



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Development of an Electronic Educational Quiz Kit that Test Student Knowledge on Translating Timing Diagram to the PLC Ladder Diagram (PLC Education Quiz Kit)

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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I hereby, declared this report entitled “Development of an Electronic Educational Quiz Kit that Test Student Knowledge on Translating Timing Diagram to the PLC Ladder Diagram” is the results of my own research except as cited in references.

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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 Electronic) with Honours. The member of the supervisory is as follow:

.....

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(Project Supervisor)

ABSTRAK

Kit kuiz pendidikan PLC adalah alat yang menguji pemahaman pelajar mengenai menukar gambarajah masa ke dalam gambarajah tangga setara. Ini akan dilakukan dengan mempunyai alat pendidikan untuk memaparkan soalan dari segi kod mnemonik. Kemudian pelajar perlu melakukan sambungan gambarajah tangga setara di papan pendidikan. Setelah sambungan dilakukan, kit pendidikan ini akan memeriksa sama ada sambungan itu betul atau tidak. Objektif projek ini adalah untuk menjadikan pelajar lebih berminat dalam mempelajari penukaran gambarajah masa ke dalam proses pembelajaran gambarajah tangga. Ia juga mahu pelajar memahami perkara ini dengan lebih mudah. Projek ini menggunakan Arduino Mega sebagai pengawal. Kepala pin pula merupakan tempat untuk melakukan sambungan. Thin film transistor liquid crystal display (TFT LCD) digunakan untuk memaparkan rajah masa, soalan paparan dan bahagian simulasi. Matriks keypad 4x4 yang digunakan untuk membuat pilihan sama ada mahu melakukan bahagian simulasi atau bahagian kuiz. Kajian yang terdiri daripada sepuluh soalan telah dilakukan di kalangan pelajar di Fakulti Teknologi Kejuruteraan di Universiti Teknikal Malaysia Melaka untuk mengesahkan sama ada kotak kuiz elektronik ini boleh membantu mereka memahami tentang menerjemahkan rajah masa ke dalam rajah tangga dengan lebih mudah dalam proses pembelajaran mereka.

ABSTRACT

PLC educational quiz kit is a trainer kit that tests the student understanding about converting timing diagram into the equivalent ladder diagram. This will be done by having the educational kit to display question in term of mnemonic code. Then the student required doing the equivalent ladder diagram connection on the educational board. Once the connection is done, this educational kit will check whether the connection is correct or not. The objective of this project is to make students more interested in translating timing diagram into ladder diagram learning process. It also want student understand about this topic more easily. The project uses Arduino Mega as controller. Female header uses as port ladder diagram connection. Thin film transistor liquid crystal display (TFT LCD) used to display timing diagram, display question and simulation part. The 4x4 matrix keypad used to select either want to do simulation part or quiz part. A survey consist of ten question was done among the students in Faculty of Technology Engineering in University Teknikal Malaysia Melaka to verify whether this electronic quiz board can help them understanding about the translating timing diagram into ladder diagram more easy in their learning process.

DEDICATION

This report is dedicated to my beloved parents who educated and supported me throughout the process of doing this project. I am also wanted to say thank u to my supervisor and my friends who have encouraged, guided and inspired me to complete this project

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CHAPTER 1

INTRODUCTION

1.0 Introduction

This chapter aim on creating the frame work of this project. It includes all the requirements that need to be achieving at the end of the associated project. The project background will be briefly described. Therefore, the structure of the whole project can be precisely visualized.

1.1 Background Study

According to Ashaari(1999)Educational kit defined as “tools used in teaching which should not be limited to devices that are commonly used as a blackboard, pictures and all hardware and software for teaching”. Development of the educational kit is to help student more understand practically about what they learn. It also wants to help student more familiar with the connection of the component.

According to A.Albert (1980) Programmable Logic Controller (PLC) was defined as “ a digitally operated electronic apparatus which uses a programmable memory for the internal storage of instruction for implementing specific function”. The Importance of the PLC is it can control some batch process easier. Moreover, PLC

makes a programmer easy to arrange the flow of the process. When using PLC also make some programmer easy to trouble shoot the problem of the process. This programmable logic control had been teach in the subject control principle (BETE 2364) for the engineering technology and subject control principle and system (BENE 3223) for the pure engineering at the University Teknikal Malaysia Melaka. It been teach in the lecture session for the general theory, specific to the calculation in the tutorial session and in the lab session student will learn how to make some program of PLC and hand on.

PLC educational quiz kit is a trainer kit that tests the student understanding about converting timing diagram into the equivalent ladder diagram. This will be done by having the educational kit to display question in term of mnemonic code. Then the student required doing the equivalent ladder diagram connection on the educational board. Once the connection is done, this educational kit will check whether the connection is correct or not.

1.2 Problem Statement

At University Teknikal Malaysia Melaka (UTeM), this programmable logic control (PLC) had been taught in the subject control principle (BETE 2364) for the engineering technology and subject control principle and system (BENE 3223) for the pure engineering. It been teach in the lecture session for the general theory, specific to the calculation in the tutorial session and in the lab session student will learn how to make some program of PLC and hand on.

During the lecture session, it will do in a hall with a big group of students. Lecturer will teach the student at the front of the hall by using the projector to display the theory of the PLC. Then lecturer will explain about the theory. The shortage of this

lesson session is student will be boring. It also makes the students feel sleepy. Moreover, just a few students can stay focus until the end of the lesson.

During the tutorial session, it will do in the small class room. Lecturer will prepare some question for students. Students need to answer that question. At the end of the class, lecturer will pick some question to discuss in the class. The weakness of this tutorial is students just understand about the theoretical. The question provided also just a little bit and it does not interesting. It cannot attract the interest of the student to learn. Moreover, just a few students do the tutorial question.

During the lab session, the lecturer will provide to all students the lab sheet. This lab sheet will explain about the thing that student has to do in that lab session. Then lecturer will explain to the student about of the procedure of the lab session. After that, lecturer will make a demonstration to all students how to do that lab. 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 guild them to make that assessment. This lab session also will be done in a group. Just a few members of the group do the lab assessment.

1.3 Objectives

The objectives for this project are:

1. To design a proof of concept an educational quiz kit that tests the students understanding of PLC's.

The design of educational quiz kit consists of 2 parts. First part is external hardware design. This part is about designing the casing of the educational quiz kit. The second part is internal hardware design which consists of electronic circuit and software design which consist of source code.

2. To build the proof of concept of the compatible that is 8cm x 10 cm and low cost that is less than RM300 educational kit that using Arduino Mega as the controller.

The external casing will be the plastic. It is because it easy to cut. It also cheap compare to the other material. So the cost of the project can be reduced. The microcontroller is Arduino Mega 2560. It is because Arduino Mega 2560 more cheaply compare to other microcontroller such as raspberry pie.

3. To verify the the functionality of the educational kit by performing a set of system testing which will be based on a checklist.

This will be done by testing one by one of the connection port at the kit and see the output results that is follow the expected output or not.

4. To validate the effectiveness of the educational kit in aiding students learning flowchart by demonstrating to the target audience (students and lecturer that taught the students Faculty Technology Engineering Universiti Teknikal Malaysia Melaka). A questionnaire will be use to measure the effectiveness.

1.4 Scope of Work

In designing the educational kit, this project had limited to certain criteria. The criteria are number of difficulty, number of input and output, number of questions and method of inserting the questions. First, the amount of the questions. In this educational kit have six questions. It limited to six questions because this educational quiz kit still in testing phase. Third is limitation number of input and output. The number of input is limited to three and number of output also limited to three. It is because this just covered a few basic instructions in the ladder diagram. It do not cover for the latching, counter and the other advance instruction in the CX Programmer. This project used Arduino Mega 2560 as it microcontroller. It is because this Arduino Mega 2560 is more cheap compare to raspberry pie and other microcontroller. It also used thin-film-resistor liquid-crystal display (TFT LCD) to display input and output. It is because TFT LCD can display apart of word such as graph. This project also just used a few button of the keypad which is button 1, 2,A and B. It is because this project used keypad just for to select either want to do simulation or question, to check the answer of the connection and to continue to the next question at quiz part.

There is limitation in designing the external hardware. The material that used to make this external hardware is Polyvinyl chloride (PVC). It is because PVC is easy to cut. It also cheap compares other material. So, the cost of the project can be reduced. PVC is a lightweight material. The user will easy to carry this educational kit. The dimension size of this project is 8cm x 10cm. I choose this dimension size because it enough to represent the entire component for my Final Years Project. The circuit design and simulation also face some limitation where the certain component is not available. Example is proteus. It is because in proteus does not have some of the component that needed in this project such as thin-film-transistor liquid-crystal display (TFT LCD) and Arduino Mega 2560. To test connection TFT LCD, it has to do using hardware. It cannot be done by simulation. There are also has some limitation in the efficiency verify. This project will be survey at the faculty of engineering technology in University Teknikal

Malaysia Melaka. I make some survey with the Engineering Technology students. It has limited to 50 of students. It is because students busy with their own work and responsibility. Moreover, I do not have enough time to make a survey more than that. It also do not has the return button because the digital pins for Arduino is full. The return button need to used interupt. The interupt needs to use certain digital pins such as digital pin 2,3,8 and 9.

1.5 Project Constribution

The main motivation in doing this project is to prepare a proper concept of a PLC education quiz kit to the student that takes the subject about PLC"s. It also wants to help the students more understand about converting timing diagram to the equivalent ladder diagram. It also want to help the students study about this without supervision and interactive. Tutorial lesson as mention is theoretical and the question is limited. This educational quiz kit is hand – on, many question and more attractive than answering question on the paper. It will attract the interesting of student in learning about the PLC"s. Lab session might be hand – on but require supervisor, the laboratory procedure is really complicated. The educational quiz kit does not require supervisor. It also give faster feedback and directly to the student.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter consists of two sections where the first section explains about the hardware used in this project and the second part explains about the previous project that related to this project.

2.1 Hardware Used

This part will explain about all the research of hardware that used in this PLC Trainer kit which is Arduino Mega 2560, thin-film-transistor liquid-crystal display (TFT LCD), Logic Gate IC and 4x4 matrix keypad.

2.1.1 Arduino Mega 2560

According to Wei et al.(2014) Arduino Mega 2560 is a one type of microcontroller board. This Arduino Mega 2560 consists of 54 digital input and output pins. This pins has their specific port which 14 can be used as PWM outputs, 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It

contains everything needed to support the microcontroller. This Arduino Mega 2560 used 5V to operate the system. This Arduino Mega 2560 is used in PLC quiz kit project as a microcontroller. It was the brain of this project. The operation flow of this project will be control by this microcontroller. It also used as a port connection for power supply to powered the whole component in this project. Figure 2.1 below show the image of Arduino Mega 2560.



Figure 2.1 : Image of Arduino Mega 2560 (Wei et al. 2014)

2.1.2 Thin-film-transistor Liquid-crystal Display (TFT LCD)

According to B.Christopher n.d.(2010) Thin-film-transistor liquid-crystal display (TFT LCD) is an lcd with the high resolution screen display. It also a touch screen lcd. It consists of 28 pin as port of the connection. It powered by 5V of power supply. This thin-film-transistor liquid-crystal display (TFT LCD) is used in this project as output display. It will display the level of difficulty, the question of this quiz kit and the answer of the question. It also acts as an instruction for this quiz kit. Figure 2.2 below show the image of TFT LCD.



Figure 2.2 : Image of TFT LCD(B.Christopher n.d.2010)

2.1.3 4x4 Matrix Keypad

According to V.R.Lopez (2008) Keypad is a component that requiring eight input and output pin. It pin is divided to two part which is row and column. The row part will be connected to peripheral input output (PIO) that configured as output pin. The column part also will be connecting to PIO and it will configure as input interrupt.

In this PLC educational quiz kit, keypad was used as an input. The user will use keypad to select the level of the difficulty. Keypad also used to check the answer of the question. Figure 2.3 below show the image of 4x4 matrix keypad.



Figure 2.3 : Image of 4x4 Matrix Keypad (B.Christopher n.d.2010)

2.1.4 Logic Gate IC

According to B.George (2000) Logic gate IC is a component that deals with the true and false instead of number. In electronic circuit, the true and false can be defined by the present of the voltage in the circuit. True will be defined when it detect the present of voltage and false will be defined when it no voltage. It has many type of logic gate IC such as AND gate IC, OR gate IC and NOT gate IC.

In this PLC educational quiz kit, the logic gate IC AND, OR and NOT will be used. It is used as an input. It also acts as basic ladder diagram input and