make that assessment.

1.4 Objective

To overcome the problem stated above, few objectives are stated to achieve the purpose of the project. The main objective for this project:

1. To design an electronic educational kit that test student understanding of logic gate subtitle in Digital Electronic subject.

This educational kit will help engineering student that learn Digital Electronic subject to know output for logic equivalent circuit. This kit will change the equivalent circuit to timing diagram. This kit also will test knowledge with answer all question given.

2. To build the proof of concept of the compatible size and low cost

This kit will use small casing (8inch x 10inch x 4inch) to convenient user especially lecturer too bring it. This kit will design with low cost material such as Arduino Mega will use as microcontroller. Estimate cost is less than RM300.

3. To verify the functionality of the educational kit

All logic gate in this kit will test and will compared with simulation that build in Multisim 2013 Software.

4. To verify the effectiveness of the educational kit during class and tutorial session.

This trainer kit will demonstrate to third year and fourth year student as respondent for survey. Interview session for lecturer that teach Digital Electronic subject also will do to get feedback and improvement for this kit.

1.5 Scope of Work

In designing E-Logic Trainer Kit this project had limited certain criteria such as number of timing diagram input and output. This Liquid-Crystal Display (LCD) will display three input timing diagrams and one output timing diagram. Three inputs will use for E-Logic Trainer Kit because this project only use Thin-Film-Transistor Liquid-Crystal Display (TFT LCD 2.4”). If four inputs timing diagram use for this LCD it will produce very small timing diagram and too hard for user to see the output. For logic gate IC, E-Logic Trainer Kit will used only five type of logic gates. Two inputs for AND, OR, XOR, three input AND gate and lastly is NOT gate. All this gate is selected because there is the basic gate that learn. All this gate also selected because it is enough to prove that this kit can give highest effectiveness during teaching and learning session. Power bank is a power source for this kit. This is because output voltage for power bank is 5V and it suitable to use at Arduino.

Arduino IDE will use to program because Arduino Mega will is a microcontroller for this educational kit. This educational kit contain nine question and user cannot add the question. User also cannot choose any question that they want. This is because question in this kit was compile from easy to hard. This kit also cannot save user mark after answer all the question because this kit not contain Internet of Thing (IoT). SolidWork 2013 software will use to design this kit in three-dimension (3D) view.

For data and analysis, 50 surveys will be done to third and fourth years student in faculty of engineering technology (FTK) in University Teknikal Malaysia Melaka (UTeM). This survey will focus to third year and fourth year student because they have strong knowledge about logic gate. Survey also will be done to lecturer that know and teach Digital Electronic subject to get feedback. This survey also will be done by using quantitative method because the statistical can do from that data.

1.6 Project Contribution

The main motivation of this project is to propose a proof of concept of an educational trainer kit for logic gate. This trainer kit will teach student how to do connection of logic gate practically.

Tutorial session as mentioned is to theoretical and the question is limited. This E-Logic Trainer Kit also contain limited questions, but it can attract student during tutorial session because it not too theoretical and can improve student hands-on. This educational kit also can attract student to learn logic gate by practically not only theoretical.

Lab session might be hands-on but required supervisor from teaching engineer. Beside for lab session need laboratory sheet that contain many instructions. The educational kit does not require supervisor, give feedback directly to student.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

In this chapter, a guide and relevant topic about logic gate educational kit will be discussed and reviewed. The guide to writing this thesis are mainly from references book, research journal and online conference article. This section will include the study about microcontroller, TFT LCD display and other related components.

2.1 Hardware Use

This part will include the study of all hardware that will used in E-Logic Trainer Kit such as Arduino Mega, 4x4 Keypad, TFT LCD 2.4' and Logic gate IC.

2.1.1 Arduino Mega 2560

According to K. Benjamin (2014) Arduino Mega 2560 is a microcontroller board based on the ATmega2560. This Arduino contain 54 digital input/output pins (of which 14 can be used as pulse width modulation (PWM) outputs), 16 analogue inputs, 4 UARTs (hardware serial ports).

In E-Logic Trainer Kit, Arduino Mega 2560 used as a microcontroller. This microcontroller will use because this Arduino has more input/output. For E-Logic Trainer Kit need more input/output pins because only LCD need 28 pins input and output. Figure 2.1 represent picture of Arduino Mega 2560.

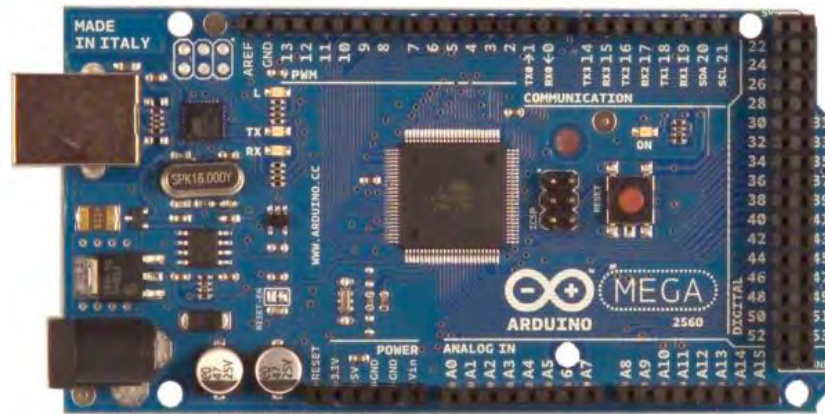


Figure 2.1: Arduino Mega (K. Benjamin, 2014)

2.1.2 Thin-Film-Transistor Liquid-Crystal Display (TFT LCD)

According to B. Sanders (2013) TFT LCD has two version of the shield. Resistive touch screen and capacitive touch screen are the version for TFT LCD. This LCD has 28 pins for display and pinouts. This TFT LCF also contain slot for micro SD card in the back.

In E-Logic Trainer Kit TFT LCD will used to display input and output timing diagram. For every input timing diagram must use distinct color. Because of that advantage this E-Logic Trainer Kit will use TFT LCD 2.4". Figure 2.2 represent picture of TFT LCD 2.4".



Figure 2.2: TFT LCD (A. Lady, 2015)

2.1.3 Keypad 4X4

According to W. E. Henley (2011), a 4x4 matrix keypad required eight input and output ports for interfaced is used as an example. Rows are connected to Peripheral Input and Output (PIO) pins configured as output but for columns are connected to PIO pins configured as input with interrupts. In this configuration, four pull-up resistors must be added to apply an important level on the corresponding input pins.

Figure 2.3 is picture for 4x4 keypad will use in this project. Keypad will use as input before start doing connection at this trainer kit. This keypad also will use for check output timing diagram when connection done.



Figure 2 3: Keypad 4X4 (W. E. Henley, 2011)

2.1.4 Logic Gate Integrated Circuit (IC)

Base on Aaronson (2008), “Logic gates are small (several micron) structure which take one or more bits as input and produce another bit as output”. For logic AND output is one if all inputs are one but for OR output will be 0 if has one input low (0). Output for XOR is the sum of all inputs but for NOT gate output is the opposite of the single input.

The most important hardware for E-Logic Trainer Kit is logic gate IC. For this educational kit, E-Logic trainer kit will use five IC for logic gate. There are IC for logic gate 2-input AND gate, 3-input AND gate, 2-input OR gate, 2-input XOR gate and lastly NOT gate. Figure 2.4 is pins diagram for IC 7400-series.