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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

19ECT221 – MICROPROCESSORS AND MICROCONTROLLERS

II YEAR - IV SEM

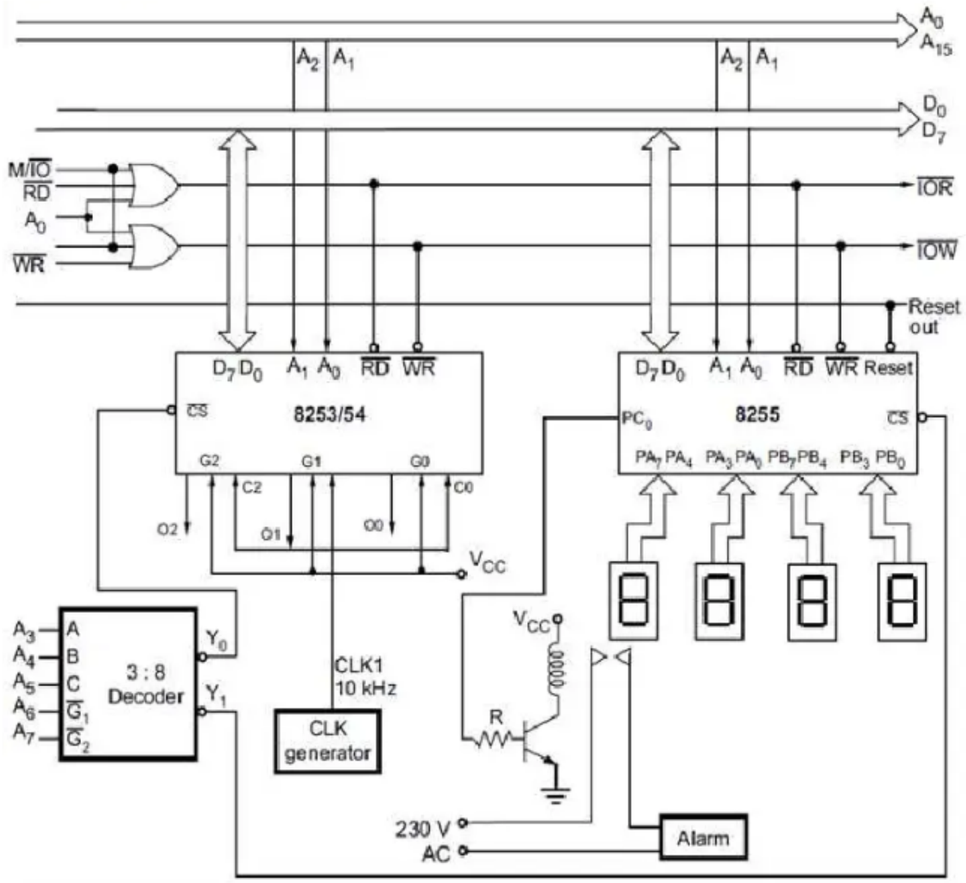
UNIT 2– ALARM CONTROLLER

Alarm Controller Case Study

Design a pre-settable alarm system using 8253/54 timer. Usethumbwheel switches to accept 4 digit value in seconds. Alarm should last for5 seconds. Do not use interrupt

Alarm Controller

Solution: Fig shows the 8086 microprocessor based pre-settable alarm system. Thumbwheel switches are interfaced through 8255 ports. Timing parameters are derived from the 8253/54. 74LS138 decoder is used to generate chip select signals for 8253/54 and 8255. One more 74LS138 decoder is used to generate $\overline{IOR}$, $\overline{IOW}$, $\overline{MEMR}$, and $\overline{MEMW}$ signals.



Counter 0 of 8253/54 is programmed in mode 0 to give the pre-settable time period and counter 2 is programmed in mode 0 to give delay of 5 seconds. As we know, clock input for 8253/54 is 10 KHZ count required to get 1 second time interval

f=10 kHz

clock period $t = 1/f = 1/10x10^3 = 100\mu sec$

$$\text{Count} = \frac{\text{Required Period}}{\text{Clock Period}} = \frac{1\,\text{sec}}{100\,\mu s} = 10000 = 2710H$$

This count value is loaded in the count register of the counter 1 and counter 1 is programmed in mode 2 to generate square wave with frequency 1 Hz. The output of counter 1 is fed to the clock input of counter 0 and counter 2. To read four digit of count, we need four thumbwheels. One thumbwheel switch can be interfaced using four input lines. So to interface four thumbwheels we need 16 lines. The IC 8255 is used to interface these thumbwheel switches. Two thumbwheel switches are connected to port A and other two are connected to port B.

Address Mapping:

Ports/ Control Register	Address Lines								Address
	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0	
Counter 0	0	0	0	0	0	0	0	0	00H
Counter 1	0	0	0	0	0	0	1	0	02H
Counter 2	0	0	0	0	0	1	0	0	04H
Control Register	0	0	0	0	0	1	1	0	06H
Port A	0	0	0	0	1	0	0	0	08H
Port B	0	0	0	0	1	0	1	0	0AH
Port C	0	0	0	0	1	1	0	0	0CH
Control Register	0	0	0	0	1	1	1	0	0EH

1. Control Word to Read/Write value in count register of counter 0 of 8254

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	
SC_1	SC_0	RW_1	RW_0	M_2	M_1	M_0	BCD	
0	0	1	1	0	0	0	1	=31H

D0=1 ; BCD count
D3, D2, D1=000; Mode: interrupt on terminal count
D5, D4=11 ; Read/write lower byte first and then higher byte
D7, D6=00 ; Counter 0

2. Control Word to Read/Write value in count register of counter 1 of 8254

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	
SC_1	SC_0	RW_1	RW_0	M_2	M_1	M_0	BCD	
0	1	1	1	0	1	1	1	=77H

D0=1 ; BCD count
D3, D2, D1=011; Mode: Square wave rate generator
D5, D4=11 ; Read/write lower byte first and then higher byte
D7, D6=01 ; Counter 1

3. Control Word to latch value in count register of counter 0 of 8254

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	
SC_1	SC_0	RW_1	RW_0	M_2	M_1	M_0	BCD	
0	0	0	0	0	0	0	1	=01H

D0=1 ; BCD count
D3, D2, D1=000; Mode: interrupt on terminal count
D5, D4= 00 ; counter latch command
D7, D6=00 ; Counter 0

4. Control Word to Read/Write value in count register of counter 2 of 8254

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	
SC_1	SC_0	RW_1	RW_0	M_2	M_1	M_0	BCD	
1	0	1	1	0	0	0	1	= B1H

D0=1 ; BCD count
D3, D2, D1=000; Mode: interrupt on terminal count
D5, D4=11 ; Read/write lower byte first and then higher byte
D7, D6=10 ; Counter 2

5. Control Word to latch value in count register of counter 2 of 8254

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	
SC_1	SC_0	RW_1	RW_0	M_2	M_1	M_0	BCD	
1	0	0	0	0	0	0	1	= 81H

D0=1 ; BCD count
D3, D2, D1=000; Mode: interrupt on terminal count
D5, D4=00 ; counter latch command
D7, D6=10 ; Counter 2

6. Control Word to initialize 8255: Port A=I/P, Port B=I/P, Port C=O/P

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	
BSR/IO	Mode A		PA	PC_H	Mode B	PB	PC_L	
1	0	0	1	0	0	1	0	= 92H

Program:

```
        MOV AL, 92H       ; Load control word in the control register of 8255
        OUT 0EH, AL
START:  IN AL, 08H        ; Get the lower two digit of count from Port A
        MOV BL, AL        ; Store the lower two digit of the count in BL register
        IN AL, 0AH        ; Get the higher two digit of count from Port B
        MOV BH, AL        ; Store the higher two digit of the count in BH register
        MOV AL, 31H       ; Load control word (31H) in the control register of 8254
        OUT 06, AL
        MOV AL, BL        ; Load 16-bit Count in count register of counter 0
        OUT 00, AL        ; Load lower byte of the count
        MOV AL, BH
        OUT 00, AL        ; Load higher byte of the count
BACK:   MOV AL, 01H       ; Load control word (01H) in control register to latch
        OUT 06, AL        ; 16-bit count in the count register of counter 0
        IN AL, 00H        ; Get the lower two digit of count from counter 0
        CMP AL, 00H       ; Compare with zero
        JNZ BACK          ; Repeat
        IN AL, 00H        ; Get the higher two digit of count from counter 0
        CMP AL, 00H       ; Compare with zero
        JNZ BACK          ; Repeat
        MOV AL, 01H       ; Load bit pattern to run alarm
        OUT 0CH, AL       ; Send it to Port C
        CALL DELAY        ; Wait for 5 seconds
        MOV AL, 00H       ; Load bit pattern to stop alarm
        OUT 0CH, AL       ; Send it to Port C
        JMP START         ; Repeat
```

Delay Routine :

This delay routine gives a delay of 5 seconds. Counter1 of 8253/54 is used to give delay of 1 second. As output of counter1 is used as a clock for counter2, the count in the counter2 acts as a multiplying factor. Therefore, by loading 05H in the count register of counter2 we get a delay of 5 (5x1) seconds.

```
DELAY:  MOV AL, 77H     ; Load control word in the control register of 8254
        OUT 06, AL
        MOV AL, 10H     ; Load lower byte of the count in counter1
        OUT 02, AL
        MOV AL, 27H     ; Load higher byte of the count in counter1
        OUT 02H, AL

        MOV AL, B1H     ; Load control word in the control register of 8254
        OUT 06H, AL     ; to write a value in the count register of counter2.
        MOV AL, 05H     ; Load lower byte 05H in the count register of
        OUT 04, AL      ; counter2
        MOV AL, 00H     ; Loads higher byte 00H in the count register of
        OUT 04, AL      ; counter2

LP1:    MOV AL, 81H     ; Load control word (81H) in the control register to
        OUT 06, AL      ; latch 16-bit count in the count register of counter2
        IN AL, 04H      ; Get the lower two digits of the count from counter2
        CMP AL, 00      ; Compare with 00H
        JNZ LP1         ; If not zero, Repeat
        IN AL, 04H      ; Get the higher two digits of the count from counter2
        CMP AL, 00      ; Compare with 00H
        JNZ LP1         ; If not zero, Repeat
        RET             ; Return to main program
```

References

https://www.scribd.com/document/691553361/Unit-3-Alarm-controller

Yu-Cheng Liu, Glenn A.Gibson, Micrcomputer systems: The 886/ 8088 Family – Architecture, Prgramming and Design, Second Edition, Prentice Hall of India, 2007