Abstract—This paper discusses development of an instructional media of teaching microcontroller 8051 based control. The results of the development can be used to help users in teaching using a simulator called MCU 8051 IDE that runs on Windows. It can also be utilized to support the implementation of active learning in higher education (ALFHE). The paper demonstrates the implementation of struct and pointer to put data in specific range of Internal Random Access Memory (IRAM) locations, to retrieve, and to display them on some displayers connected to the ports of the microcontroller 8051.

Index Terms—Microcontroller 8051, C Programming, Simulator, Active Learning

I. INTRODUCTION

The application of active learning strategy has demonstrated significant efficacies compared to conventional learning [1][2]. Active learning strategy has been shown to increase participation and engagement (reduction in stress level of the students and teachers) of students in the classroom [3]. It has also increased learning desire of students that finally produces more innovative students. In active learning, students are given more freedom to try new things or ideas by using innovative and interactive teaching media [4].

Based on [3][4][5][6], it has been found that, in teaching at college, there is a need for changing in teaching methodologies (Instructional Strategy of Teaching) in order to increase the success rate of teaching and learning process. The process might be carried out by transforming the conventional learning methodology (teacher as central or learning resources) to the active teaching methodologies or Active Learning Methodology (students as a learning center) [7].

Simulators have been considered widely as an ideal tool to mimic and to stimulate real systems. The simulator can also be used before starting to develop or to manufactur real equipments as it can decrease the production costs [8][9]. One of the strategies in the application of active learning is the use of an instructional media in the process of teaching and learning. Nowadays, various simulators of 8051 microcontroller can be found and downloaded for free to be used as a media in the active learning [10][11].

The availability of these free to download simulators has also motivated to develop similar media that will help poor and under developing countries in saving their budget on buying paid programs. Moreover, this can give users the opportunity to master and to implement the technology with low operation costs. In this paper, it is used one of widely known as MCU 8051 IDE to develop microcontroller 8051-based control simulator runs on Windows XP operating system, and to test the program on MCU 8051 IDE [12].

The programming language used in the development of this program is C program embedded on MCU 8051 IDE widely known as SDCC-Small Devices C Compiler. It also utilizes output and input visual hardwares provided by the simulator. The visual output hardware displays output information based on the data taken from the lookup table data, saved in a specific range of IRAM locations. The program retrieves the information based on the input data received from the input port of the 8051.

The strength of struct and pointer of C programming language is in database and data retrieving application. The hardships of students to mastering struct and pointer concepts of C programming language has also motivated to develop this program in the paper. It is aimed that the simulator will contribute to development of sciences, particularly in computer sciences, microcontrollers, computer-based control systems and engineering. In addition, the simulator can also be used in higher education as a media of teaching in active learning class and can further inspire the teachers to create a variety of other media by utilizing the developed program, MCU 8051 IDE simulator, and SDCC of C programming language [13].

II. MAIN OBJECTIVES

The paper focusses on the development of a simulator based on MCU 8051 IDE. In this simulator, a user can employ struct and pointer functions to put data, to retrieve data in the specific Internal RAM at a certain location, and to display data at LED. The simulator receives input data from key_Pad (a-g) lowercase letter and number from 0-9. This is more complex than the previous development that only simulate to show the letter “h” and “I” at the display related to the condition of high or low voltage [6].

The benefits of the simulators are as follow. Students or users can carry out simulation to display alphabet a-g and number 0-9 by turning on the related LED as a response to the given input. After that, students or users can perform further
study for another letter or character.

Fig. 1a below shows the global concept or the block diagram of the research. The main components of the simulator are as follows: virtual output display (in this paper we use virtual seven segment display), virtual command anode LED Structure, virtual input device (virtual keypad) and virtual microprocessor 8051. The simulation program is developed by using small devices C compiler provide download freely from the internet. User can edit, recompile and run the developed program by using it (in integrated development environment). The flowchart of the simulator is given in Fig. 1b respectively.

Fig. 1a. Block diagram simulator

III. MAIN RESULTS

Fig. 2 below shows the result of a print screen of the GUI (Graphical User Interface) [14] of 3 pieces of visualized hardware before compiling the program. In that figure, it can be seen that one should set the character inside of the square bracket of struct member named as sev[] to be “0” as follows sev[0]. P1 named as key_pad, works as an input port. It was connected with a simple switch structure (A-H).

Each pin on the switch P1 (P1.0-P1.7) is independent and is a toggle switch, when the switch is pressed the switch will be connected to GND and if it is re-pressed again then the corresponding switch will be opened or released again (logic “1”); normally high or open switch.

Both P2 named as led dsp, and P0 known as sev dsp function as output ports. The virtual output device in the form of seven segment display connected to P0 is a common anode Light Emitting Diode (LED) structure. The anode pins or leads of the LED structure are connected together to a 5 V DC voltage source and each cathode lead of the LED structure is connected to the appropriate bit of P0 (P0.0-P0.7); to light up a single segment of the seven segment, one needs to send a logic 0 to the appropriate bit of P0.

For example to light up segment “a” of the seven segment display, one needs to send data of 11111110b (FE1) to P0. P2 known as the led dsp as mentioned before is connected with a
structure of LEDs in a common anode structure either; each anode pin of the LEDs was connected together and connected to a 5 voltage DC source.

To lit each LED up, one only needs to connect the cathode pin of the LED to the ground voltage of the source. The developed program will send the data received in key_pad to the led_dsp (led_dsp=key_pad); it will lit a single LED up in associated with the pressed button of key_pad port; if P1.0 was pressed the associated LED connected to P2 in this case P2.0 will be litted on.

If the program is compiled and run by clicking the appropriate buttons (compile and run button) and followed by clicking one switch to switch it on (normally open switch) of P1; connecting the appropriate pin of P1 to ground. By clicking the switch that connected to P1.0 as shown in Fig. 3., a character of number “0” will be displayed on P0 and LED0 (the first LED) will be on as well. To display “1” character on P0, one needs to connect P1.1 to GND by clicking P1.1. It will switch the second LED (LED1) that connected to P2.1 on as well.

Fig. 4. below shows how to display a character of letter (lowercase) a- g. As mentioned before, before compiling the program, the user needs to set the contents of square bracket of member struct sev[] to 1 as follows sev[1]. To display “a” character one needs to compile the program and press key_pad bit 0 (P1.0) as shown in Fig. 5. below.

The program as mentioned above will lit the first LED structure of P2 (P2.0) on. To display “g” character on sev_disp user needs to press P1.7 of key_pad as the program is running.
IV. CONCLUSIONS

The simulator developed by using MCU 8051 IDE, SDCC was robust and successful in demonstrating data receiving from an input device. In this case, a Key Pad and the using of struct in data retrieval from Specific IRAM location and displayed the result appropriately on some tests.

The paper was expected to contribute in simulator development for sciences, in the areas of microcontroller, computer, and microcontroller or computer based control system engineering and computer education. It was also intended as a media of learning in an active learning model in higher education to facilitate the study of participants to master the subjects more fully and enable the teacher to improve the teaching process.

REFERENCES


