



AN ACTIVE LEARNING MEDIA OF INTERFACING MICROCONTROLLER 8051 TO 4X4 KEYPAD USING MCU 8051 IDE AND ASM-51

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ABSTRACT

On this occasion, the author discusses the development of an instructional media of active learning teaching to interface microcontroller 8051 to a virtual 4 X 4 Keypad by using a simulator called MCU 8051 IDE on Windows 7 (MCU 8051 IDE runs on various operating systems) to support the implementation of active learning for higher education. The developed Learning and teaching Media is in the form of simulating program to read the pressed button of the virtual 4 X 4 Keypad and display the ASCII code obtained to a virtual structure of 8 common anode LEDs and to the virtual 2 X 16 LCD display as well. The developed program was built by using ASM-51 embedded in the MCU 8051 (in assembly language); this simulator (MCU 8051 IDE) can be downloaded for free at sourceforge.net site [3]. The scenario of this simulating media is as follows, the simulating program runs continuously and pooling the virtual keypad. When a button is pressed by clicking one of the virtual buttons the program will decode the pressed button to the ASCII code and display it to the two virtual displays mentioned above and then repeat the program continuously. According to the writer's observation the developed simulation program has been stable and successful as a media of teaching and learning of Microcontroller 8051 in interfacing Microcontroller 8051 to the 4 X 4 Keypad and 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 in supporting active learning [6]. The simulation program has also been successful in reducing errors in developing or manufacturing the real equipment (reducing costs) [5] [7] [8] [9] [10].

Keywords: 8051, ASM-51, LEDs, LCD, simulator, active learning.

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 center). 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 the stress level of the students and teachers) in the classroom and increasing students learning desire and finally produce more innovative students; students are given more freedom to try new things by using innovative and interactive teaching media. They 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. There are various microcontroller 8051 simulators that can be downloaded for free and can then be used as a media of learning in the application of active learning currently [3] [4]. The author picked and used MCU 8051 IDE that runs on Windows 7 operating system to develop the teaching media in the form of simulator in connecting or interfacing microcontroller 8051 to the virtual Keypad provided by

MCU 8051. The programming language used in developing this simulation program was assembly language 8051-ASEM-51 and used one input virtual device dubbed as virtual Keypad and two virtual hardware provided by the simulator. The virtual hardware displays the information of the ASCII code of the read code of the pressed button of the virtual Keypad. The virtual Keypad is connected to P0 of the microcontroller 8051 and will be pooled by 8051 microcontroller continuously. The virtual output hardware used to display the ASCII code obtained from the pressed button of the Keypad. The virtual 8 LED structure will display the ASCII code read in the binary digit format and the LCD will display the ASCII character of the read code. The author 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 [5] [7] [8] [9] [10].

RELATED WORK

Using media of active learning teaching developed both by using the computer program in the form of a 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 [7] the author reported the designing of a 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 the electronic digital laboratory. In this paper [8] the authors reported the development of a simulator program that simulates the process of multiple interrupts runs on an 8051 microcontroller by using MCU8051 IDE and ASEM 51. In this paper [9] the author reported the development of simulator programming using MCU8051 IDE and ASM 51 to generate CGRAM characters (special character/customized character) and displaying them on LCD. This program was developed to be used as learning media in ALFHE class as well.

PROPOSED SYSTEM

In this paper, the author proposed the development of an active learning media of teaching microcontroller 8051 in connecting it to the virtual Keypad and displaying the ASCII code of the pressed button of the virtual Keypad and the character of the ASCII code obtained successively on the virtual 8 LEDs structure and the virtual LCD. Figure-1, below shows the block diagram of the proposed system.

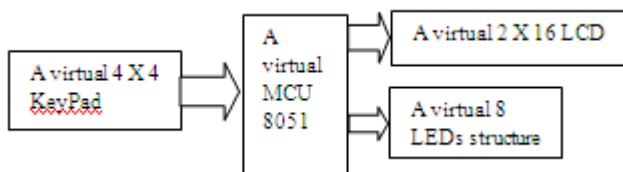


Figure-1. The block diagram of the proposed system.

The developed simulator can be used in an active learning class or a laboratory. The simulator program was developed by using MCU 8051 IDE and ASM-51 program embedded in it; free to download program from the Internet and can be run on various operating systems (OSs). This simulator will answer some people questions on the Internet of how to develop the program in assembly language to connect virtual Keypad to the microcontroller 8051. It also enables 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 the mentioned above virtual hardware as shown on Figure-1, Figure-4 below.

SIMULATION

A simulation has been done and the result of it has been captured as shown on the Figure-2, Figure-5.

Figure-2, below shows the result of a print screen of the GUI (Graphical User Interface) of the simulator before running; the program virtual hardware consisting of a virtual 4 X 4 Keypad, a virtual 8 common anode LEDS structure and a virtual LCD. All the virtual displayers displayed no binary code on the virtual 8 LEDs structure and the virtual LCD display no character on it; the simulator has not been run.

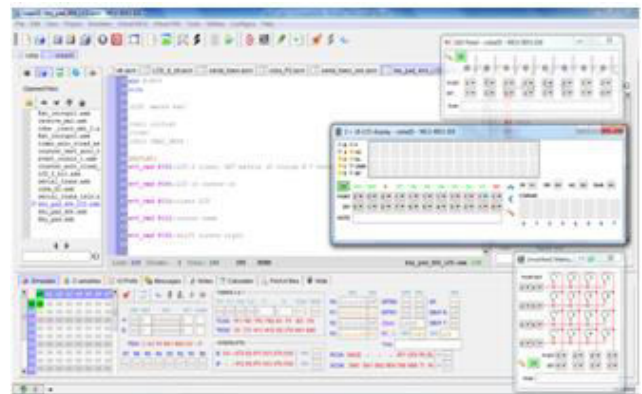


Figure-2. Print screen of GUI prior executing of the program [3] [4].

Figure-3 below shows the GUI print screen of the simulation program after running the program; by clicking the play button on GUI of MCU 8051 IDE but prior to the event of a pressed button of the virtual Keypad.

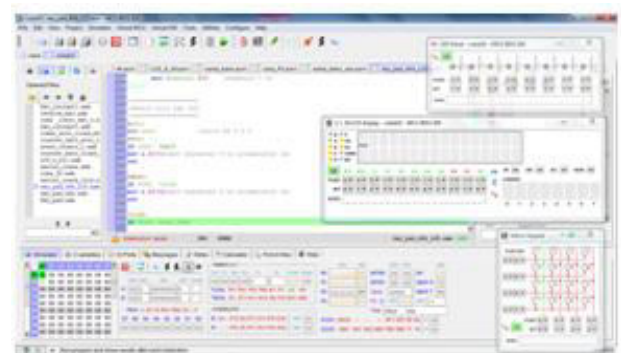


Figure-3. Print screen of GUI shows the program running normally prior to the event of a pressed button [3] [4].

Figure-4 below shows the GUI after the occurring of a pressed button of Keypad; a “1” button of the Keypad.

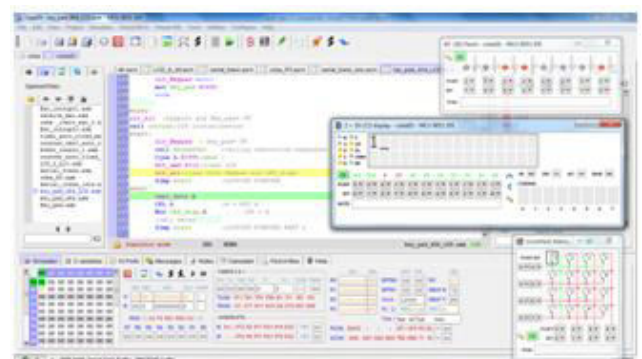


Figure-4. Print screen of GUI shows the occurring of a pressed button of character “1” of the Keypad [3] [4]

It can be seen clearly from the figure 4 that the ASCII code for character “1” is 00110001_b or 31_H; displayed on the virtual 8 LEDs common anode structure that connected to the MCU 8051 IDE via port 2 (P2). The



corresponding “1” character to the pressed button of the Keypad was displayed on the virtual LCD (connected to the MCU 8051 via both port 3 (P3) and port 1 (P1). The virtual LCD used two ports (P3 and P1); P3 as the control bus (bi-direction bus) and P1 as the data bus to transmit both the code and the data.

Figure-5 below shows the GUI when “D” button of the Keypad was pressed.

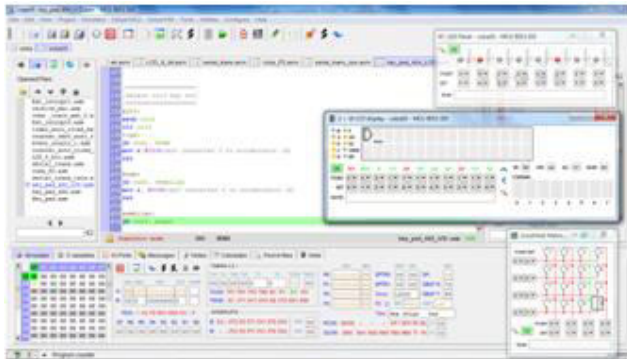


Figure-5. Print screen of GUI shows the occurring of a pressed button of character “D” of the Keypad [3] [4] [3] [4].

From the figure, one can see that the ASCII code of “D” character of the corresponding pressed buttons of the Keypad was displayed on the virtual 8 LEDs common anode structure. The ASCII code of it is as follows, 01000100_b or 44_H. The “D” character was displayed on the virtual LCD.

The complete program of simulator

The flow chart and the full program of the simulator are shown below.

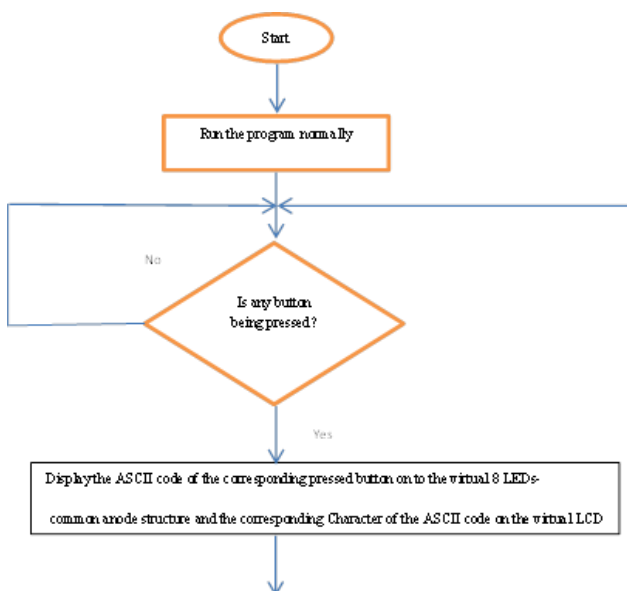


Figure-6. The flowchart program of the simulator.

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

;In this simulation we'll scan keypad and get data out to LED

;and convert it into binary data, and display it on a LCD

=====

;LCD section

=====

jmp mulai

RS bit P3.0

RW bit P3.1

E bit P3.2

D equ P1

wrt_cmd macro cmd

setb E;E=1

clr RS;select command/instruction reg

clr RW;write operation

mov d,cmd

;call rdy

clr E;E=0

endm

wrt_data macro dta

setb E;E=1

setb RS;select data reg

clr RW;write operation

mov d,dta

;call rdy

clr E;E=0

endm

initial:

wrt_cmd #38h; LCD 2 lines, 5X7 matrix (5 coulum X 7 rows)

wrt_cmd #0eh;LCD on cursor on

wrt_cmd #01h;clear LCD

wrt_cmd #02h;cursor home

wrt_cmd #06h;shift cursor right

ret

-----the start of program to display data on lcd-----

tmpl_data macro kar

wrt_cmd #80h; return to the initial position of DDRAM address(at the first line and coulum 1)

wrt_data kar

endm

-----The end of program to display data on LCD-----

rdy:

setb p1.7

clr rs

setb RW



```

ulang:
setb E
;nop
;nop
;nop
clr E
jb p1.7, ulang
;mov r3,#50
;here2:mov r4,#255
;here1:djnz r4,here1
;djnz r3,here2
ret

;=====
;END of LCD Section
;=====

row1 bit P0.4
row2 bit P0.5
row3 bit P0.6
row4 bit P0.7
col1 bit P0.0
col2 bit P0.1
col3 bit P0.2
col4 bit P0.3
;
keybounc equ 71h
LED_disp equ P2
Key_pad equ P0

org 0h

clr_all macro;clear led_disp and Key_pad
mov key_pad,#0ffh
mov LED_disp,#0ffh
endm

clr_Keypad macro
mov key_pad,#0ffh
endm

mulai:
clr_all ;keyport and Key_pad= FF
call initial;LCD initialization
start:
clr_Keypad ; Key_pad= FF
call keypad4x4 ;calling subroutine keypad4x4
Cjne A,#0FFh,send ;
wrt_cmd #01h; clear LCD
clr_all;clear both Keypad and LED_displ
sjmp start ;LOOPING FOREVER
send:
tmp1_data A
CPL A ; A = NOT A
Mov LED_disp, A ; P0 = A
;call delay
Sjmp start ; LOOPING FOREVER PART 2;
delay: mov R0,#4
delay1:mov R2,#4
djnz R2,$

```

```

djnz R0,delay1
ret
;
;=====
; subroutine scan keypad 4x4
;=====
Keypad4x4:
; mov keybounc,#50 ;keybounc = 50

;=====
;Detact col1 key tut
;=====
kol1:
clr col1 ;col1= P3.0 = 0
satu:
jb row1, empat
mov a,#031h;mov character 0 to accumulator (A)
ret

empat:
jb row2, tujuh
mov a,#034h;mov character 4 to accumulator (A)
ret

tujuh:
jb row3, star_char
mov a,#037h;mov character 8 to accumulator (A)
ret

star_char:
jb row4,kol2
mov a,#02ah;mov character star to accumulator (A)
ret

;=====
;Detact col2 key tut
;=====
kol2:
setb col1
clr col2
dua:
jb row1, lima
mov a, #032h;mov character 1 to accumulator (A)
ret

lima:
jb row2, delapan
mov a,#035h;mov character 5 to accumulator (A)
ret

delapan:
jb row3, nol
mov a,#038h;mov character 9 to accumulator (A)
ret

nol:
jb row4, kol3
mov a,#030h;mov 0 character to accumulator (A)
ret

```




```

;=====
;Detact col3 key tut
;=====
kol3:
setb col2
clr col3
tiga:
jb row1, enam
mov a, #033h; mov character 3 to accumulator (A)
ret

enam:
jb row2, sembilan
mov a, #036h; mov character 6 to accumulator (A)
ret

sembilan:
jb row3, pagar
mov a, #039h; mov character 9 to accumulator (A)
ret

pagar:
jb row4, kol4
mov a, #023h; mov character E to accumulator (A)
ret

;=====
;Detact col4 key tut
;=====
kol4:
setb col3
clr col4
char_A:
jb row1, char_B
mov a, #041h; mov character A to accumulator (A)
ret

char_B:
jb row2, char_C
mov a, #042h; mov character B to accumulator (A)
ret

char_C:
jb row3, char_D
mov a, #043h; mov character C to accumulator (A)
ret

char_D:
jb row4, Nokey
mov a, #044h; mov character F to accumulator (A)
ret

Nokey: mov a, #0FFh
ret
;=====
;The end of Keypad 4x4 subroutine
;=====
End

```

CONCLUSIONS

From the results of the simulation and its implementation in the class a few thing can be observed [5] [7] [8] [9] [10] [11] [12] [13],

- MCU 8051 IDE can be used as an alternative media of teaching of Microcontroller in ALFHE class;
- The ASM-51 language can be used to build up the simulation program;
- The program runs according to the plan and is stable;
- The simulator displayed the corresponding ASCII code of the pressed button of the virtual keypad on the virtual 8 LEDs common Anode structure;
- The corresponding character of the obtained ASCII code from the pressed button of the virtual 4 X 4 Keypad displayed on the virtual 2 X 16 LCD;
- The learning participants can immediately modify the program according to the needs or ideas that come up in each student group of study.

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 can be used as a media of learning and teaching in an active learning model in higher education that will facilitate the teaching and learning participants to master the subjects more conveniently and enable the teacher to carry out the teaching process better [5] [7] [8] [9] [10] [11] [12] [13].

REFERENCES

- Action Research and Active Learning in Indonesia, Excellence in Higher Education, Volume 2, Number 2, December 2011, pp. 67-69
- Ely Djulia, Tita Juwitaningsih, Abdul Hamid, Roslin Siallagan. 2011. Active Learning in Language Study and Science: Transforming Teacher Practice in North Sumatra's Elementary Schools, Excellence in Higher Education. 2(2): 90-96.
- Ošmera Martin. Czech Republic (Central Europe, member of EU), MCU 8051 IDE, [Online]. Available: <http://sourceforge.net/projects/mcu8051ide>.
- James Rogers. 2013. Introducing EdSim51DI. [Online]. Available: <http://www.edsim51.com>.
- Dahlan R, P Sitompul, Poltak Sihombing. 2014. Designing Learning Media Of Control Based On Micro Controller 8051 By Using The Mcu 8051 Ide To Support The Implementation Of Active Learning In Higher Education-Alfhe (Active Learning For



- Higher Education). International Journal IJECIERD, ISSN (P): 2249-684X; ISSN (E): 2249-7951, 4(3), TJPRC Pvt. Ltd. Jun 2014, 9-14 [online] Available: www.tjprc.org.
- [6] Charles C. Bonwell, Ph.D. Active Learning: Creating Excitement in the Classroom. Active Learning Workshops PO Box 407 Green Mountain Falls, CO 80819 (719): 684-9261 [online] Available: https://www.ydae.purdue.edu/lct/HBCU/documents/Active_Learning_Creating_Excitement_in_the_Classroom.pdf.
- [7] Poltak Sihombing, Dahlan Sitompul. 2014. Designing a Ttl Voltage Level Logic Probe by Using Common Anode Seven Segment Display and an Inverting Logic Gate on Proteus Isis 7 Professional. International Journal Of Electronics, Communication & Instrumentation Engineering Research And Development (Ijecierd) Issn(P): 2249-684x; Issn(E): 2249-7951, 4(3): 79-84 14 [online] Available: www.tjprc.org.
- [8] P. Sihombing and D. R. Sitompul. 2015. Designing A Media Of Active Learning (AL) Strategy Of Micro Controller 8051 Multiple Interrupts Handling Teaching By Using The MCU 8051 IDE-Integrated Development Environment And Asem-51 In Supporting The Implementation Of Active Learning In Higher Educat. International Journal of Applied Engineering Research (IJAER). 10(3): 5751-5763, 18 4.
- [9] Mhd. Furqan and Dahlan R. P. Sitompul. 2016. Developing a teaching media of microcontroller 8051in displaying CGRAM character on LCD by using the MCU8051IDE and ASM 51 in supporting ALFHE. ARPN Journal of Engineering and Applied Sciences. 11(19): 11363-11367, 19 10.
- [10] Darwis Robinson Manalu and Dahlan RP Sitompul. 2016. Designing a Learning Media of Teaching in ALFHE class by Implementing MCU 8051 IDE, SDCC-Small Devices C Compiler, and Function of C Language Programming in Accessing Ports bits. International Journal of Applied Engineering Research (IJAER). 11(10): 6897-6900, 19 12.
- [11] Darwis Robinson Manalu and Dahlan RP Sitompul. 2017. Developing Learning Media of Teaching of 8051 Microprocessor in Data Retrieval to Support the ALFHE. Internetworking Indonesia Journal (IIJ). 9(1): 89-92, 08 04.
- [12] D.R.P. Sitompul, P. Sihombing. 2017. A teaching media of using the busy bit and SDCC in displaying character string on LCD in MCU 8051 IDE, Alexandria Eng. J. <http://dx.doi.org/10.1016/j.aej.2017.01.037>.
- [13] Dahlan RP Sitompul and Mhd.Furqan. 2015. Developing a Media of Active Learning (AL) strategy of Micro controller 8051 Multiple Interrupts handling teaching by using the MCU 8051 IDE-Integrated Development Environment and C program-SDCC in supporting the implementation of Active Learning in Higher Education-ALFHE. International Journal of Applied Engineering Research (IJAER). 10(17): 38453-38458, xx xx.