Microcontroller System Laboratory

Experiment 1

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Part 1 – Turning LEDs ON and OFF

Objective

Using assembly language code, sequentially and periodically turn ON and OFF three LEDs say red, yellow and green, representing traffic signal lights according to the following timing sequence:

- The red LED to be ON for 5 seconds, then
- The green LED to be ON for 2 seconds, then
- The yellow LED to be ON for 1 second and repeat

Circuit Diagram

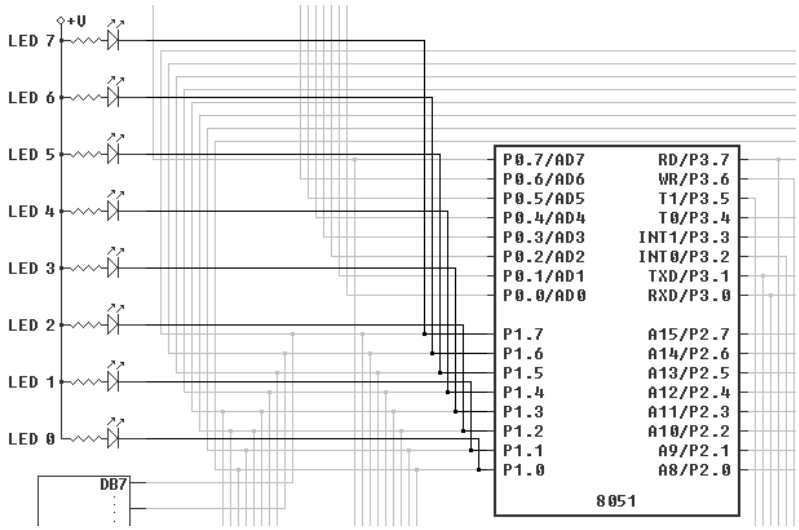

Fig. 1. Circuit diagram of LED connections in Edsim simulator

Code

```
; Run this file with Update Freq 100

start:
	MOV P1, #11111110B ; red LED
	CALL delay1
	CALL delay1
	CALL delay1
	CALL delay1
	CALL delay1
	MOV P1, #11011111B ; green LED
	CALL delay1
	CALL delay1
	MOV P1, #11101111B ; yellow LED
	CALL delay1
	JMP start

delay1: ; creating a delay of 1 s when Update Freq is set to 100
```

```
MOV R0, #250
MOV R1, #250
DJNZ R0, $
DJNZ R1, $
RET
```

Simulation

Visit https://drive.google.com/file/d/1F-6chkQruINI8t2KXUAhsUeBl8pFi3qR/view?usp=sharing to see the simulation of Part 1.

Discussion

- From Fig. 1. we can observe that the LEDs can be manipulated by changing the values of P1[7:0].
- The red color corresponds to 11111110, the green color corresponds to 11011111 and the yellow color corresponds to 11101111. Logic high corresponds to OFF and logic low corresponds to ON.
- As the clock frequency is set to 12 MHz, each MOV instruction takes 1 us and each DJNZ instruction takes 2 us.
- As we set the value of R0 and R1 to 250, DJNZ will be called 500 times, hence the total execution time of delay1 module is 1 + 1 + 2 x 250 + 2 x 250 = 1002 us = 1 ms (approx.)
- The code was executed with update frequency set to 100. Hence, a delay of 1 ms in code corresponds to 1 s while simulation.
- Five calls are made to delay1 module before switching from red to green which results in red LED to be ON for 5 s.
- Two calls are made to delay1 module before switching from green to yellow which results in green LED to be ON for 2 s.
- One call is made to delay1 module before switching from yellow to red which results in yellow LED to be ON for 1 s.

Part 2 – Activating one 7-segment display unit

Objective

Using assembly language code, display all digits of your cell phone number sequentially on one 7 segment display unit. For readability, display each digit for one second before going to the next digit. After displaying the whole number, black out for 3 seconds and then repeat displaying the number.

Circuit Diagram

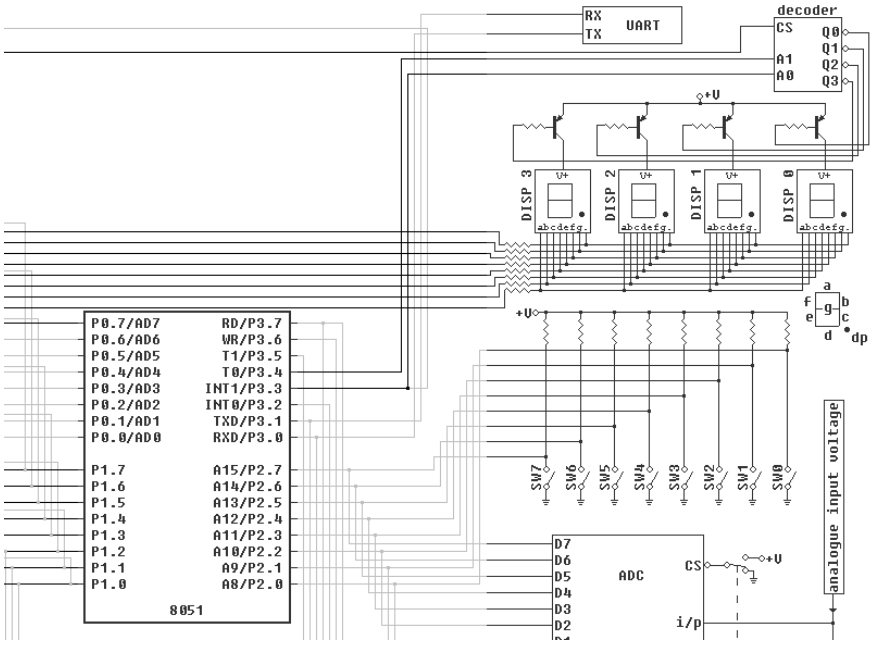

Fig. 2. Circuit diagram of multiplexed 7-segment displays in Edsim simulator

Code

```
; Run this code with update frequency = 100

start:
	SETB P3.3 ; to select 7-seg display 3
	SETB P3.4 ; P3.3 and P3.4 must be logic high
	MOV P1, #10010000B
	CALL delay1
	MOV P1, #10010010B
	CALL delay1
	MOV P1, #10011001B
	CALL delay1
	MOV P1, #11111000B
	CALL delay1
	MOV P1, #10000010B
	CALL delay1
	MOV P1, #10100100B
	CALL delay1
	MOV P1, #11111001B
	CALL delay1
	MOV P1, #11111001B
	CALL delay1
	MOV P1, #11111001B
	CALL delay1
	MOV P1, #11111001B
	CALL delay1
```

```
        MOV P1, #11111111B
        CALL delay1
        CALL delay1
        CALL delay1
        JMP start

delay1: ; creating a delay of 1 s when Update Freq is set to 100
        MOV R0, #250
        MOV R1, #250
        DJNZ R0, $
        DJNZ R1, $
        RET
```

Simulation

Visit https://drive.google.com/file/d/126wTkcrQhLcI_lJ8j0Ywl-QRLir2R4w3/view?usp=sharing to see the simulation of Part 2.

Discussion

- To select multiplexed 7-segment displays as current display, P0.7 must be set to logic high, otherwise DAC will be the current display. By default, P0.7 is set to logic high.
- For this part, the mobile number is displayed on the display #3.
- To select display #3 as current display, P3.3 and P3.4 must be set to logic high.
- To display any character on 7-segment display, P1 must be set to corresponding value using (dp)gfedcba format. Logic high corresponds to OFF and logic low corresponds to ON.
- As my mobile number is 9547621111, the code for each character is as follow:

Character	Code
9	10010000
5	10010010
4	10011001
7	11111000
6	10000010
2	10100100
1	11111001
NULL	11111111

- As the clock frequency is set to 12 MHz, each MOV instruction takes 1 us and each DJNZ instruction takes 2 us.
- As we set the value of R0 and R1 to 250, DJNZ will be called 500 times, hence the total execution time of delay1 module is 1 + 1 + 2 x 250 + 2 x 250 = 1002 us = 1 ms (approx.)
- The code was executed with update frequency set to 100. Hence, a delay of 1 ms in code corresponds to 1 s while simulation.
- While transitioning from one character to another, one call is made to delay1 module which results in that character being shown on the display for 1 s.
- At the end, three calls are made to delay1 module as described in the objective and the process is repated after that.

Part 3 – Activating four 7- segment display units

Objective

Using assembly language code, display first four digits of your roll number (18EC) on four 7-segment display units.

Circuit Diagram

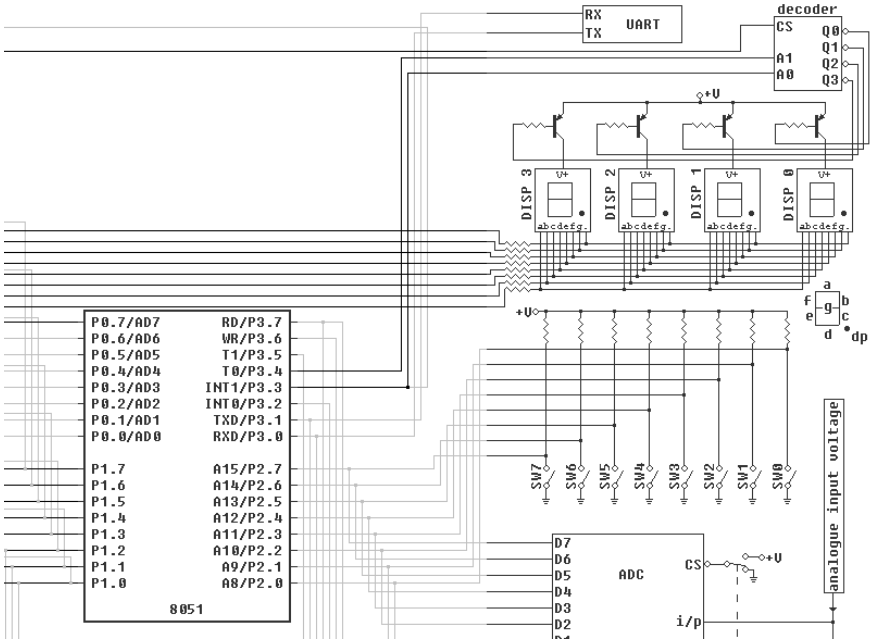

Fig. 3. Circuit diagram of multiplexed 7-segment displays in Edsim simulator

Codes

```
; Run the program with update frequency = 100

start:
       SETB P3.3
       SETB P3.4          ; selecting display #3
       MOV P1, #11111001B ; code for ‘1’
       CALL delay
       CLR P3.3           ; selecting display #2
       MOV P1, #10000000B ; code for ‘8’
       CALL delay
       CLR P3.4
       SETB P3.3          ; selecting display #1
       MOV P1, #10000110B ; code for ‘E’
       CALL delay
       CLR P3.3           ; selecting display #0
       MOV P1, #11000110B ; code for ‘C’
       CALL delay
       JMP start

delay:
       MOV R0, #250
       DJNZ R0, $
       RET
```

Simulation

Visit https://drive.google.com/file/d/1sQnuBS_CgI_hRNbaXgBxzWfYXBgi_8n5/view?usp=sharing to see simulation of Part 3.

Discussion

- To select multiplexed 7-segment displays as current display, P0.7 must be set to logic high, otherwise DAC will be the current display. By default, P0.7 is set to logic high.
- For this part, first four characters of my roll number, i.e., 18EC is displayed on different displays preserving the order.
- As the 7-segment displays are connected to a decoder, we cannot activate all four of them simultaneously. We can choose the display by setting P3.3 and P3.4 to appropriate logic levels.
- To select display #3 as current display, P3.3 and P3.4 must be set to logic high.
- To select display #2 as current display, P3.3 must be set to logic low and P3.4 must be set to logic high.
- To select display #1 as current display, P3.3 must be set to logic high and P3.4 must be set to logic low.
- To select display #0 as current display, P3.3 and P3.4 must be set to logic low.
- To display any character on 7-segment display, P1 must be set to corresponding value using (dp)gfedcba format. Logic high corresponds to OFF and logic low corresponds to ON.
- The code for each character is as follow:

Character	Code
1	`11111001`
8	`10000000`
E	`10000110`
C	`11000110`

- While transitioning from one character to another, small delay is added.