



# e-FLOWCHART: AN ELECTRONIC EDUCATIONAL QUIZ BOARD THAT TEST STUDENT KNOWLEDGE ON C PROGRAMMING CONCEPT USING FLOWCHART COMMAND

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## ABSTRACT

Flowchart is a visual representation of a flow of data. It can be used to outline a process or a solution to a problem, whether it is simple or complex. For beginners in programming, it is vital to learn flowcharting to understand the basic logic behind a program. This paper presents the development of an electronic quiz board for testing primary school students' knowledge related to basic flowchart in C programming called e-FLOWCHART. The device works by displaying question to user, then user has to insert relevant flowchart blocks on the slots boards. Once done, the user press button and e-FLOWCHART will give feedback whether the answer given by the user is correct or otherwise. The interactive element of e-FLOWCHART yet keeping the tactile or "hands-on" feeling highlights the novelty of this educational compared to other available flowchart teaching aids which are software-based. Future study includes the evaluation of the effectiveness of e-FLOWCHART.

**Keywords:** flowchart, educational kit, c programming.

## 1. INTRODUCTION

According to [1], "A flowchart is a formalized graphic representation of a logic sequence, work or manufacturing process, organization chart, or similar formalized structure. The purpose of a flow chart is to provide people with a common language or reference point when dealing with a project or process". Flowchart is basically used for the construction of a program that mostly important to create a project.

Flowchart uses simple geometric symbols and arrows to define relationships. In programming, for instance, the beginning or end of a program is represented by an oval. A process is represented by a rectangle, a decision is represented by a diamond and an I/O process is represented by a parallelogram. Every process that is used in the cycle is important to determine the output of the program.

Flowchart has been used extensively in teaching programming as a visual aid to describe briefly the operation of an algorithm or a written programming program. Based on [2] and [3], although flowchart is an important tools but it has been difficult for the primary school students to master it as it has different symbol used for a certain process that make them unable to identify the function of the whole flowchart.

Besides that, there are some primary school students that do not know to how to read and write command used in C programming. A basic knowledge of C language is required to understand the command used in a program.

This project attempts to develop an electronic based educational kit that tests primary school student knowledge on concept of flowchart and C programming.

The purpose of this project is to increase student understanding about the operation of the flowchart besides increase their knowledge in C programming subject.

Several electronic-based educational boards have been developed over the years. R. F. Mustafa *et al.* in 2017 [4] developed an electronic based of the popular Mastermind game where Red-Green-Blue (RGB) Light Emitted Diode (LED) are used as clue indicator for user to solve the game.

In 2018, M. H. A. H. A. M. Faseh *et al.* [5] proposed electronic educational board games that used Arduino to simulate or translates Programmable Logic Controller's (PLC) Mnemonic Codes to hardware execution.

In the same year, A. Amar *et al.* [6] proposed an electronic based Arduino component tester called E-Tester. It able to test around 12 commonly used Arduino components and modules. In the area of flowchart software, e-Draw Created by Edrawsoft Company [7] is all-in-one diagram software, which can simplify the creation of over 200 types of diagram such as business presentations, building plans, mind maps, science illustration and more. It supports all Windows started with Window 2000. This software is able to create different types of diagram aside flowchart and a professional quality diagramming tool but it is not suitable for educational purpose and expensive.

1888 Quick Flowchart Creator [8] is a free flow chart creator with the entire symbol required in flowchart. Flow chart and diagram can be draw quickly for presentation and documents. Not only small and lightweight, which makes it run smoothly even on low-end computer systems, this program is also can be download



free from the internet. But it is hard to modify and cannot be used as educational purpose.

## 2. METHODOLOGY

The proposed e-FLOWCHART can be divided into three stages as illustrated in Figure-1 of process that is input, control and output stage. The first stage is input stage where the variable resistor (R2) is used for each command that will be used in the flowchart. Besides that, keypad also included in the input stage where the user will insert or pressed the keypad button to answer the question. Next, the control stage is located between input and output stage. Arduino Mega 2560 microcontroller is located in the control stage where it acts as a brain that controls all the input and output of the project. Lastly, the output stage is represented by buzzer, LED, TFT LCD and LCD screen (20x4). During this stage, the components will produce the expected output based on the input that inserted by the user.

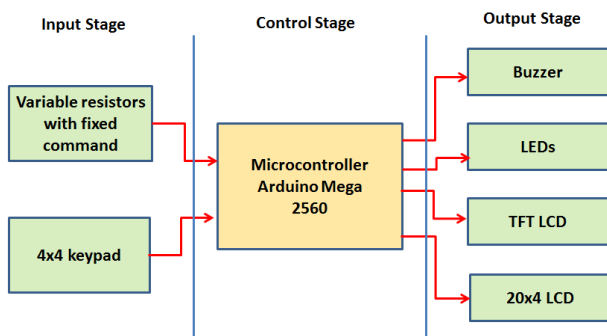


Figure-1. e-FLOWCHART block diagram.

Figure-2 shows that the flowchart of e-Flowchart educational kit. The project flowchart is important because

it concludes all the process of the project from the start until the end of project's process. This flowchart can be an easy guide to the user and also give them a proper understanding regarding the project.

Firstly, the project will start soon after it connected to a power supply. After a few seconds, LCD screen will light up and display the title of project, student's name and supervisor's name on the last row. Next, there will be a delay for a few seconds until LCD screen print an instruction where it says to press the button on the keypad in order to proceed to the question. After the user press the button, a question will pop up on the LCD screen where it says "Place the flowchart command so actual output is the same as expected output". In the meantime, the TFT LCD is displaying the expected output which is linked to the question form the LCD screen that also act as a reference for the user in order to get the actual output. The command is then placed on the flowchart based on the expected output to get the actual one.

After done with placing command on the flowchart, push button on top of the flowchart is pressed to answer the question. The actual output is then will display on the TFT LCD. Green LED will light up if the user gets the correct answer and buzzer will produce a tone with melody while the red LED will light up if the user provides wrong answer and buzz sound will be produced. In the meantime, the LCD screen will display the result from answering the question whether it is correct or wrong and mark is given only for the correct answer. Lastly, an instruction is given in last row of the same display for the result and mark obtained where it ask the user to press '#' button to proceed to the next question. This project consists of 4 questions and the same process is repeated for the entire questions except command us.

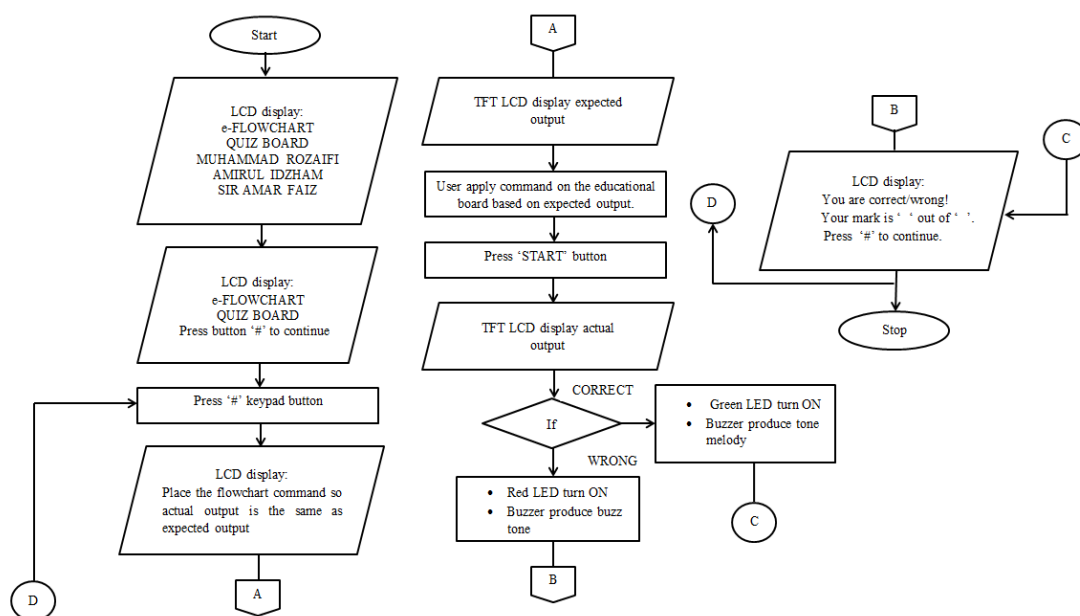


Figure-2. e-FLOWCHART flowchart.



Figure-3 shows a complete hardware of e-Flowchart. This project consists of 8 female headers that act as a slot for the command where user has to insert the command based on the expected output given to get the actual output. A push start button is used in this project to run the flowchart when all the command is applied on the kit. The keypad button is pressed after obtaining the answer to proceed for the next question. Besides that, the components used to produce the output in this project are LCD screen (20x4), LED, buzzer, and TFT LCD.

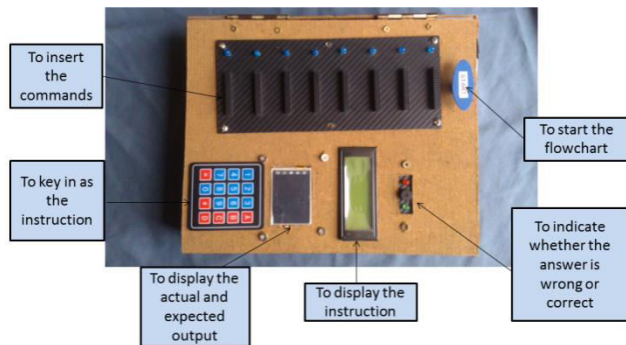


Figure-3. Project prototype.

Figure-4 shows the schematic diagram for e-Flowchart Educational Kit. There are many resistor with different value used in this project where each resistor will represent each command that we included in this project. The resistor that used for the command will be obtained by using the concept of voltage divider rule (VDR). Figure-5 shows a basic circuit of Voltage Divider Rule that being applied in this project. Table-1 shows the resistor values and the command they represent.

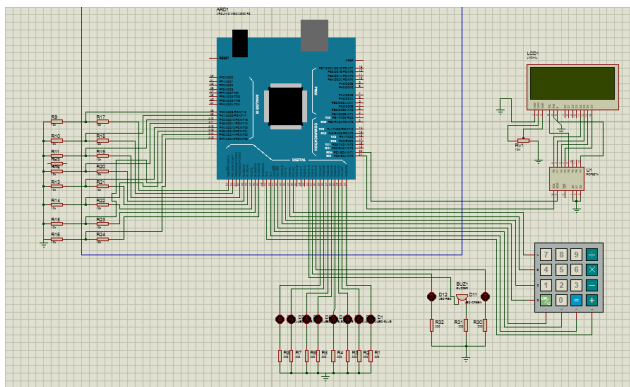


Figure-4. Project schematic diagram.

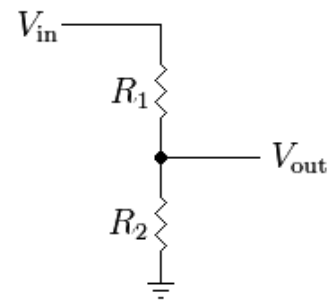


Figure-5. Basic circuit of VDR.

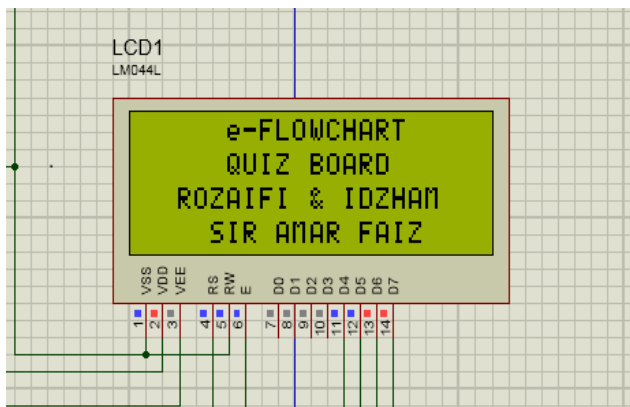
Table-1. Resistor value for command.

No.	Basic input command	Resistor value(R2)
1	A = 0	470 $\pm$ 5% $\Omega$
2	B = 1	2000 $\pm$ 5% $\Omega$
3	A = 5	3320 $\pm$ 5% $\Omega$
4	B = 20	4300 $\pm$ 5% $\Omega$
5	++A	5900 $\pm$ 5% $\Omega$
6	++B	7500 $\pm$ 5% $\Omega$
7	A += 2	9100 $\pm$ 5% $\Omega$
8	B += 5	10000 $\pm$ 5% $\Omega$
9	B -= 5	11000 $\pm$ 5% $\Omega$
10	B *= 2	12100 $\pm$ 5% $\Omega$
11	B = A+2	13000 $\pm$ 5% $\Omega$
12	B = B+A	16000 $\pm$ 5% $\Omega$
13	B = B-A	18000 $\pm$ 5% $\Omega$
14	if A <= 5	20000 $\pm$ 5% $\Omega$
15	if B >= 0	24000 $\pm$ 5% $\Omega$
16	printf("\A = %d\n",A);	22000 $\pm$ 5% $\Omega$
17	printf("\B = %d\n",B);	27000 $\pm$ 5% $\Omega$
18	STOP	43000 $\pm$ 5% $\Omega$

### 3. RESULTS AND DISCUSSIONS

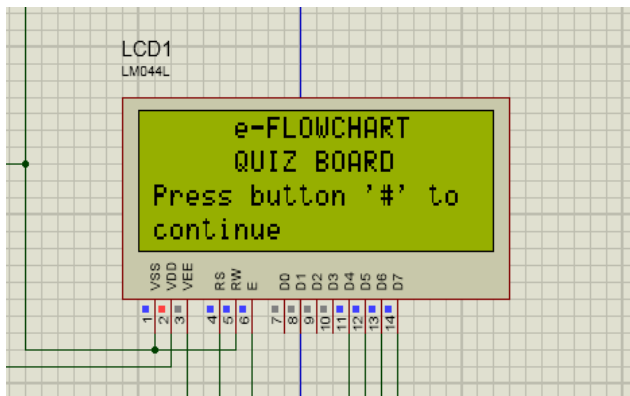
Figure-4 shows the schematic diagram that is used to obtain simulation result. The Proteus Software is used to get the simulation operate. There are several conditions of the simulation that has been included to show the result of the simulation such as display on the LCD screen.

In this project, LCD screen (20x4) is used for the visual display that will be responsible to display the output. A bigger LCD screen is chosen in order to provide enough space for the question that is created in the program to fit enough on the screen. For the initial visual display, LCD screen will display 4 lines of word soon after the project turned on. The word appeared on the screen will be the title of the project, student's name and the supervisor's name. Figure 6 show the display of the LCD screen.



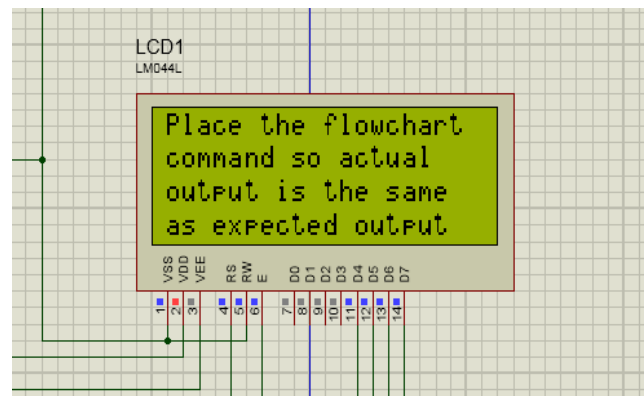
**Figure-6.** LCD screen displayed project's title, students' and supervisor's names.

Then, after a few seconds, the LCD will display an instruction as for the user guidance. The word print on the screen is title of the project at the top part of the screen while middle screen is printed "Press button # to continue" instruction that is referring to the keypad button where user have to press button "-" to proceed to the question as this is due to the keypad without hashtag "#" button. The result is shown as in Figure-7.



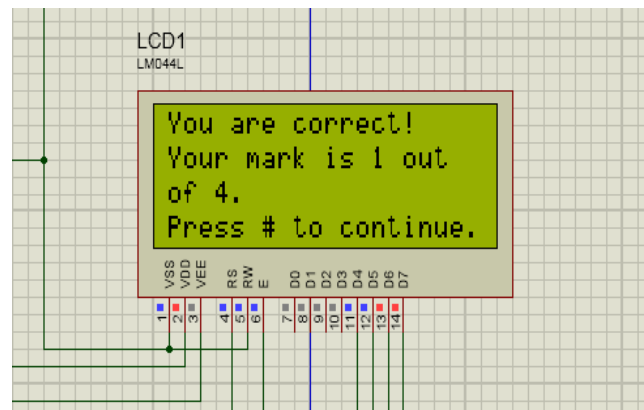
**Figure-7.** LCD Screen display instruction provided for the user guidance.

Next, a question will be appeared in a few seconds after the user press the keypad button which as illustrated in Figure-8. The LCD screen will show "Place the flowchart command so actual output is the same as expected output" where it give an order to the user to place the command on the flowchart based on the expected output given. The question will appear on LCD display until START button is pressed to show the next display. For simulation, the arrangements of resistor values are set accordingly.

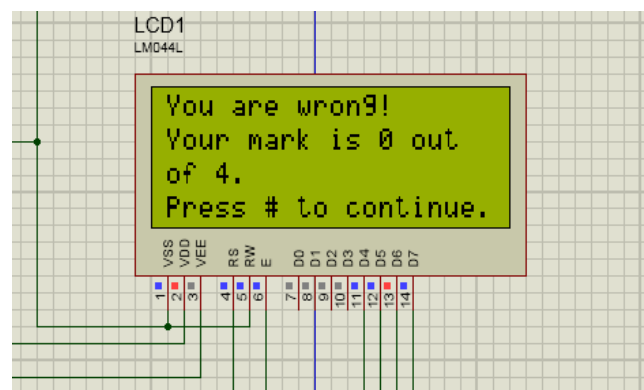


**Figure-8.** LCD screen display question.

After that, the LCD screen will display the answer whether the answer is correct or wrong then mark is obtained from answering the question given. It then displays an instruction for the user to proceed for the next question. Figure-9 and Figure-10 shows the examples of the display on LCD screen for the answer with correct or wrong followed by the mark given for both of the situation.



**Figure-9.** LCD screen display if answer correct.



**Figure-10.** LCD screen display if answer wrong.

Table-2 shows that the result of the flowchart for a different condition. The situation is observed and the result and output of the process is recorded. The





simulation and hardware result has obtained is in line with the expected result.

**Table-2.** Hardware implementation result.

Subject	Situation 1	Situation 2	Situation 3
Condition	User inserts the right command for the first question on the flowchart to get the actual output based on the expected output given.	User inserts the right command for the second question on the flowchart to get the actual output based on the expected output given.	User inserts a wrong commands for the next question on the flowchart to get the actual output based on the expected output given.
Expected output	<ul style="list-style-type: none"> <li>Green LED light up.</li> <li>Buzzer produce tone melody.</li> <li>1 mark is given.</li> </ul>	<ul style="list-style-type: none"> <li>Green LED light up.</li> <li>Buzzer produce tone melody.</li> <li>2 mark is given.</li> </ul>	<ul style="list-style-type: none"> <li>Red LED light up.</li> <li>Buzzer produce beep sound.</li> <li>No mark is given</li> </ul>
Insert command in simulation			
LCD Display during simulation			
Result			

#### 4. CONCLUSIONS

This paper presents the development of the electronic-based educational kit called e-FLOWCHART that test student knowledge on basic C Programming commands. The device has the unique features whereby students are able to do hands-on to learn flowchart for programming in hardware base instead of software. Details of the hardware and software had been explained extensively. The hardware and software results obtained are as expected result.

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