THE MICROPROCESSORS & MICROCONTROLLERS

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PRACTICE EXERCISE #1:

ACQUAINTANCE WITH PROTEUS AND THE 8051 MICROCONTROLLER FAMILY

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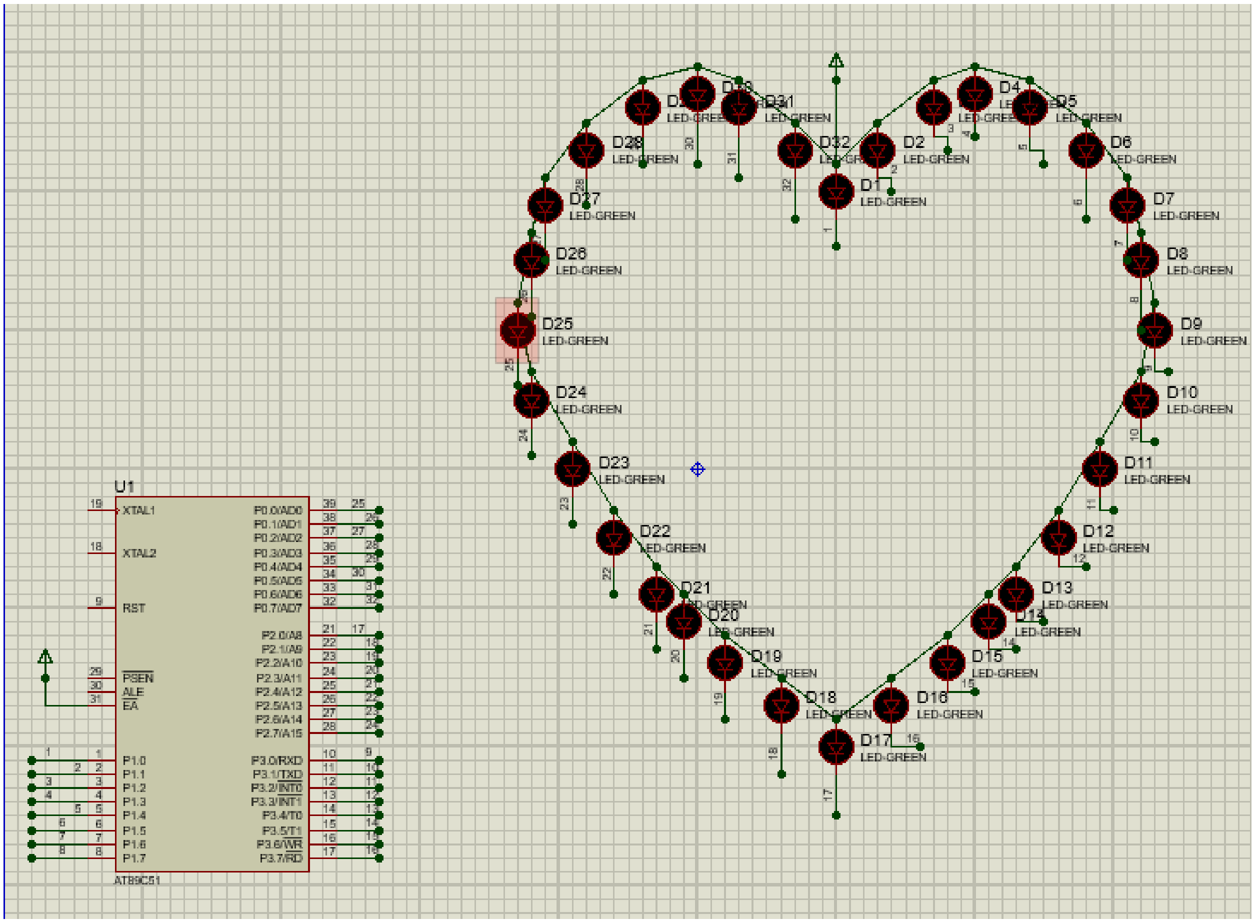
1. Design Result

Design a heart-led circuit consisting of 32 LEDs controlled by AT89C51.



2. Explain the operating principle of the effects

Google Drive link: https://tinyurl.com/54x9x4xe

Source code, include explanation:

Note: When copy from Proteus to Word, the color for each instruction, initial number has been changed to black. So I try to change the color like the same which it display on Proteus.

Source Code (Include English Explanation)

```
;===========================================================
==============
; Main.asm file generated by New Project wizard
;
; Created:   Wed Mar 15 2023
; Processor: 80C31
; Compiler:  ASEM-51 (Proteus)
;===========================================================
==============

$NOMOD51
$INCLUDE (8051.MCU)

;===========================================================
==============
; DEFINITIONS
;===========================================================
==============


;===========================================================
==============
; VARIABLES
;===========================================================
==============


;===========================================================
==============
; RESET and INTERRUPT VECTORS
```

```
;=======================================================
=============

    ; Reset Vector
    org   0000h
    jmp   Start

;=======================================================
=============
; CODE SEGMENT
;=======================================================
=============

    org   0100h  ;set the starting address
Start:
    ; Write your code here
    org 00h   ; set origin .address, turn off all leds

main:
    mov r0, #4          ; Repeat Mode1 for 4 times
l1:
    call Mode1
    djnz r0, l1

    mov r0, #4          ; Repeat Mode2 for 4 times
l2:
    call Mode2
    djnz r0, l2

    mov r0, #8          ; Repeat Mode3 for 8 times
l3:
    call Mode3
    djnz r0, l3

jmp main
;; in each mode, when bit is set to 1 mean the led turn off
;; when bit is set to 0, the led turn on
;; Mode1 to turn on the bulbs from leg 0 to 8 of each port
Mode1:
            mov P0, #11111111B
mov P1, #11111111B
mov P2, #11111111B
mov P3, #11111111B
call Delay
mov P0, #11111110B
mov P1, #11111110B
mov P2, #11111110B
mov P3, #11111110B
call Delay
mov P0, #11111100B
mov P1, #11111100B
mov P2, #11111100B
mov P3, #11111100B
call Delay
mov P0, #11111000B
mov P1, #11111000B
mov P2, #11111000B
mov P3, #11111000B
call Delay
mov P0, #11110000B
mov P1, #11110000B
mov P2, #11110000B
mov P3, #11110000B
call Delay
mov P0, #11100000B
mov P1, #11100000B
mov P2, #11100000B
mov P3, #11100000B
call Delay
mov P0, #11000000B
mov P1, #11000000B
mov P2, #11000000B
mov P3, #11000000B
call Delay
mov P0, #10000000B
mov P1, #10000000B
mov P2, #10000000B
mov P3, #10000000B
call Delay
mov P0, #00000000B
```

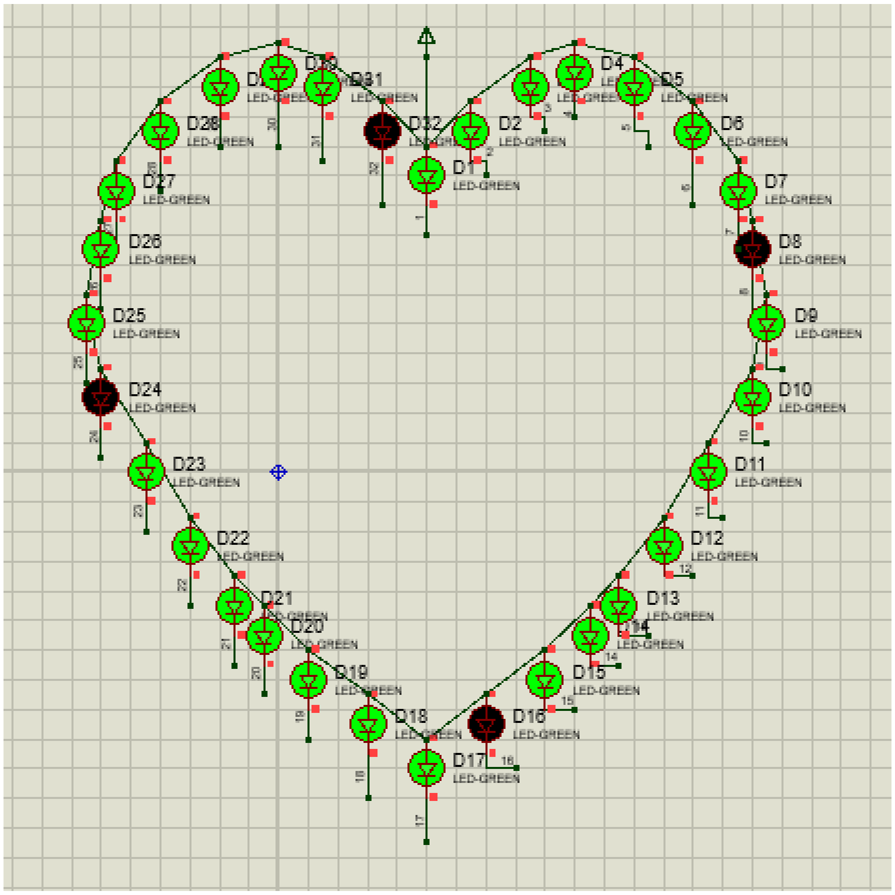
```
                mov P1, #00000000B
                mov P2, #00000000B
                mov P3, #00000000B
                call Delay

ret
;;Mode2 to turn off the bulbs from leg 8 to 0 of each port
Mode2:
                mov P0, #10000000B
                mov P1, #10000000B
                mov P2, #10000000B
                mov P3, #10000000B
                call Delay
                mov P0, #11000000B
                mov P1, #11000000B
                mov P2, #11000000B
                mov P3, #11000000B
                call Delay
                mov P0, #11100000B
                mov P1, #11100000B
                mov P2, #11100000B
                mov P3, #11100000B
                call Delay
                mov P0, #11110000B
                mov P1, #11110000B
                mov P2, #11110000B
                mov P3, #11110000B
                call Delay
                mov P0, #11111000B
                mov P1, #11111000B
                mov P2, #11111000B
                mov P3, #11111000B
                call Delay
                mov P0, #11111100B
                mov P1, #11111100B
                mov P2, #11111100B
                mov P3, #11111100B
                call Delay
                mov P0, #11111110B
                mov P1, #11111110B
```

```
        mov P2, #11111110B
        mov P3, #11111110B
        call Delay
        mov P0, #11111111B
        mov P1, #11111111B
        mov P2, #11111111B
        mov P3, #11111111B
        call Delay
ret
;;Mode 3 to turn off two consecutive bulbs, the turn on them and turn off two next consecutive bulbs, end up with turn off all bulbs
Mode3:
        mov P0, #00000000B
        mov P1, #00000000B
        mov P2, #00000000B
        mov P3, #00000000B
        call Delay
        mov P0, #00000011B
        mov P1, #00000011B
        mov P2, #00000011B
        mov P3, #00000011B
        call Delay
        mov P0, #00001100B
        mov P1, #00001100B
        mov P2, #00001100B
        mov P3, #00001100B
        call Delay
        mov P0, #00110000B
        mov P1, #00110000B
        mov P2, #00110000B
        mov P3, #00110000B
        call Delay
        mov P0, #11000000B
        mov P1, #11000000B
        mov P2, #11000000B
        mov P3, #11000000B
        call Delay
        mov P0, #11111111B
        mov P1, #11111111B
        mov P2, #11111111B
```

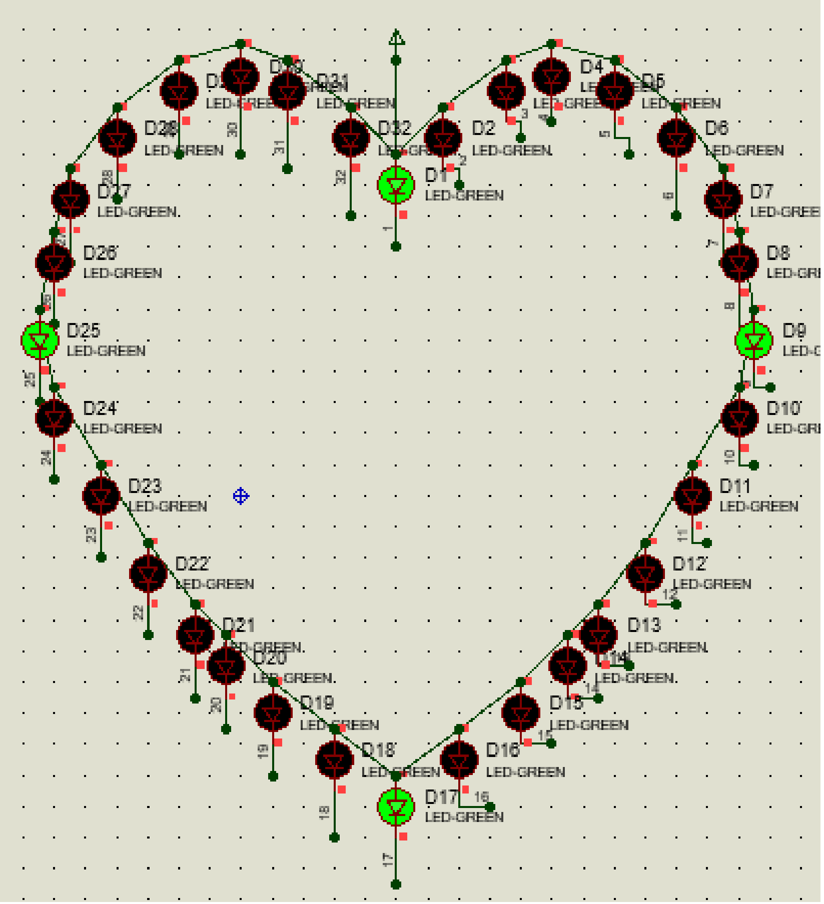
```
                mov P3, #11111111B
                call Delay
ret


;;create 3 nested loops that each count down from an initial value
;;each time a loop decrements its counter, it jump back to the beginning of that loop until the counter reaches zero
;;will create a delay - the processor must spend time executing these loops before moving on to the next instruction
Delay:
   mov r1, #30
; Set the initial loop of r1 for 15
Loop1:
   mov r2, #50
; Set the initial loop of r2 for 50
Loop2:
   mov r3, #50
; Set the initial loop of r3 for 50
   djnz r3, $
; decrements the value of r3 by 1 and jumps back to the current location - '$' symbol if it is not zero
   djnz r2, Loop2
; decrements the value of r2 by 1 and jumps back to Loop2 it is not zero
   djnz r1, Loop1
; decrements the value of r3 by 1 and jumps back to Loop1 if it is not zero
ret
;; djnz instruction takes 2 clock cylcles
;;for r1=30, r2=r3=50, the total time of delay is 15*50*50*2µs = 0.15s
end
```

Picture of each effect (more clearly on video):

Effect 1:



Effect 2:


D29
D30
D31
D32
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
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D14
D15
D16
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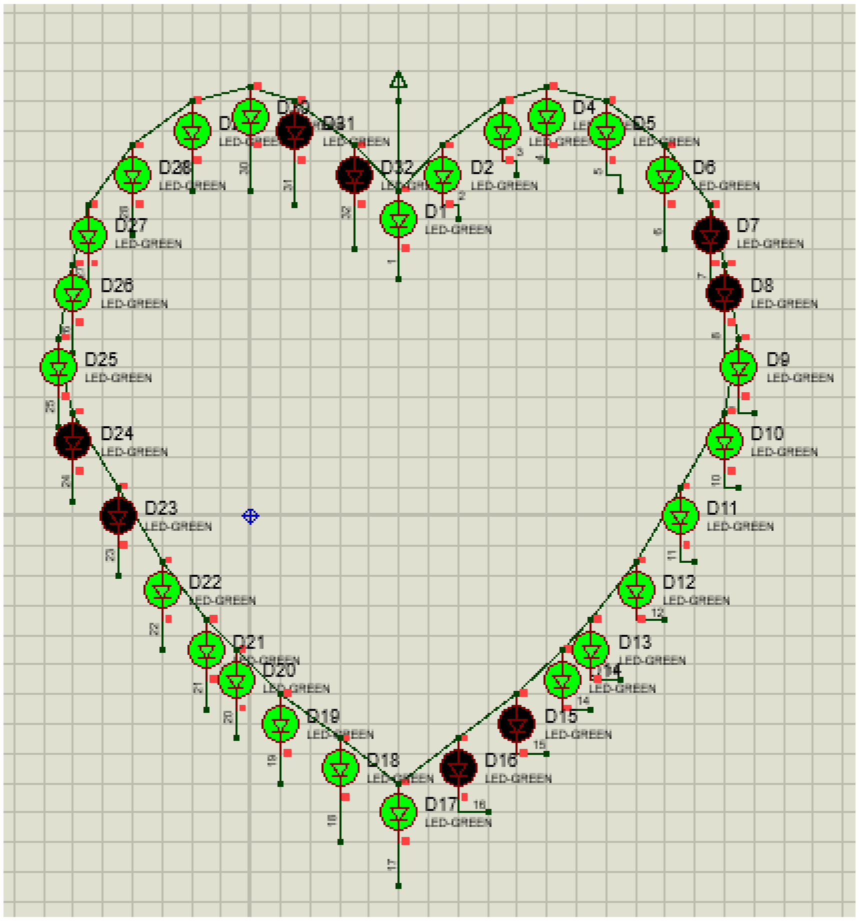
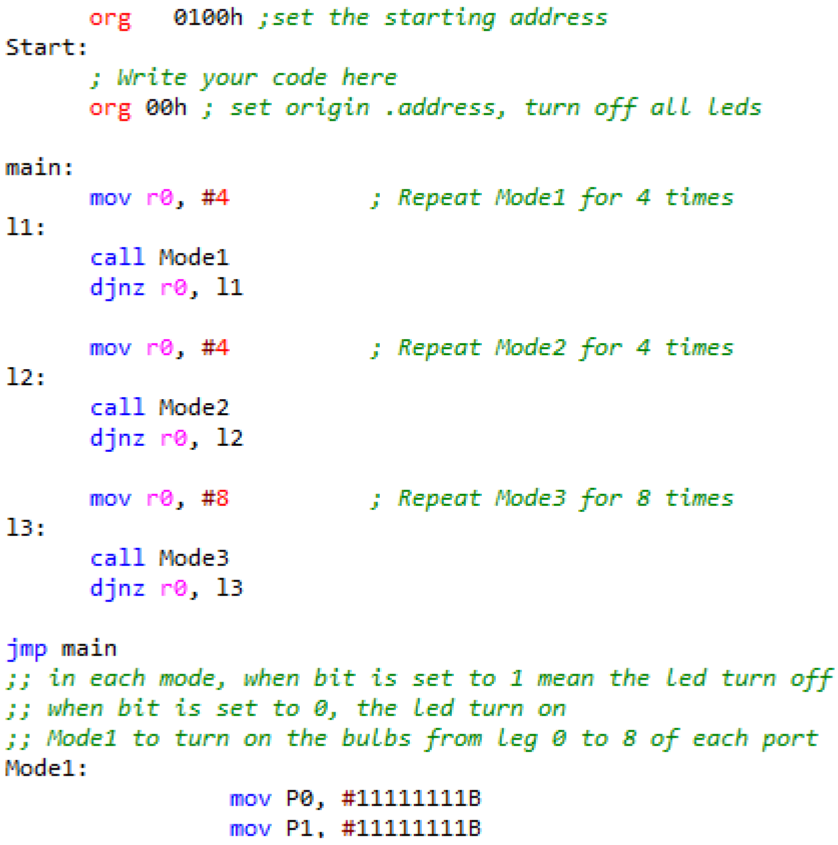
D18
D19
D20
D21
D22
D23
D24
D25
D26
D27
D28
LED-GREEN

Effect 3


D31
D32
D1
D2
D4
D5
D6
D7
D8
D9
D10
D11
D12
D13
D14
D15
D16
D17
D18
D19
D20
D21
D22
D23
D24
D25
D26
D27
D28
LED-GREEN

Picture of source code:



```
      org   0100h ;set the starting address
Start:
      ; Write your code here
      org 00h ; set origin .address, turn off all leds

main:
      mov r0, #4          ; Repeat Mode1 for 4 times
l1:
      call Mode1
      djnz r0, l1

      mov r0, #4          ; Repeat Mode2 for 4 times
l2:
      call Mode2
      djnz r0, l2

      mov r0, #8          ; Repeat Mode3 for 8 times
l3:
      call Mode3
      djnz r0, l3

jmp main
;; in each mode, when bit is set to 1 mean the led turn off
;; when bit is set to 0, the led turn on
;; Mode1 to turn on the bulbs from leg 0 to 8 of each port
Mode1:
                mov P0, #11111111B
                mov P1, #11111111B
```

3. Presentation of the steps to implements the printed circuit

Design Step on Proteus:

Step 1: Create a new project on Proteus software

Step 2: Add the AT89C51 microcontroller to the schematic diagram and connect it to the pins of the LEDS. Put and arrange 32 LEDs to make a heart circuit.

Step 3: Add any necessary resistors or other components to the circuit

Step 4: Run a simulation to verify the circuit design and make any necessary adjustments

Programing Steps (Build an Assembly Program)

Step 1: Right click on the AT89CT51, choose Soucre Code to edit, build a new Assembly Program

Step 2: Implement the code to run different effects (Mode1, Mode2, Mode3)

Step 3:Debug and test the code to make sure that it runs correctly on the microcontroller

PCB Layout Steps:

Step 1: Switch to the PCB layout tool on Proteus

Step 2: Create the PCB layout of the circuit based on the schematic diagram.

Step 3: Arrange the components and their connections on the PCB layout.

Step 4: Add any necessary labels or notes to the PCB layout for clarity.

Step 5: Run a Design Rule Check (DRC) to verify that the PCB layout meets the necessary design rules.

Step 6: Export the PCB layout in Gerber file format for manufacturing.

Manufacturing Steps:

Step 1: Send the Gerber file to a PCB manufacturer (ex: maihungpcb, Kim Son Co PCB,…) to fabricate the printed circuit board

Step 2: Open the PCB is received, mount the components onto the PCB according to the PCB layout

Step 3: Double-check the connections and solder joints to ensure proper assembly

Step 4: Test the completed circuit to verify that it runs the program's effects correctly.