MUKESH PATEL SCHOOL OF TECHNOLOGY MANAGEMENT AND ENGINEERING

(Affiliated to NMIMS Deemed to be University, Mumbai)

MPMC PROJECT

On

Ultrasonic Distance Calculator using 8051 Microcontroller

Submitted by

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Semester/Year: VIII/IV		

B. Tech Integrated Program

Department of Computer Science Engineering

MPSTME, Mumbai

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SVKM'S NMIMS Deemed to be UNIVERSITY

MUKESH PATEL SCHOOL OF TECHNOLOGY MANAGEMENT & ENGINEERING™

CERTIFICATE OF SUBMISSION

This is to certify that **Reneeka Nadkarni** (Roll Number: C034, SAP ID: 70322000186), **Amishi Desai** (Roll Number: C044, SAP ID: 70322000023), and **Chahel Gupta** (Roll Number: C049, SAP ID: 70322000047), students of B.Tech Integrated (Computers), Division B, Batch B2, Semester VIII, Year IV at MPSTME, Mumbai, have successfully completed and submitted the project titled "***Ultrasonic Distance Calculator using 8051 Microcontroller***" as a part of the Microprocessors and Microcontrollers course.

Prof. Vipul Gohil	**Head of Department**
MPMC Faculty	**(Computers)**

ULTRASONIC DISTANCE CALCULATOR USING 8051 MICROCONTROLLER

INDEX

I. INTRODUCTION

The Ultrasonic Distance Calculator using 8051 is a sophisticated electronic device that utilizes ultrasonic technology to accurately measure distances. This report provides an in-depth understanding of the principles behind ultrasonic rangefinders, the circuitry involved, and how the 8051 microcontroller plays a crucial role in making distance calculations.

II. DESIGN & PRINCIPLES

Ultrasonic rangefinders operate on the pulse-echo method, similar to RADAR systems. The basic principle involves transmitting an ultrasonic signal towards an object, receiving the echo signal from the object, and calculating the distance based on the time taken for the signal to travel to and from the object.

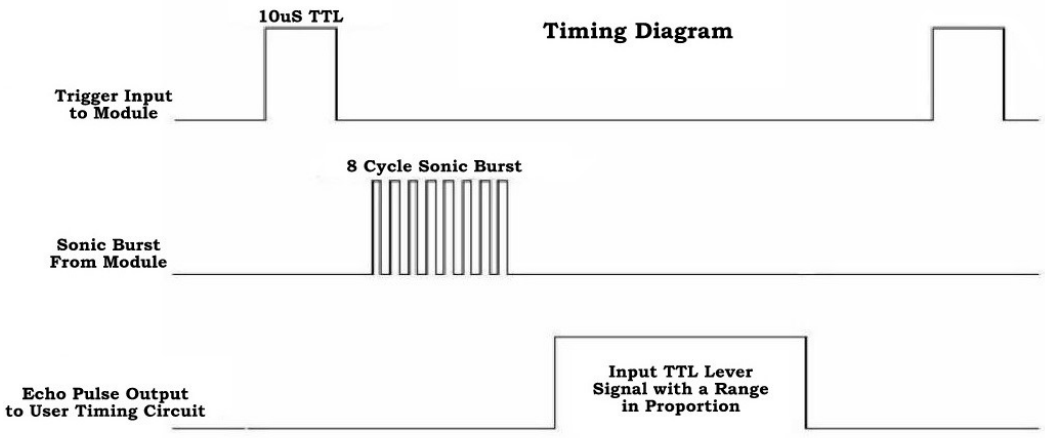
2.1 Component List

Name	Quantity	Component
LM016L	1	LCD Display
HC - SR04	1	Ultrasonic Sensor
AT89C51	1	8051 Microcontroller

2.2 How does the circuit work?

1. The HC-SR04 module has ultrasonic transmitter, receiver and control circuit on a single board. The module has 4 pins, Vcc, Gnd, Trig and Echo.

2. When a pulse of 10µs or more is given to the Trig pin, 8 pulses of 40 kHz are generated. After this, the Echo pin is made high by the control circuit in the module.



3. Echo pin remains high till it gets echo signal of the transmitted pulses back.

4. The time for which the echo pin remains high, i.e. the width of the Echo pin gives the time taken for generated ultrasonic sound to travel towards the object and return.

5. Using this time and the speed of sound in air, we can find the distance of the object using a simple formula for distance using speed and time.

   Object Distance(in cm) = (Sound Velocity * Time)/2,
   Where, Sound Velocity = 34300 (in cm per second)

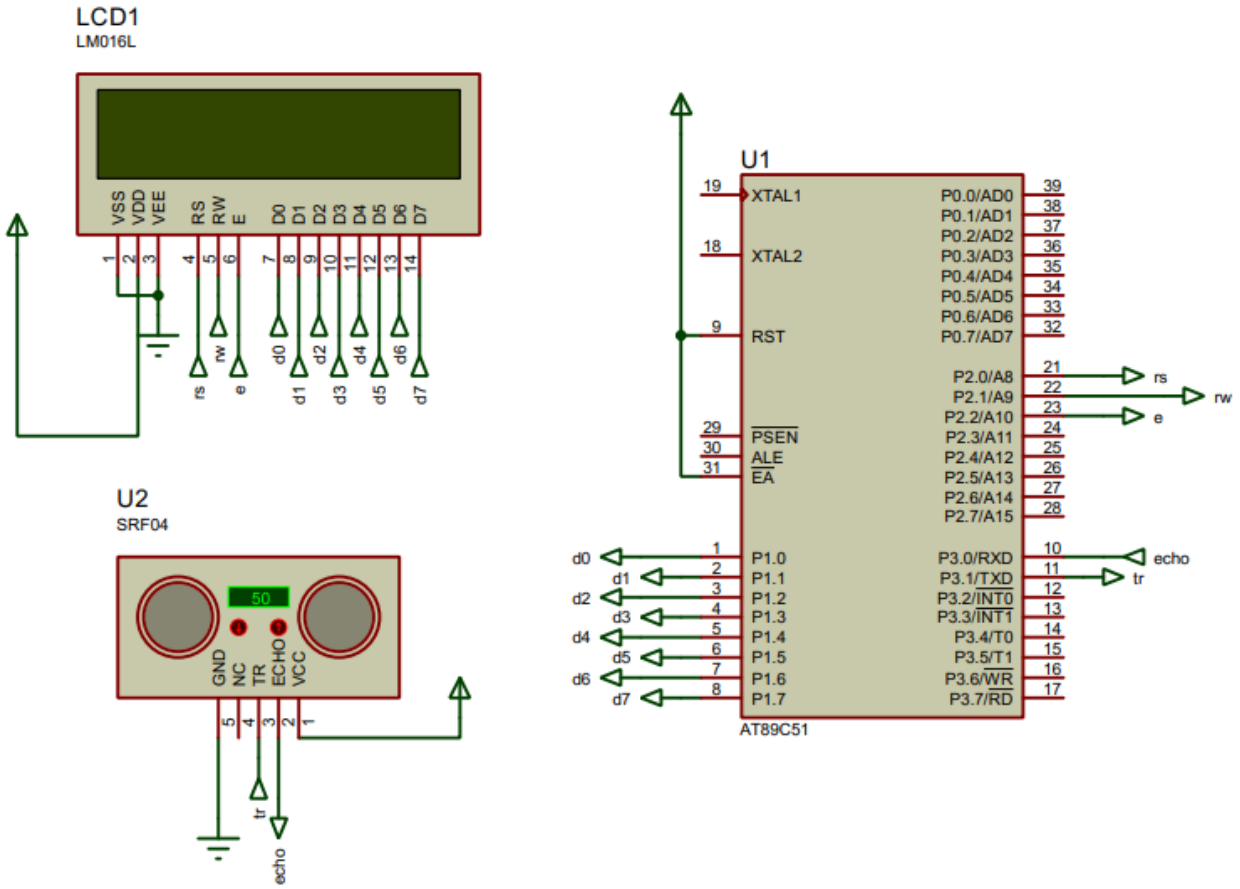
   Here, oscillator frequency of AT89C51 (8051) is 11.0592 MHz, then timer frequency of 8051 will be 921.6 kHz.

   So, Time required to execute 1 instruction is 1.085 us.
   Thus, timer gets incremented after 1.085 us time elapse.

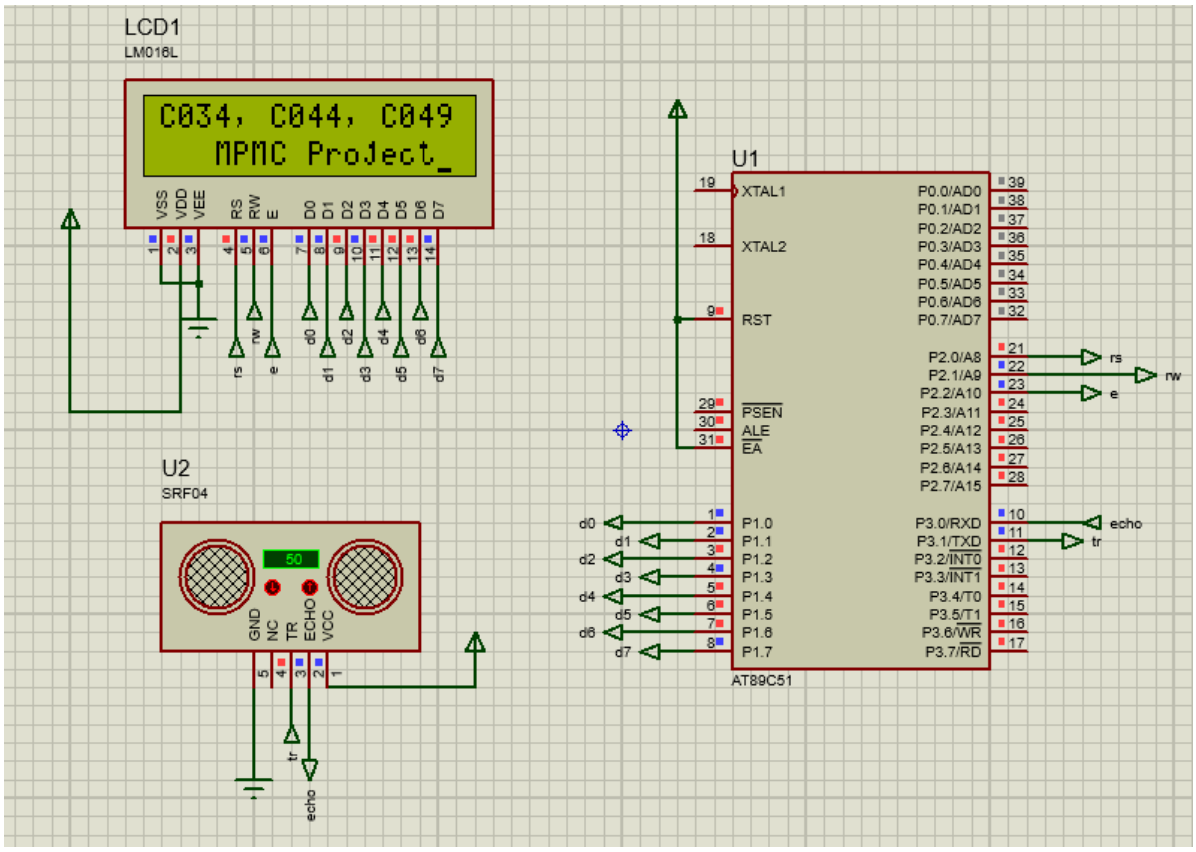
   $\therefore$ Distance = $(34300 * \text{TimerCount} * 1.085 * 10^{-6}) / 2$
   = TimerCount / 54

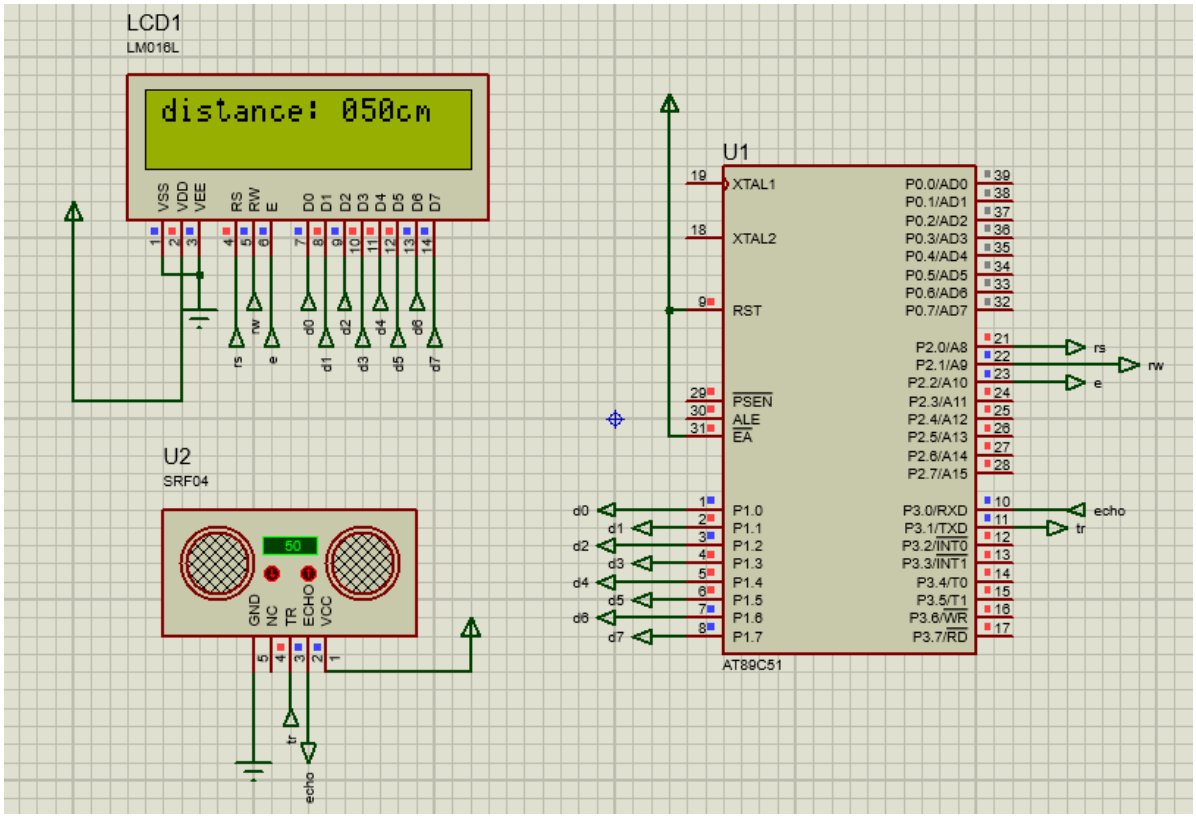
III. SIMULATION & TESTING

3.1 Circuit Diagram



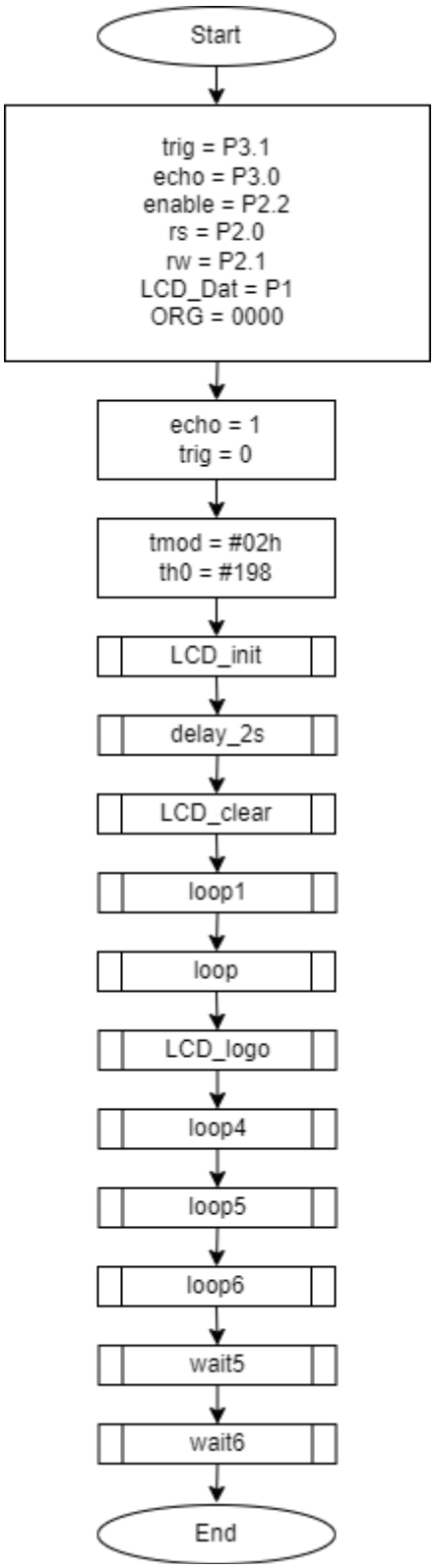
3.2 Simulation



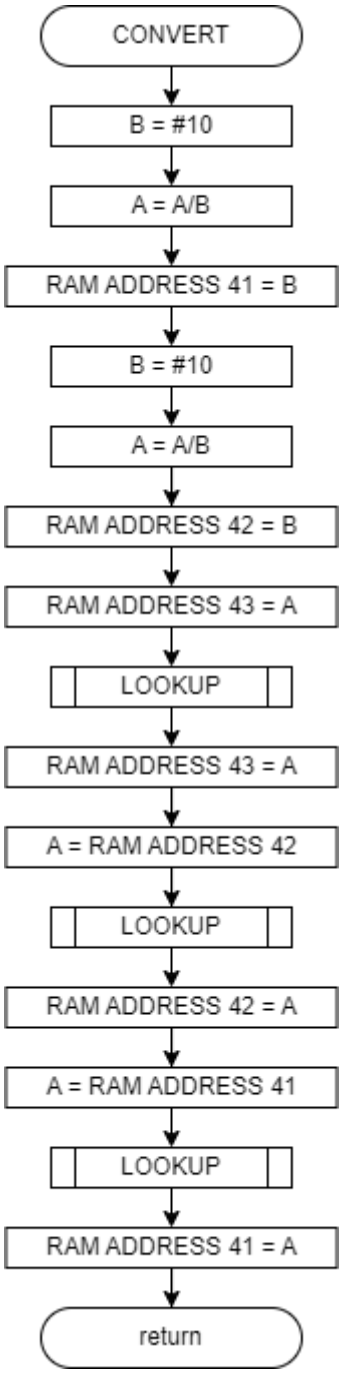


IV. FLOWCHART

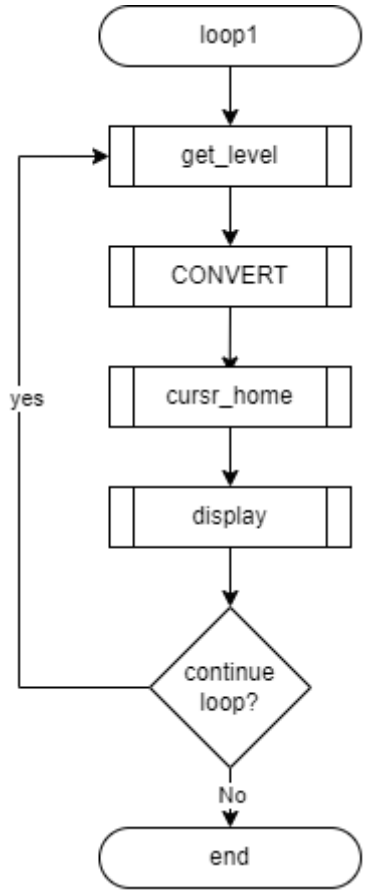
Main:



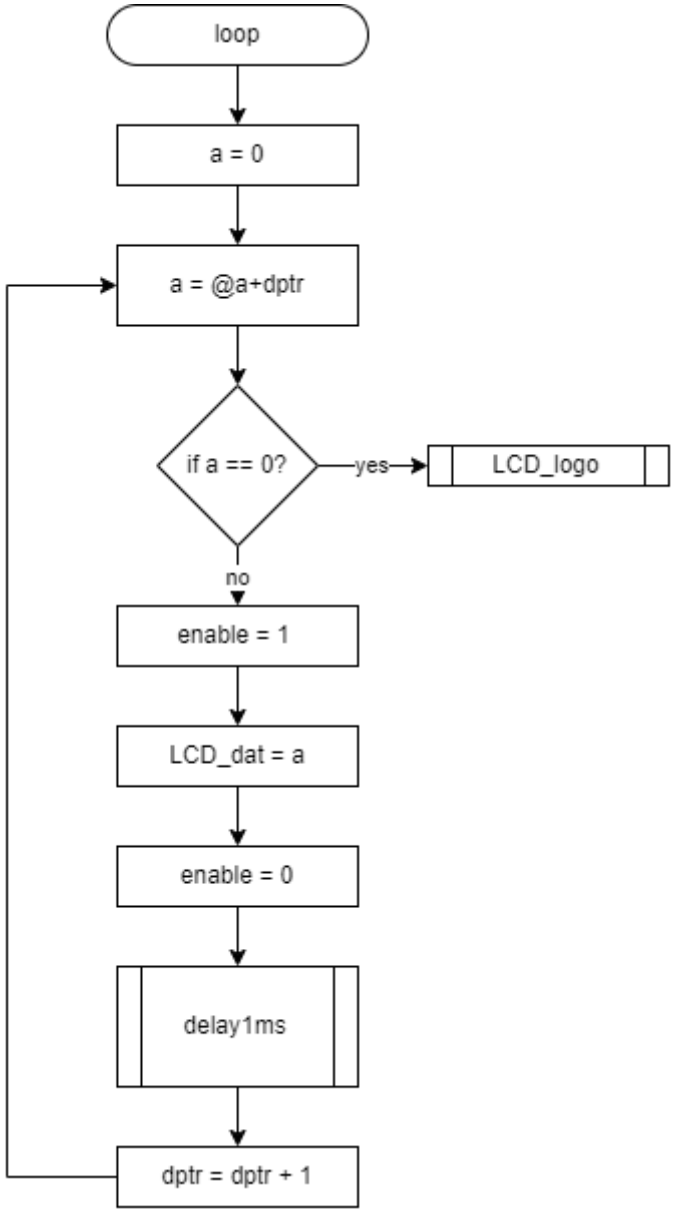
convert:



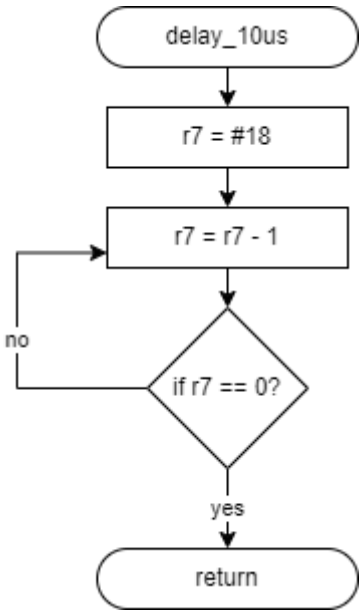
loop1:



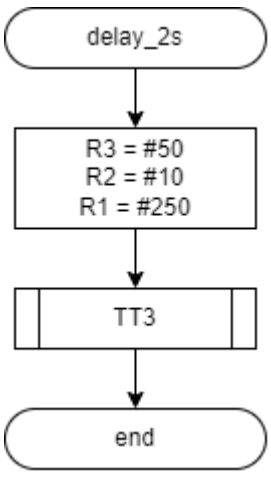
loop:



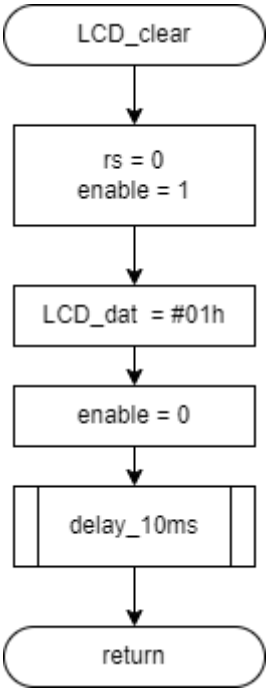
delay_10us:



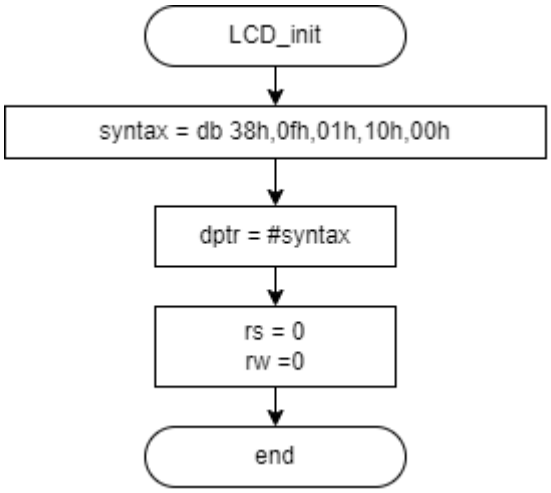
delay_2s:



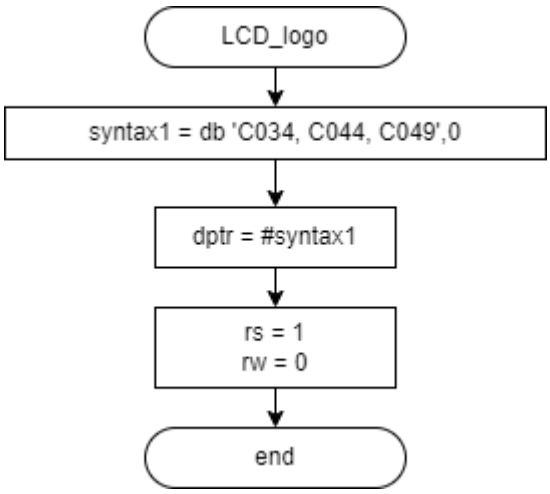
LCD_clear:



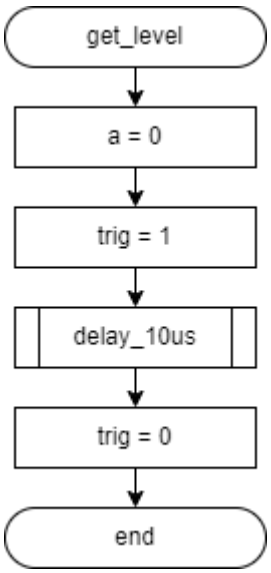
LCD init:

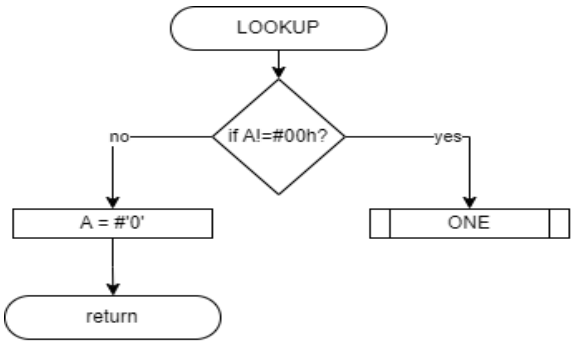


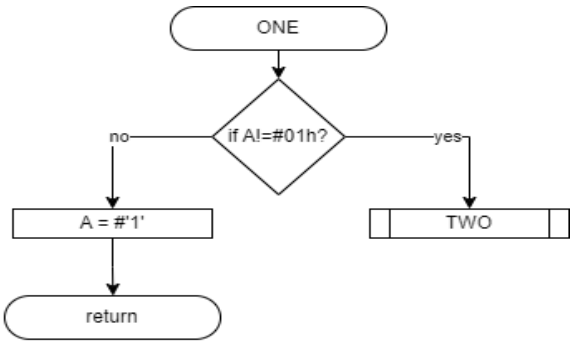
LCD_logo:

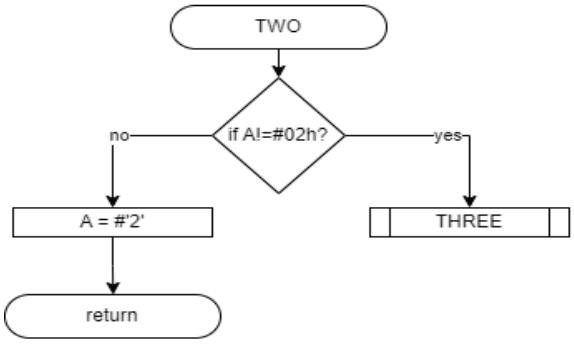


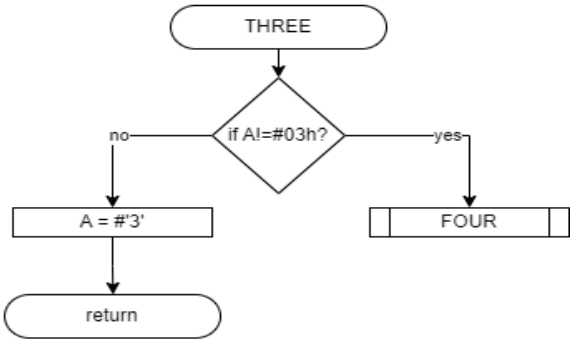
get_level:

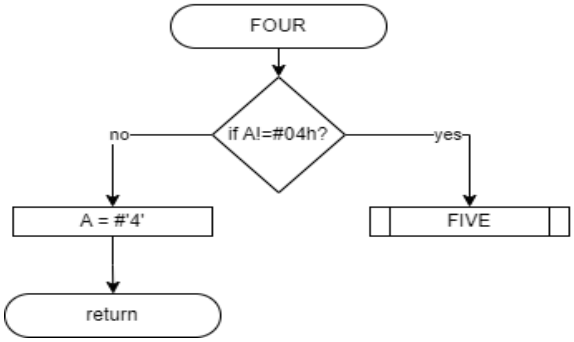


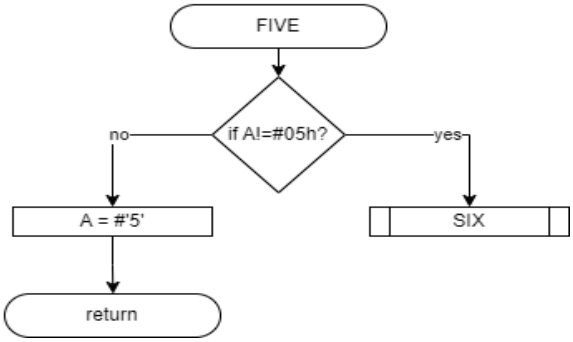

LOOKUP
if A!=#00h?
no
yes
A = #'0'
ONE
return

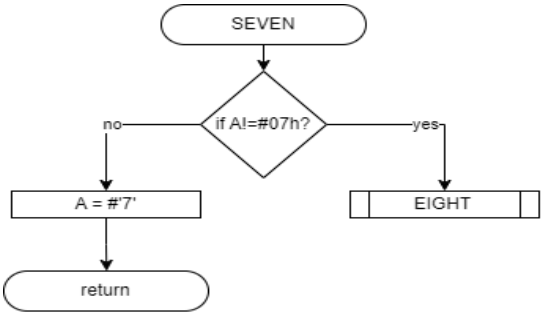

ONE
if A!=#01h?
no
yes
A = #'1'
TWO
return

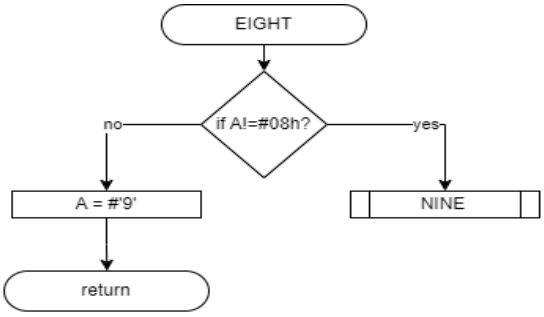

TWO
if A!=#02h?
no
yes
A = #'2'
THREE
return

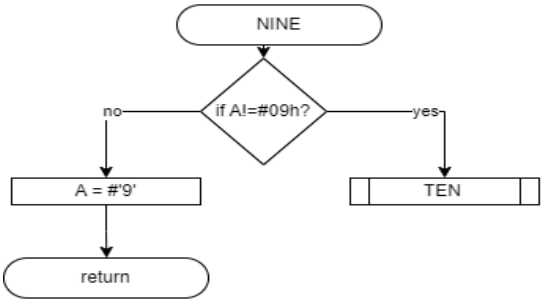

THREE
if A!=#03h?
no
yes
A = #'3'
FOUR
return

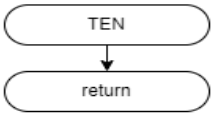

FOUR
if A!=#04h?
no
yes
A = #'4'
FIVE
return


FIVE
if A!=#05h?
no
yes
A = #'5'
SIX
return

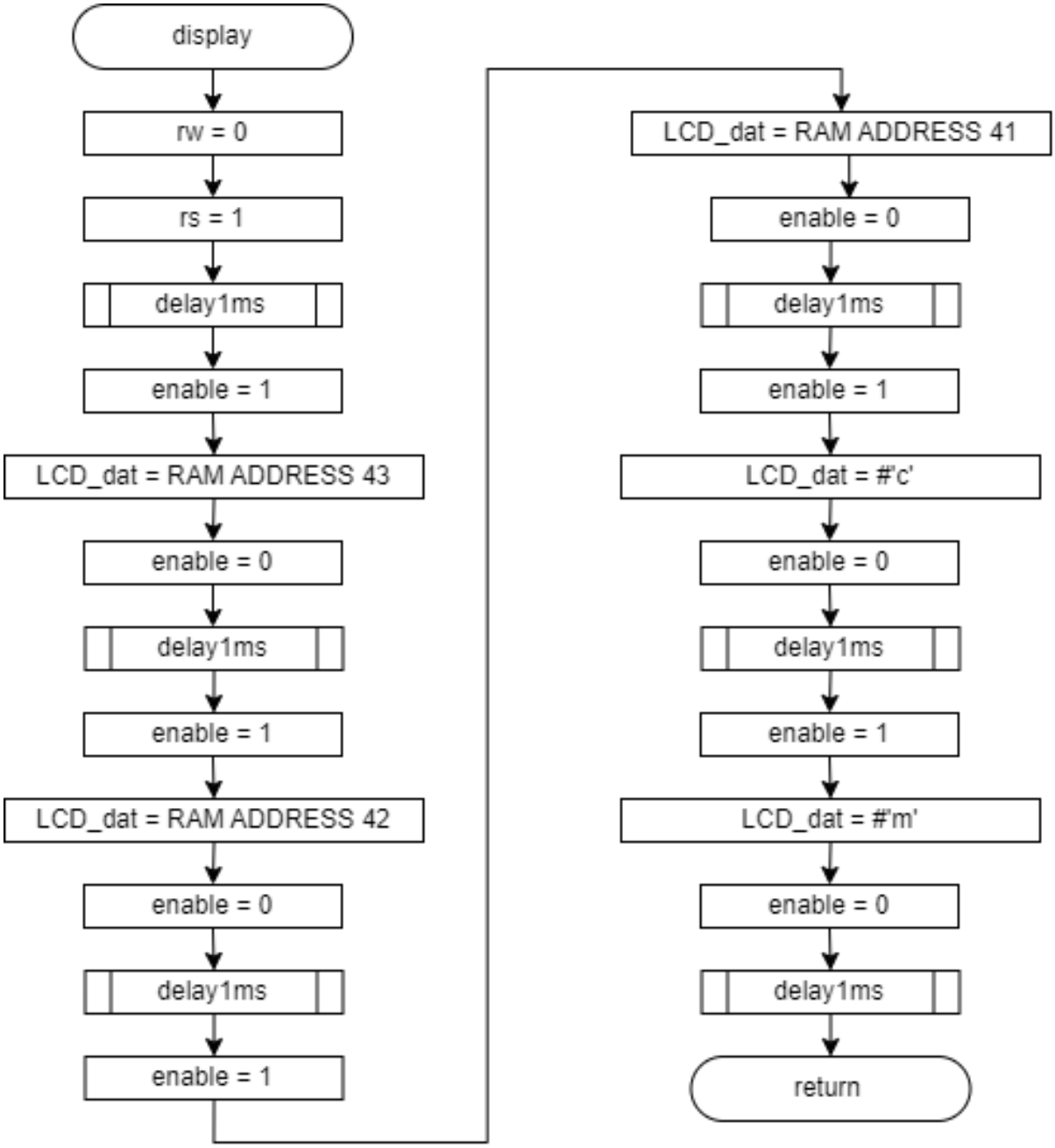

SEVEN
if A!=#07h?
no
yes
A = #'7'
EIGHT
return


EIGHT
if A!=#08h?
no
yes
A = #'9'
NINE
return


NINE
if A!=#09h?
no
yes
A = #'9'
TEN
return


TEN
return

display:


display
rw = 0
rs = 1
delay1ms
enable = 1
LCD_dat = RAM ADDRESS 43
enable = 0
delay1ms
enable = 1
LCD_dat = RAM ADDRESS 42
enable = 0
delay1ms
enable = 1
LCD_dat = RAM ADDRESS 41
enable = 0
delay1ms
enable = 1
LCD_dat = #'c'
enable = 0
delay1ms
enable = 1
LCD_dat = #'m'
enable = 0
delay1ms
return

V. CODE

```
trig  EQU  P3.1
echo  EQU  P3.0
enable EQU p2.2
rs EQU p2.0
rw EQU p2.1
LCD_dat EQU p1
ORG 0000

setb echo
clr trig
mov tmod, #02h
mov th0, #198
acall LCD_init
acall delay_2s
acall LCD_clear

loop1:
        acall get_level
        acall CONVERT
        acall cursr_home
        acall display
        SJMP loop1

LCD_init:
        mov dptr, #syntax
        clr rs
        clr rw

loop:
        clr a
        movc a, @a+dptr
        jz LCD_logo
        setb enable
        mov LCD_dat, a
        clr enable
        acall delay1ms
        inc dptr
        sjmp loop

syntax: db 38h,0fh,01h,10h,00h

LCD_logo:
        mov dptr, #syntax1
        setb rs
        clr rw

loop4:
        clr a
        movc a, @a+dptr
        jz new_command
        setb enable
        mov LCD_dat, a
        clr enable
        acall delay1ms
        inc dptr
        sjmp loop4

syntax1: db 'C034, C044, C049',0

new_command:
        mov dptr, #syntax2
        clr rs
        clr rw

loop5:
        clr a
        movc a, @a+dptr
        jz LCD_logo_2
        setb enable
        mov LCD_dat, a
        clr enable
        acall delay1ms
        inc dptr
        sjmp loop5

syntax2: db 0c0h,14h,14h,14h,00h

LCD_logo_2:
        mov dptr, #syntax3
        setb rs
        clr rw

loop6:
        clr a
        movc a, @a+dptr
        jz return
        setb enable
        mov LCD_dat, a
        clr enable
        acall delay1ms
        inc dptr
        sjmp loop6
```

```
syntax3: db "MPMC Project",0

return:ret

cursr_home:
        clr rs
        setb enable
        mov LCD_dat,#80h
        clr enable
        acall delay10ms
        setb enable
        mov LCD_dat,#0Ch
        clr enable
        ret

LCD_clear:
        clr rs
        setb enable
        mov LCD_dat,#01h
        clr enable
        acall delay10ms
        ret

get_level:
        clr A
        setb trig
        acall delay_10us
        clr trig

wait5:
        jnb echo, wait5
        setb tr0

wait6:
        jnb tf0, wait6
        inc A
        clr tf0
        jz return

        jb echo, wait6
        clr tr0
        ret

delay_10us:
        mov r7, #18

stay:
        djnz r7, stay
        ret

CONVERT:
        MOV B,#10
        DIV AB
        MOV 41,B
        MOV B,#10
        DIV AB

        MOV 42,B
        MOV 43,A

        CALL LOOKUP
        MOV 43,A
        MOV A,42

        CALL LOOKUP
        MOV 42,A
        MOV A,41

        CALL LOOKUP
        MOV 41,A
        RET

LOOKUP:
        CJNE A,#00H,ONE
        MOV A,#'0'
        RET

ONE:
        CJNE A,#01H,TWO
        MOV A,#'1'
        RET

TWO:
        CJNE A,#02H,THREE
        MOV A,#'2'
        RET

THREE:
        CJNE A,#03H,FOUR
        MOV A,#'3'
        RET
```

```
FOUR:
        CJNE A,#04H,FIVE
        MOV A,#'4'
        RET

FIVE:
        CJNE A,#05H,SIX
        MOV A,#'5'
        RET

SIX:
        CJNE A,#06H,SEVEN
        MOV A,#'6'
        RET

SEVEN:
        CJNE A,#07H,EIGHT
        MOV A,#'7'
        RET

EIGHT:
        CJNE A,#08H,NINE
        MOV A,#'8'
        RET

NINE:
        CJNE A,#09H,TEN
        MOV A,#'9'
        RET

TEN:
        RET

display:
        clr rw
        setb rs
        acall delay1ms

        SETB enable
        MOV LCD_dat,#'d'
        clr enable
        acall delay1ms

        SETB enable
        MOV LCD_dat,#'i'
        clr enable
        acall delay1ms

        SETB enable
        MOV LCD_dat,#'s'
        clr enable
        acall delay1ms

        SETB enable
        MOV LCD_dat,#'t'
        clr enable
        acall delay1ms

        SETB enable
        MOV LCD_dat,#'a'
        clr enable
        acall delay1ms

        SETB enable
        MOV LCD_dat,#'n'
        clr enable
        acall delay1ms

        SETB enable
        MOV LCD_dat,#'c'
        clr enable
        acall delay1ms

        SETB enable
        MOV LCD_dat,#'e'
        clr enable
        acall delay1ms

        SETB enable
        MOV LCD_dat,#':'
        clr enable
        acall delay1ms

        SETB enable
        MOV LCD_dat,#' '
        clr enable
        acall delay1ms

        SETB enable
        MOV LCD_dat,43
        clr enable
```

```
        acall delay1ms

        SETB enable
        MOV LCD_dat,42
        clr enable
        acall delay1ms

        SETB enable
        MOV LCD_dat,41
        clr enable
        acall delay1ms

        SETB enable
        MOV LCD_dat,#'c'
        clr enable
        acall delay1ms

        SETB enable
        MOV LCD_dat,#'m'
        clr enable
        acall delay1ms
        RET

delay10ms:
    MOV R3,#1
    MOV R2,#1
    MOV R1,#19

    TT1:
        DJNZ  R1,TT1
        DJNZ  R2,TT1
        DJNZ  R3,TT1
    RET

delay1ms:
    MOV R2,#04
    MOV R1,#18

    TT2:
        DJNZ  R1,TT2
        DJNZ  R2,TT2
    RET

delay_2s:
    MOV R3,#50
    MOV R2,#10
    MOV R1,#250

    TT3:
        DJNZ  R1,TT1
        DJNZ  R2,TT1
        DJNZ  R3,TT3
    RET

END
```

VI. APPLICATIONS

- Parking distance sensors in automobiles.
- Industrial automation for object detection and measurement.
- Robotics for obstacle avoidance and navigation.
- Security systems for detecting intrusions.
- Used in terrain monitoring robots.

VII. CITATIONS

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