DEVELOPING A TEACHING MEDIA OF MICROCONTROLLER 8051 IN DISPLAYING CGRAM CHARACTER ON LCD BY USING THE MCU 8051 IDE AND ASM51 IN SUPPORTING ALFHE

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ABSTRACT

On this occasion, the author developed an instructional media of active learning teaching of microcontroller 8051 in displaying Character Generator Random Access Memory (CGRAM) on Liquid Crystal Display (LCD). This simulator simulated of how the program in generating special character, also widely called as customized character, like symbol, smiley, and etc. that had not been provided by the LCD manufacturer on Character Generator Read Only Memory (CGROM) and eventually displaying the CGRAM character on LCD as the normal character of CGROM. This program of simulator was developed in Micro Controller Unit (MCU) 8051 Integrated Development Environment (IDE) widely known as MCU 8051 IDE and Assembly-51 (ASM51).

Keywords: micro controller, MCU8051 IDE, ASM51, simulator, active learning, teaching, media, CGRAM, LCD, CGROM, controller, screen.

1. INTRODUCTION

Based on the author's experience in teaching at college, the authors see the need for a changing in teaching methodologies (Instructional Strategy of teaching) in order to increase the success rate of teaching and learning process; transforming conventional learning methodologies (teacher as central or learning resources) to the active teaching methodologies or Active Learning Methodology (students as a learning centre). The application of active learning strategy has demonstrated some significant efficacies compared to the conventional learning [1] [2]. Active learning strategy has been shown to increase the participation and student engagement (reduction in stress level of the students and teachers) in the classroom and increasing students' learning aspiration and eventually produce more innovative students; students are given more freedom to try new things come up in their mind by using innovative and interactive teaching media. They can use the simulator before starting developing or manufacturing real equipment; the implication is the decrease of the production costs. One of the strategies in the application of active learning is the use of instructional media in the process of teaching and learning, especially the use of computer simulation as the media of teaching. At this time there are various microcontroller simulator 8051 learning that can be downloaded for free and can then be used as a media of learning in the application of active learning[3][4]. The author used the simulator MCU 8051 IDE and ASM-51to develop the simulator. Issue or problem of how to display CGRAM character on the LCD screen has been accidentally read by the author occasionally when browsing the Internet and while reading a few posts on discussion groups of microcontroller and robotics enthusiasts. Writers saw some readers tried to help by providing some answers and examples of the program, but not so many of them have given a satisfactory answer to them. This problem background and the need for the media of microprocessor teaching in the classroom when teaching, and in supporting the ALFHE implementation worldwide have encouraged and droved author to develop a simulator to generate the CGRAM character and displaying it on the LCD screen. LCD module consists of two main devices, the controller and LCD. The controller is a kind of microcontroller that has its own instruction set and two kinds of memory, Display Data RAM (DDRAM), and CGROM. CGRAM actually is part of and located in CGROM with addresses of 00h-07H; only 8 special characters can be generated and saved there each will take one location. Each character has a size of 5X8.

2. RELATED WORK

Using media of active learning teaching developed both by using computer program in the form of simulator and non-computer related media have been done by some researchers and scholars. Some of them have published their works in this field as follow; in this paper [5] the author reported the designing of decoder to display the result of the digital voltage level on a seven segment display in the form of character “H” and “L”. The author proposed the using of his design to be implemented in active learning class especially in electronic digital laboratory. In paper [7] the authors develop an active learning simulator using both MCU8051 IDE and SDCC. In this paper they report that the simulator will display the level voltage of a pin of an 8051 port on a virtual seven segment display and propose to use it as a media of teaching especially in the classes that have adopted active learning strategies. In this paper[8] the authors reported the development of a simulator program that simulate the process of multiple interrupts runs on a 8051 microcontroller by using MCU8051 IDE and ASEM 51.
3. PROPOSED SYSTEM

In this paper the author proposed the development of an active learning media of teaching microcontroller 8051 in the form of simulator in displaying some special character/customized character on LCD. The developed simulator can be used in an active learning class or a laboratory. The simulator program was developed by using free to download programs MCU8051 and ASM-51 from Internet and can be run on various operating systems (OSs). This simulator will answer some people questions in the Internet of how to generate customized character or CGRAM character and display them on the LCD and also enable the learning participants in an active learning class to run the learning process conveniently. This simulator also will display the running program on a Graphical User Interface (GUI) and some virtual hardware as shown on Figure-1, Figure-4 below.

4. SIMULATION

A simulation has been done and the result of it has been captured as shown on the Figure-1, Figure-4. Figure-1 below shows the result of a print screen of the GUI (Graphical User Interface) of the simulator prior compiling the program.

![Figure-1. Print screen of GUI Prior compiling the program](image1)

In Figure-2, you can see the GUI picture with the three special function characters of CGRAM displayed on CGRAM addresses (00h-02h). As mentioned before that CGRAM located in CGROM with address location of 00h-07h.

![Figure-2. Print screen of GUI after compiling the program](image2)

In Figure-3 you can see the GUI picture with the three special function characters of CGRAM displayed on LCD. As mentioned before that CGRAM located in CGROM with address location of 00h-07h.

![Figure-3. Print screen of GUI shows the program generating three special characters of CGRAM prior displaying them on the LCD](image3)

In Figure-4, you can see those three special characters of CGRAM displayed on LCD.

![Figure-4. Print screen of GUI shows the program displaying the special character of CGRAM on LCD](image4)

4.1 The complete program of simulator

The flow chart and the full program of the simulator are shown below:
Based on the circuit connection of LCD pins to Microcontroller pins, configure the LCD in enabling it to communicate with Microcontroller 8051

Develop the macro to do the commands; write instruction register and data

Give commands to LCD controller to generate the special characters and save them on addresses of 00h-02h

Display the characters on the LCD (DDRAM)

Figure-5. The flowchart program of the simulator.

The complete program of the simulator is shown below:\[7\].

```
org 0
jmp start

RS bit P3.0 ; Register Select (Instruction ; or data register)
RW bit P3.1 ; read (1) or write operation (0)
E bit P3.2 ; Enable (from 1 to 0)
D equ P1 ; P1 was put as data bus

cmd macro cmd_code
    setb E
    mov D, cmd_code
    clr E
endm

main: clr RS ; choose Instruction Register

start:
    clr RS ; choose Instruction Register
    clr RW ; write operation
    cmd #40h ; command to set CGRAM address
    setb RS
    cmd #01h ; pattern of 1st row of CGRAM
    cmd #02h ; pattern of 2nd row of CGRAM
    cmd #04h ; pattern of 3rd row of CGRAM
    cmd #08h ; pattern of 4th row of CGRAM
    cmd #010h ; pattern of 5th row of CGRAM
    cmd #011h ; pattern of 6th row of CGRAM
    cmd #01fh ; pattern of 7th row of CGRAM
    cmd #00h ; pattern of 8th row of CGRAM
    setb RS
    cmd #04h ; pattern of 1st row of CGRAM
    cmd #0eh ; pattern of 2nd row of CGRAM
    cmd #11h ; pattern of 3rd row of CGRAM
    cmd #04h ; pattern of 4th row of CGRAM
    cmd #04h ; pattern of 5th row of CGRAM
    cmd #04h ; pattern of 6th row of CGRAM
    cmd #04h ; pattern of 7th row of CGRAM
    cmd #00h ; pattern of 8th row of CGRAM

    main: clr RS ; choose Instruction Register
    cmd #0000001b ; clear display
    cmd #0000011b ; cursor home
    cmd #00000110b ; entry mode set
    cmd #00001111b ; display
    clr RS
```

;the next character on CGRAM on 50h

;the next character on CGRAM on 48h

11365
5. CONCLUSIONS
From the results of the simulation and its implementation in the class a few things can be observed,

a) MCU 8051 IDE can be used as an alternative media of teaching of Microcontroller in ALFHE class.
b) The ASM-51 language can be used to build up the simulation program.
c) The program runs according to the plan, and is stable.
d) The learning participants can immediately modify the program according to the needs or ideas that come up in each student group of study [7][8].
e) CGRAM character is also known as customized character is character that was not prepared by the LCD manufacturer.
f) CGRAM addresses are memory spaces located in CGROM with addresses of 00h-07h.
g) CGRAM locations in CGROM are empty location; blanked intentionally.
h) One needs to give command to LCD controller to generate the characters needed on CGRAM addresses.
i) The character size is 5 X 8 (5 column X 8 rows).
j) Give command to displayed the generated characters on LCD (DDRAM).

6. CLOSING This article is expected to contribute to science, particularly in the areas of microprocessor, computer, robotics, microcontroller or computer based control system engineering. And the simulator can be used as a media of learning and teaching in active learning class. The author hopes it will increase the participation and engagement of the students in the learning process, allowing the teacher to apply their teaching strategies more conveniently and successfully in overcoming the lack of funds to meet the needs for equipment or devices in supporting active learning [6]. The simulation program has also been successful in reducing errors in developing or manufacturing the real equipment (reducing costs) [7][8]. The author also hopes that this simulator will contribute to the development of science, particularly in the fields of microprocessor, microcontroller, computer science, telecommunication, robotics, and computer-based control system and engineering and 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 of teaching by utilizing the MCU 8051 IDE simulator and ASM-51 [7][8]. Eventually hopefully it will enable the teacher to carry out the teaching process better as well [7][8].

REFERENCES