Benha University

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“Simple Calculator”

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Abstract

This code is an implementation of a calculator .There are two modes in calculator :

a-Normal mode

1-This mode do four operation on two two digits numbers .

Operations:

a-addtion ab+cd=ans
b-subtraction ab+cd=ans
c-multiplication ab+cd=ans
d-division ab+cd=ans

2-If user enter only one number and press equal it will print only the entered number

b-Advanced mode

1-This mode do four operation on one three digits number max(255) .

Operations:

a-convert from decimal format to binary
b convert from decimal format to hexa
c- convert from decimal format to BCD
d-square root

2-If user enter only one number and press equal it will print only the entered number

Features

1-calculator contain two modes(a-normal mode→(+ , - , * , / , =) ,b- advanced mode)
2-User can press ON button to go to select mode in any time while using calculator →don't need to restart calculator

a-features in normal mode

1-do all operation on two digits not one digit
2-any answer printed with no additional zeroes on the left
- a- 22+22=44
- b- 2+3=5 →not 05
- c- 1*3=3 →not 0003
- d- 7/4=1.75 →not 01.75000

3-user can input numbers with any format for all operations
- a- 1+3= → doesn't have to input 01+03
- b- 1/33=
- c- 10*33=
- d- …and so on

4-calculator covers all input formats as three digit number or many operations in format
- a- 1++3= →errror
- b- +12*36= →error
- c- 123+12 →error
- d- ….and so on

5-calculator do multiplication on any two numbers from to digit and print a correct answer

a- 99*99=9801
b- 3*22=66
c- ….and so on

6-calculator do division and print exponent part and fraction part with no error in calculation and cover corner case input

a-divition by zere →error

7-In subtraction it print a correct ans even ans is positive or negative

b-advanced mode

1-it works on a three digit number from 0 to 255
2-it have four operations

a-convert decimal to binary
b-convert decimal to hexa
c-convert decimal to BCD with no additional zeroes
d-square root

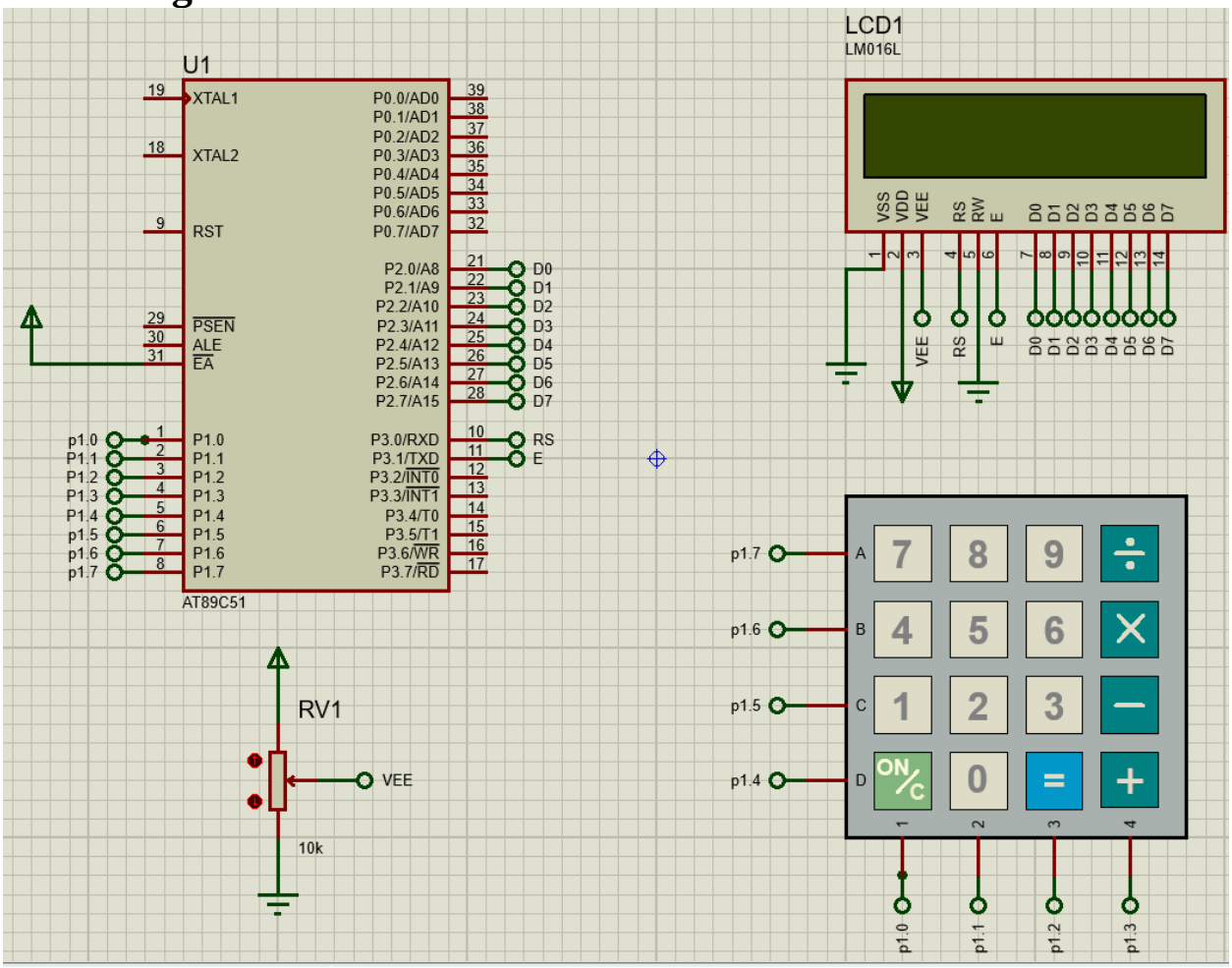
3-if user enter number then equal it will print number not error
4-it covers wrong input formats

a- 1235=→error
b- 1236956=→error
c- …and so on

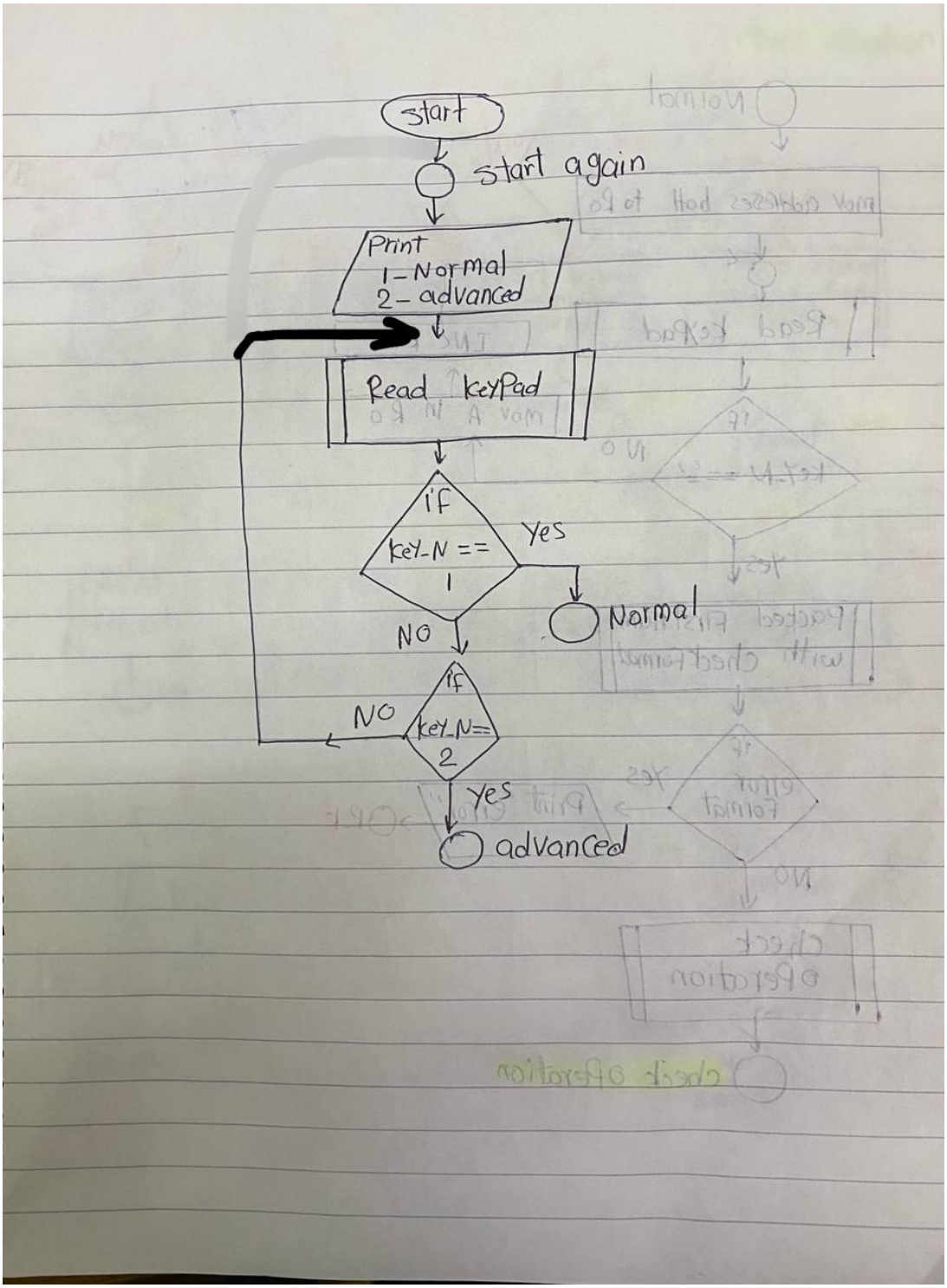
Components

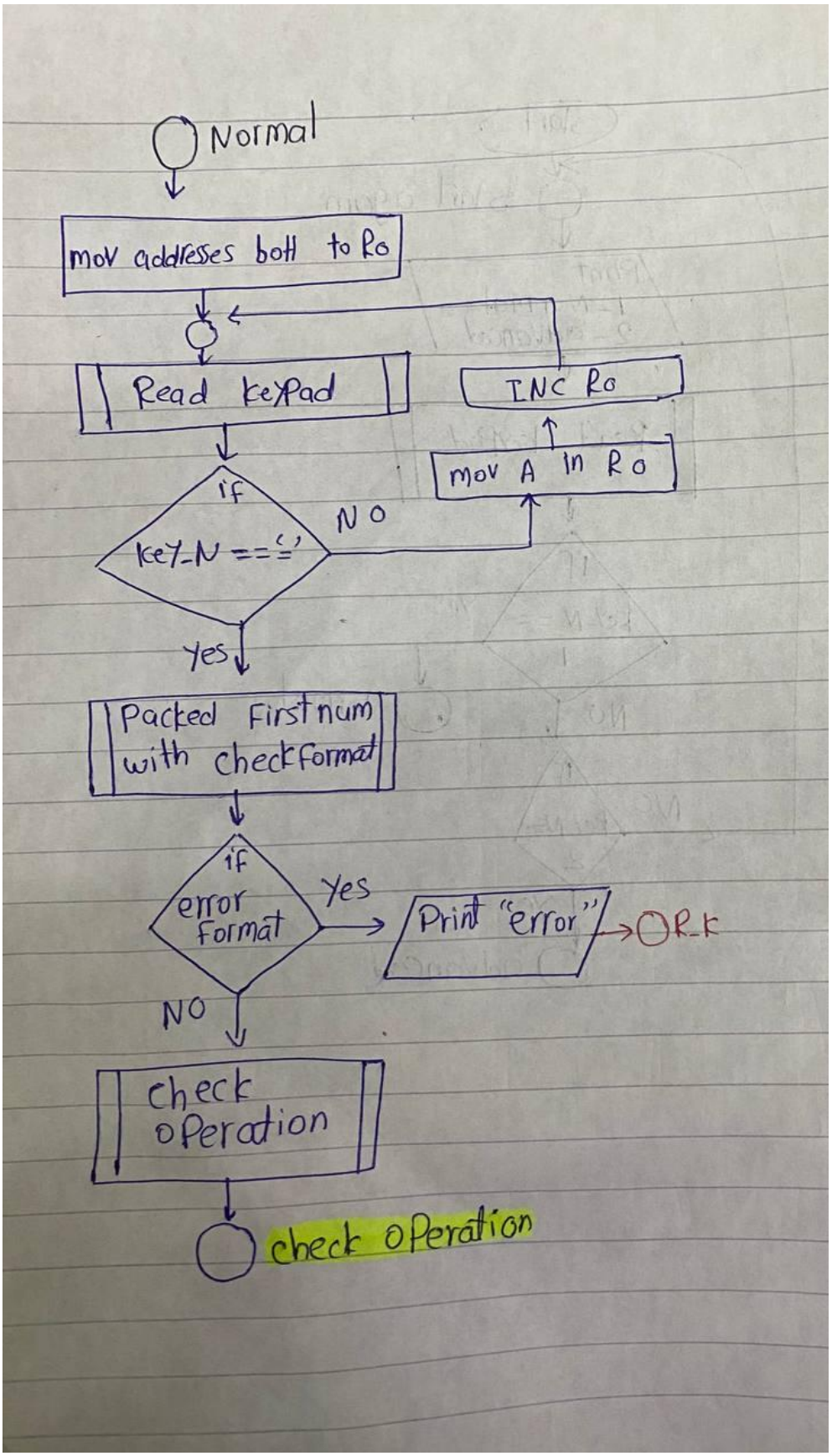
1-80s51 Microcontroller
2-LCD
3-Keypad
4-crystal 11.0952 MHZ
5- capacitors (10uf , 30uf)
6-resistances (10kΩ)
7-variable resistance(10kΩ)

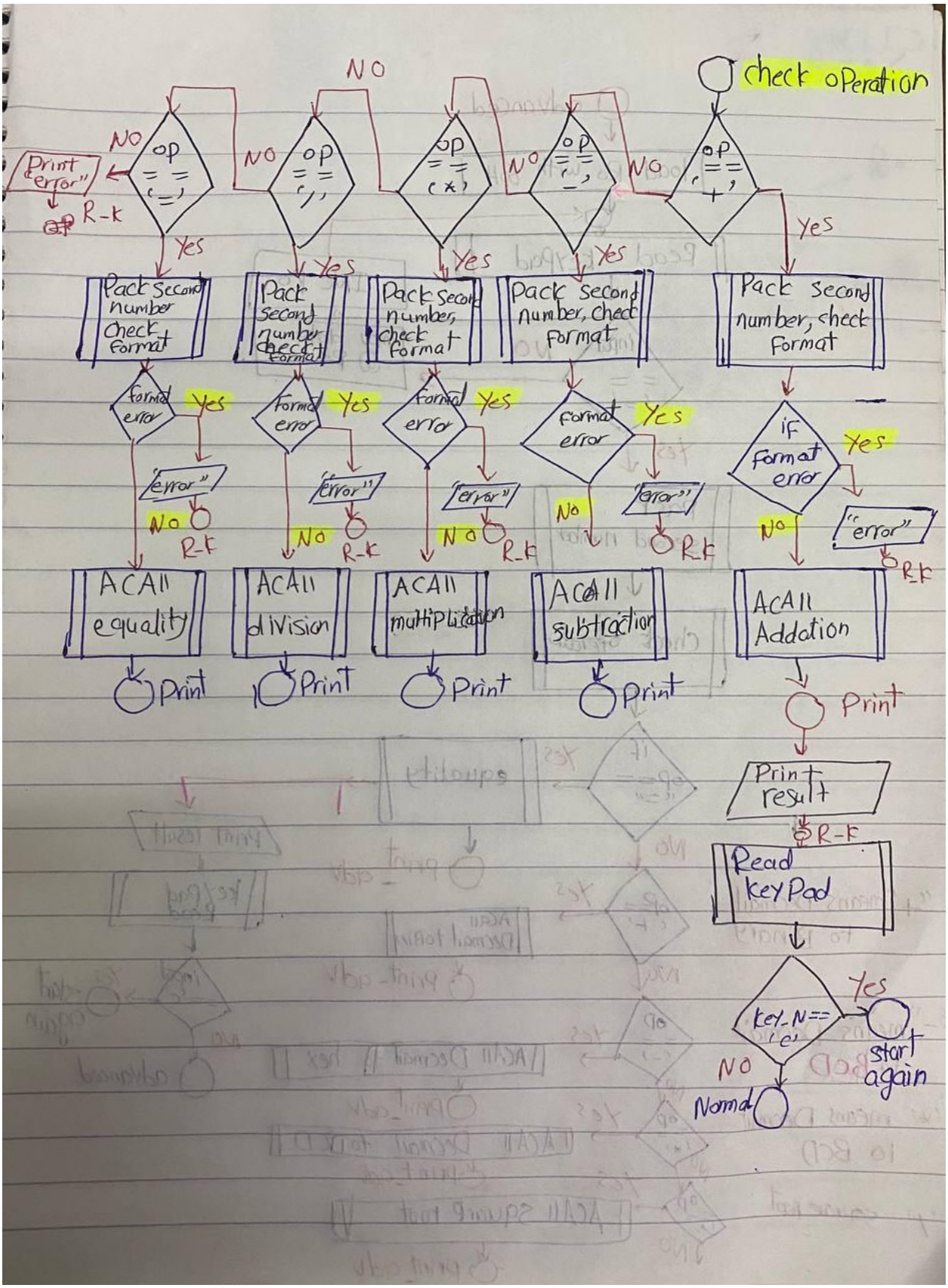
Block diagram

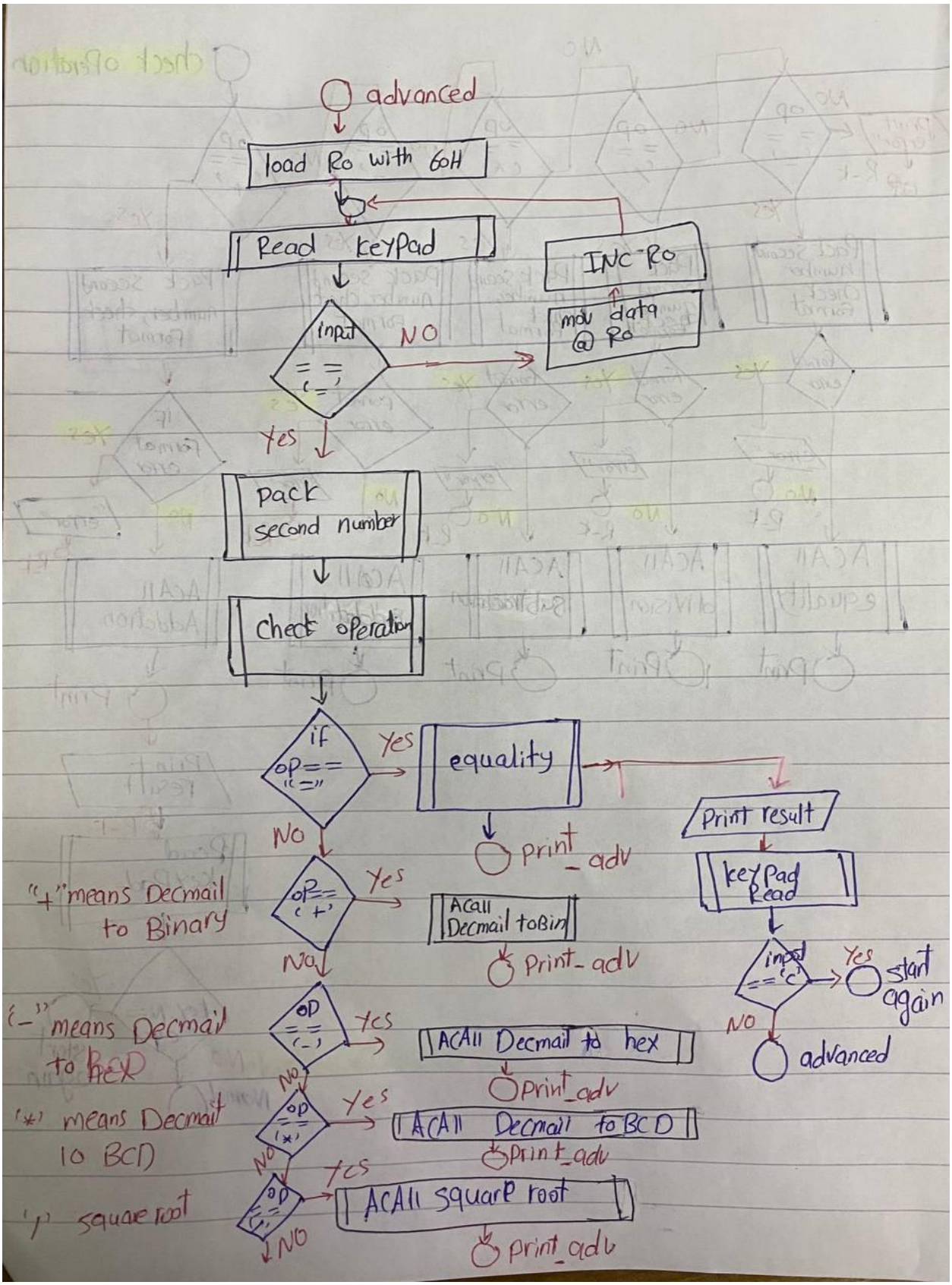


Flowchart


start
start again
Print
1-Normal
2-advanced
Read keyPad
if
key-N ==
1
Yes
Normal
NO
if
key-N==
2
NO
Yes
advanced


Normal
mov addresses both to R0
Read keyPad
INC R0
mov A in R0
if
key_N == '='
NO
yes
Packed Firstnum with checkformat
if
error format
Yes
Print "error"
ORG
NO
check operation
check operation


check operation
op == '='
op == '/'
op == '*'
op == '-'
op == '+'
NO
Yes
Print "error"
R-t
Pack second number check format
Pack second number, check format
format error
"error"
No
ACALL equality
ACALL division
ACALL multiplication
ACALL subtraction
ACALL Addation
Print
Print result
Read keyPad
key_N == 'e'
start again
Nomal


advanced
load R0 with 60H
Read keypad
INC R0
mov data @ R0
input
NO
Yes
pack second number
check operation
if op == "="
Yes
equality
print_adv
No
"+" means Decmail to Binary
op == '+'
Yes
ACall Decmail to Bin
Print_adv
No
"-" means Decmail to hex
op == '-'
Yes
ACall Decmail to hex
Print_adv
No
"*" means Decmail to BCD
op == '*'
Yes
ACall Decmail to BCD
Print_adv
No
"/" square root
op == '/'
Yes
ACall square root
print_adv
No
Print result
keypad Read
input == 'c'
Yes
start again
NO
advanced

Assembly code

```
KEYPAD_PORT EQU P1
C1 BIT P1.0
C2 BIT P1.1
C3 BIT P1.2
C4 BIT P1.3
RO4 BIT P1.4
RO3 BIT P1.5
RO2 BIT P1.6
RO1 BIT P1.7

LCD_PORT EQU P2
Rs BIT P3.0
E BIT P3.1

;INITIAL MESSAGE

ORG 00H
MOV KEYPAD_PORT,#0FFH          ;KEYPAD PORT AS INPUT
LCALL LCD_INIT
MOV DPTR,#MESSAGE              ;PRINT THE INITIAL MESSAGE
AGAIN:
CLR A
MOVC A,@A+DPTR
JZ HERE
LCALL LCD_DATA
INC DPTR
SJMP AGAIN

HERE:
LCALL DELAY
LCALL DELAY
LCALL LCD_INIT
MOV A,#'1'
LCALL LCD_DATA
MOV A,#'-'
LCALL LCD_DATA
MOV A,#'N'
LCALL LCD_DATA
```

```
MOV A,#'O'
LCALL LCD_DATA
MOV A,#'R'
LCALL LCD_DATA
MOV A,#'M'
LCALL LCD_DATA
MOV A,#'A'
LCALL LCD_DATA
MOV A,#'L'
LCALL LCD_DATA
MOV A,#0C0H
LCALL LCD_COMMAND
MOV A,#'2'
LCALL LCD_DATA
MOV A,#'-'
LCALL LCD_DATA
MOV A,#'A'
LCALL LCD_DATA
MOV A,#'D'
LCALL LCD_DATA
MOV A,#'V'
LCALL LCD_DATA
MOV A,#'A'
LCALL LCD_DATA
MOV A,#'N'
LCALL LCD_DATA
MOV A,#'C'
LCALL LCD_DATA
MOV A,#'E'
LCALL LCD_DATA
MOV A,#'D'
LCALL LCD_DATA
CHECK_MOD:
LCALL READ_KEY
CJNE A,#'1',CHECK_ADV
SJMP NORMAL
CHECK_ADV:
CJNE A,#'2',CHECK_MOD
LJMP ADVANCED
NORMAL:
LCALL LCD_INIT
;-----------------RELEASE USED BYTES---------------------------------
;CALCULATOR
MOV 66H,#'Y'          ;TO CHECK THAT USER USED ONLY SIX BYTES OR LESS
MOV R0,#60H           ;START LOCATION TO STORE INPUT DATA
MOV R1,#5
```

```
CLEAR_LOOP:          ; LOOP TO CLEAR 5 BYTES USED IN NUMBER
MOV @R0,#0
INC R0
DJNZ R1,CLEAR_LOOP
MOV R0,#60H          ;SRART INPUT FROM LOCATION WITH ADDRESS H
;---------------------------------RECIEVE INPUT FROM USER----------------------
INPUT_LOOP:
LCALL READ_KEY
LCALL LCD_DATA             ;PRINT ANY INPUT VALUE
MOV @R0,A                  ;INDIRECT SAVE FOR DARA IN RESERVED LOCATION
INC R0                     ;TO SAVE IN NEXT LOCATION
CJNE A,#'=',INPUT_LOOP     ;USER INPUT DATA UNTIL PRESS '='
MOV A,66H                  ;CHECK BYTE 66H IF = 'Y'-->ACESS OPERATION   ELSE--
->WRONG
CJNE A,#'Y',ERORROR        ;ERROR INPUT FORMAT
SJMP START_CALCULATE
ERORROR:LJMP ERROR         ;ERROR MESSAGE
;-----------------------------------------------------------------------
START_CALCULATE:
MOV R0,#60H
MOV A,@R0
LCALL CHECK_BYTE           ;CHECK THAT FIRST BYTE IS A DIGIT
CJNE R7,#0,ILLEAGAL_INPUT  ;NOT DIGIT -->ERROR
SJMP LEAGAL_1              ;DIGIT -->START PACKING OF FIRST NUMBER
ILLEAGAL_INPUT:
LJMP ERROR
LEAGAL_1:
ANL A,#0FH                 ;GET BCD NUMBER FROM ASCII INPUT
MOV R1,A                   ;SAVE FIRST NUMBER IN R0
INC R0                     ;GET NEXT LOCATION OF INPUT DATA
MOV A,@R0
LCALL CHECK_BYTE           ;CHECK IF NEXT BYTE IS DIGIT OR OPERATION
CJNE R7,#0,CHECK_OPERATON  ;IF BYTE CONTAIN ANY SIGN --->GO TO CHECK
OPERATION
ANL A,#0FH                 ;ELSE IF BYTE CONTAIN DIGIT WE CONTINUE IN PACKING
FIRST NUMBER
MOV R3,A                   ;SAVE VALUE TEMPRARY IN R3
MOV A,R1                   ;NUMBER=10*R1+R3
MOV B,#10
MUL AB                     ;10R1
ADD A,R3                   ;10*R1+R3
MOV R1,A
INC R0                     ;GET THIRD INPUR BYTE
MOV A,@R0
                    ;BYTE MUST BE SIGN OF OPERATION
```

```
                                        ;IF BYTE NOT SIGN THIS MEAN THAT USER
INPUT NUMBER FROM 3 DIGITS
;-------------------------------CHECK OPERATION-------------------------

CHECK_OPERATON:
LCALL CHECK_BYTE
CJNE R7,#1,NEXT_OPERATION
SJMP EQUALITY
NEXT_OPERATION:CJNE R7,#2,NEXT_OPERATION1
SJMP ADDITION
NEXT_OPERATION1:CJNE R7,#3,NEXT_OPERATION2
SJMP SUBTRACTION
NEXT_OPERATION2:CJNE R7,#4,NEXT_OPERATION3
LJMP MULTIPLICATION
NEXT_OPERATION3:CJNE R7,#5,ERROR_BYTE  ; ENTERED NUMBER IS 3 DIGIT SO
CALCLATOR SHOULD PRINT ERROR
LJMP DIVISION
ERROR_BYTE:
LJMP ERROR                      ;PRINT ERROR


;*******************************OPERATIONS**********************************
;-----------------------------EQUALITY----------------------------------

EQUALITY:       ;WILL PRINT ENTERED NUMBER(FIRST NUMBER)
MOV A,R1        ;FIRST NUMBER SAVED IN R1 SO WE WANT TO PRINT IT
LCALL PRINT          ;FUNTION TO PRINT ANY DATA IN ONE BYTE IN DECIMAL
FORMAT
LCALL READ_KEY    ;PRESS ANY KEY TO START NEXT OPERATION
LJMP NORMAL

;---------------------------ADDITOIN--------------------------------
ADDITION:
ACALL PACING_SECOND ;FUNCTION TO PACK SECOND NUMVER (IT ALSO CHECK
ERROR IN INPUT  IN SECOND DIGIT)-->1+
ADD A,R1
LCALL PRINT
LCALL READ_KEY
LJMP NORMAL

;-------------------------SUBTRACTION-------------------------------
SUBTRACTION:
ACALL PACING_SECOND
CLR C            ;BECAUSE ALL SUB IS A=A-R-C
MOV R4,A         ;R4=SECOND NUMBER
MOV A,R1
```

```
SUBB A,R4
JNC POSITIVE        ;IF C=0 THEN RESULT IS POSITIVE
MOV B,A             ;SAVE RESULT VALUE
MOV A,#'-'          ;PRINT NEGATIVE SIGN
LCALL LCD_DATA
MOV A,B             ;PREPARE NEGATIVE VALUE TO PRINT BY 2'S COMPLEMENT
CPL A               ;2'S = 1'S+1
INC A
POSITIVE:           ;PRINT RESULT
LCALL PRINT
LCALL READ_KEY
LJMP NORMAL

;----------------------------------------MULTIPLICATION--------------------------------
MULTIPLICATION:                 ;A*R1
ACALL PACING_SECOND                 ;A=SECOND NUMBER
MOV B,R1
MUL AB
;-----------------------------------PRINT RES OF MULTIPLICATION--------------------------
MOV R6,#0
SJMP SUB_1000
INC_COUNT:
INC R6
SUB_1000:
CLR C
SUBB A,#0E8H
XCH A,B
SUBB A,#03H
XCH A,B
JNC INC_COUNT
MOV R7,A            ;SAVE VALUE OF ACC TO GET NEXT REMAINDER
MOV 1,B             ;SAVE VALUE OF B TO GET NEXT REMAINDER
MOV A,R6
MOV 11H,A           ;SAVE FIRST DIGIT TO CHECK WHICH ZEROES WON'T BE PRINTED
-->(0025)
JZ DOONT_PRINT      ;0521-->DON'T PRINT 0
LCALL PRINT
DOONT_PRINT:
CLR C
MOV A,R7            ;ADD WITH 1000 AGAIN TO GET REMAINTER
ADD A,#0E8H
XCH A,1             ;GET B VALUE FROM ADDRESS 1 BY XCH IT WITH A
ADDC A,#03H
XCH A,1             ;RETURN VALUE OF A
MOV R6,#0
MOV B,1             ;VALUE OF B FROM LOC 1
```

```
SJMP SUB_100
;-----------------------GET THIRD DIGIT TO PRINT BY SUBRACT FROM 100 IN LOOP-------
------------------------
SUB_INC_2:
INC R6
SUB_100:
CLR C
SUBB A,#100
XCH A,B
SUBB A,#0
XCH A,B
JNC SUB_INC_2
MOV R7,A
MOV A,R6
MOV 12H,A           ;USED IN PRINT WHICH ZEROES WON'T BE PRINTED -->(0005)
JNZ DONNT_PR2
MOV A,11H
JNZ DONNT_PR2
SJMP ADD_100
DONNT_PR2:
MOV A,12H
LCALL PRINT
ADD_100:
MOV A,R7
ADD A,#100
MOV B,#10
DIV AB
MOV 13H,A           ;0001-->NO ZEROES WILL BE PRINT
JNZ NOOO1           ;0901-->901 WILL BE PRINTED
MOV A,12H           ;9001-->ALL NUMBER WILL BE PRINTED
JNZ NOOO1           ;SO WE USE EACH SAVED VALUE TO PRINT CORRECT FORMAT
MOV A,11H
JNZ NOOO1
SJMP PRINT_LAST_DIGIT
NOOO1:
MOV A,13H
ADD A,#30H
LCALL LCD_DATA
PRINT_LAST_DIGIT:
MOV A,B
ADD A,#30H
LCALL LCD_DATA
LCALL READ_KEY
LJMP NORMAL
;---------------------------------------DIVISION----------------------------------------
DIVISION:                   ;R1/A------>A/B
```

```
ACALL PACING_SECOND
CJNE A,#0,DIVIDE                ;A MUST 1= ZERO TO BE ABLE TO DO OPERATION
LJMP ERROR
DIVIDE:
MOV B,A
MOV 58H,A                       ;SAVE VALUE DIVIDED BY IT TO USE IN REMAINDER
MOV A,R1                        ;A/B
DIV AB
MOV R7,#0                       ;REMINDER FLAG        INTTIOL WITH ZERO  (0-->NO
REM)**(1-->REM)
XCH A,B                         ;TO BE ABLE TO CHECK   B=0-->NO REM   B=VALUE -->REM
CJNE A,#0,REM_FLAG
SJMP NO_REM                     ;NO REM SO SKIP INST OF SET FLAG (MOV R7,#1)
REM_FLAG:
MOV R7,#1                       ;SET REM FLAG BECAUSE B CONTAIN VALUE
NO_REM:
XCH A,B                         ;RETURN A VALUE TO PRINT INTEGER PART   (A CONTAINS
INT ),(B CONTAINS REM)
MOV 57H,B                       ;SAVE REM VALUE TO USE IN REMAINDER
MOV B,#10
DIV AB
JZ DONT_PRINTT                  ;IF NUM=04 -->WE WON'T PRINT 0
ADD A,#30H
LCALL LCD_DATA
DONT_PRINTT:
MOV A,B                         ;VALUE OF B WILL BE PRNTED ANY WAY BECASE WE DIV
2 DIGITS SO MAX RES IS IN 2 DIGITS (00) WILL PRINT ONE ZERO AS RESULT
ADD A,#30H
LCALL LCD_DATA
CJNE R7,#1,NOO_REM              ;USE FLAG TO CHECK IF THERE IS A REM
MOV A,#'.'                  ;FALG =1 SO WE PRINT '.' THEN PRINT VALUE OF REMAINDER
LCALL LCD_DATA
MOV R7,#5                   ;4 NUMBER FOR REMAINDER
MOV B,57H                   ;REMAINDER VALUE ASSINED TO B
REMAINDER:
MOV A,#10                   ;R=(10*REM)/DIVBY
MUL AB                      ;10REM
XCH A,B                     ;TO CHECK IF VALUE IN ONE OR TWO BYTES  (VALUE>255)-
->DIV USING SUBTRACTION     ELSE-->USE DIV INST
CJNE A,#0,SUB_REM
XCH A,B                     ;RETURN VALUE OF A
MOV B,58H                   ;VALUE DIIDED BY
DIV AB
CJNE A,#0,PR_REM            ;WE CONTIUE IN DETERMINING REMAINDER VALUE
UTIL A,B REACH 0
```

```
XCH A,B                    ;IF A=0  BUT B=VALUE WE SHOULD PRINT ZERO THEN MUL BY 10
CJNE A,#0,NEE_REM          ;IF A,B=0 END OF DETERMINING REMAINDER
SJMP NOO_REM
NEE_REM:                   ;WE PRINT VALUE IN A"0" ANY WAY EXPECT IF B ALSO = '0' WE END DETERMINING REMAINDER
XCH A,B
MOV A,#30H
LCALL LCD_DATA
SJMP REMAINDER1
PR_REM:                    ;WE WRITE TWO DIFF INST FOR PRINT BEACAUSE IF A EQUAL VALUE WE DON'T WANT TO CHECK IF B=0 BCUASE A PRINTED ANY WAY
ADD A,#30H
LCALL LCD_DATA
REMAINDER1:
DJNZ R7,REMAINDER          ;DEC COUNTER
SJMP NOO_REM               ;END OF LOOP IF R7=0
SUB_REM:                   ;TO GET DIV ANS BY SUB
XCH A,B                    ;RETURN VALUE OF A BECOUSE WE DO XCH A,B BEFORE LAST CHECK
MOV R6,#0                  ;COUNTER OF NUMBER OF SUB
SJMP SUBBBBB               ;TO SKIP INC IN FIRST LOOP
SUBBBBB1:
INC R6
SUBBBBB:
CLR C
SUBB A,58H                 ;SEB A FROM VALUE DIVIDED BY IT UNTIL REACH VALUE LESS THAN VALUE DIVIDED BY
XCH A,B
SUBB A,#0                  ;AFTER SUBB MAX VALUE IS 2 DIGITS DON'T REACH B SO WE DO B-C
XCH A,B
JNC SUBBBBB1
MOV 70H,A                  ;SAVE VALUE TO USE IN NEXT REM
MOV A,R6                   ;RES TO PRINT
ADD A,#30H
LCALL LCD_DATA
MOV A,70H
ADD A,58H                  ;GET NEXT REMAINDER
XCH A,B                    ;REMAINDER ALWAYS IN B
DJNZ R7,REMAINDER          ;DECREASE COUNTER
NOO_REM:
;CLR C
LCALL READ_KEY
LJMP NORMAL
;-----------------------------------------ADVANCED---------------------------
```

```
ADVANCED:
LCALL LCD_INIT
MOV 65H,'Y'
MOV R0,#60H
MOV R5,#4
CLEAR_LOCATIONS:
MOV @R0,#0
INC R0
DJNZ R5,CLEAR_LOCATIONS
MOV R0,#5FH
READ_AGAIN:
INC R0
LCALL READ_KEY
MOV R6,A
CJNE A,#'+',HEXAAA
MOV A,#'D'
SJMP PRINT_BUTTON
HEXAAA:CJNE A,#'-',DECCIMALL
MOV A,#'D'
SJMP PRINT_BUTTON
DECCIMALL:CJNE A,#'*',BINAAARY
MOV A,#'D'
SJMP PRINT_BUTTON
BINAAARY:CJNE A,#'/',PRINT_BUTTON
MOV A,#'^'
LCALL LCD_DATA
MOV A,#'.'
LCALL LCD_DATA
MOV A,#'5'
PRINT_BUTTON:
LCALL LCD_DATA
MOV A,R6
MOV @R0,A
CJNE A,#'=',READ_AGAIN
PACK_NUMBER:
MOV A,65H
CJNE A,'Y',ER_ROR
SJMP C_PACK
ER_ROR:
LJMP ERROR2
C_PACK:

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

MOV R0,#60H
MOV A,@R0
```

```
LCALL CHECK_BYTE              ;CHECK THAT FIRST BYTE IS A DIGIT
CJNE R7,#0,ILLEAGAL_INPUT2      ;NOT DIGIT -->ERROR
SJMP LEAGAL_12                ;DIGIT -->START PACKING OF FIRST NUMBER
ILLEAGAL_INPUT2:
LJMP ERROR2
LEAGAL_12:
ANL A,#0FH                     ;GET BCD NUMBER FROM ASCII INPUT
MOV R1,A                      ;SAVE FIRST NUMBER IN R0
INC R0                      ;GET NEXT LOCATION OF INPUT DATA
MOV A,@R0
LCALL CHECK_BYTE              ;CHECK IF NEXT BYTE IS DIGIT OR OPERATION
CJNE R7,#0,CHECK_OPERATON2      ;IF BYTE CONTAIN ANY SIGN --->GO TO CHECK
OPERATION
ANL A,#0FH                     ;ELSE IF BYTE CONTAIN DIGIT WE CONTINUE IN PACKING
FIRST NUMBER
MOV R3,A                      ;SAVE VALUE TEMPRARY IN R3
MOV A,R1                      ;NUMBER=10*R1+R3
MOV B,#10
MUL AB                      ;10R1
ADD A,R3                      ;10*R1+R3
MOV R1,A
INC R0                      ;GET THIRD INPUR BYTE
MOV A,@R0
LCALL CHECK_BYTE
CJNE R7,#0,CHECK_OPERATON2
ANL A,#0FH                     ;ELSE IF BYTE CONTAIN DIGIT WE CONTINUE IN PACKING
FIRST NUMBER
MOV R3,A                      ;SAVE VALUE TEMPRARY IN R3
MOV A,R1                      ;NUMBER=10*R1+R3
MOV B,#10
MUL AB                      ;10R1
ADD A,R3                      ;10*R1+R3
MOV R1,A
INC R0
MOV A,@R0
LCALL CHECK_BYTE

                    ;BYTE MUST BE SIGN OF OPERATION
                                          ;IF BYTE NOT SIGN THIS MEAN THAT USER
INPUT NUMBER FROM 3 DIGITS
;-------------------------------CHECK OPERATION-------------------------

CHECK_OPERATON2:
CJNE R7,#1,NEXT_OPERATION22
LJMP EQUALITY2
NEXT_OPERATION22:CJNE R7,#2,NEXT_OPERATION122
```

```
SJMP BINARY
NEXT_OPERATION122:CJNE R7,#3,NEXT_OPERATION222
LJMP HEXA
NEXT_OPERATION222:CJNE R7,#4,NEXT_OPERATION322
LJMP DICIMAL_BCD
NEXT_OPERATION322:CJNE R7,#5,ERROR_BYTE2  ; ENTERED NUMBER IS 3 DIGIT SO CALCLATOR SHOULD PRINT ERROR
LJMP SQUARE_ROOT
ERROR_BYTE2:
LJMP ERROR2
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
EQUALITY2:        ;WILL PRINT ENTERED NUMBER(FIRST NUMBER)
MOV A,R1          ;FIRST NUMBER SAVED IN R1 SO WE WANT TO PRINT IT
LCALL PRINT           ;FUNTION TO PRINT ANY DATA IN ONE BYTE IN DECIMAL FORMAT
LCALL READ_KEY    ;PRESS ANY KEY TO START NEXT OPERATION
LJMP ADVANCED

BINARY:
MOV R0,#8
MOV A,R1
PRINT_BINARY:
RLC A
XCH A,R1
JC PRINT_B1
MOV A,#30H
LCALL LCD_DATA
SJMP COUNT_BINARY
PRINT_B1:
MOV A,#31H
LCALL LCD_DATA
COUNT_BINARY:
XCH A,R1
DJNZ R0,PRINT_BINARY
MOV A,#'B'
LCALL LCD_DATA
LCALL READ_KEY
LJMP ADVANCED
HEXA:
MOV R5,#2
MOV A,R1
SJMP HEXA2
HEXA_REPEAT:
MOV A,R1
SWAP A
HEXA2:
```

```
SWAP A
ANL A,#0FH
CJNE A,#10,CARRY_CHECK
MOV A,#'A'
LCALL LCD_DATA
SJMP END_HEXA
CARRY_CHECK:
JC LESS_THAN_TEN
CJNE A,#11,TWELVE
MOV A,#'B'
LCALL LCD_DATA
SJMP END_HEXA
TWELVE:CJNE A,#12,THERTEEN
MOV A,#'C'
LCALL LCD_DATA
SJMP END_HEXA
THERTEEN:CJNE A,#13,FOURTEEN
MOV A,#'D'
LCALL LCD_DATA
SJMP END_HEXA
FOURTEEN:CJNE A,#14,FIFTEEN
MOV A,#'E'
LCALL LCD_DATA
SJMP END_HEXA
FIFTEEN:CJNE A,#15,END_HEXA
MOV A,#'F'
LCALL LCD_DATA
SJMP END_HEXA
LESS_THAN_TEN:
ADD A,#30H
LCALL LCD_DATA
END_HEXA:
DJNZ R5,HEXA_REPEAT
MOV A,#'H'
LCALL LCD_DATA
LCALL READ_KEY
LJMP ADVANCED

DICIMAL_BCD:
MOV A,#0C0H
LCALL LCD_COMMAND
MOV A,60H
ANL A,#0FH
MOV R5,#4
SWAP A
PRINT_AGAAIN:
```

```
RLC A
XCH A,R0
JNC PRINT_ZZERO
MOV A,#31H
LCALL LCD_DATA
XCH A,R0
SJMP DEC_COUNT
PRINT_ZZERO:
MOV A,#30H
LCALL LCD_DATA
XCH A,R0
DEC_COUNT:
DJNZ R5,PRINT_AGAAIN
MOV A,61H
LCALL CHECK_BYTE
CJNE R7,#0,END_BCD
MOV A,61H
ANL A,#0FH
MOV R5,#4
SWAP A
PRINT_AGAAIN1:
RLC A
XCH A,R0
JNC PRINT_ZZERO1
MOV A,#31H
LCALL LCD_DATA
XCH A,R0
SJMP DEC_COUNT1
PRINT_ZZERO1:
MOV A,#30H
LCALL LCD_DATA
XCH A,R0
DEC_COUNT1:
DJNZ R5,PRINT_AGAAIN1
MOV A,62H
;;;;;;;;;;;;;;;
LCALL CHECK_BYTE
CJNE R7,#0,END_BCD
MOV A,62H
;;;;;;;;;;;;;;;;;;
ANL A,#0FH
MOV R5,#4
SWAP A
PRINT_AGAAIN2:
RLC A
XCH A,R0
```

```
JNC PRINT_ZZERO2
MOV A,#31H
LCALL LCD_DATA
XCH A,R0
SJMP DEC_COUNT2
PRINT_ZZERO2:
MOV A,#30H
LCALL LCD_DATA
XCH A,R0
DEC_COUNT2:
DJNZ R5,PRINT_AGAAIN2
END_BCD:
MOV A,#'B'
LCALL LCD_DATA
MOV A,#'C'
LCALL LCD_DATA
MOV A,#'D'
LCALL LCD_DATA
LCALL READ_KEY
LJMP ADVANCED
SQUARE_ROOT:
CJNE R1,#220,HIHIHIHHI
SJMP SQUARE_CALCULATE
HIHIHIHHI:
JC SQUARE_CALCULATE
LJMP ERROR2

SQUARE_CALCULATE:
MOV DPTR ,#SQUARE
CLR A
MOV R0,#0 ; R0 IS THE COUNTER
MOV 5AH,R1 ; SAVE THE VALUE IN R2
AGAINNN:
MOVC A,@A+DPTR
XCH A,R1
CLR C
SUBB A,R1
JNC LOOP ; IF CARRY=0 JUMP
MOV A,R0
LCALL PRINT
MOV A,5CH
CJNE A,#0 ,LLL
SJMP FINISH
LLL: MOV A,#'.'
LCALL LCD_DATA ;DISPLAY IS THE FUNCTION OF PRINT
MOV A,R0
```

```
MOV B,#2
MUL AB ;A=2*COUNTER
MOV 5BH,A
MOV B,5CH ; THE VALUE OF SUBTRACTION
MOV A,#10
MUL AB ; A= 10 * SUBTRACTION VALUE
MOV B,5BH
DIV AB
LCALL PRINT
SJMP FINISH
LOOP : INC DPTR
MOV 5CH ,A ; KEEP THE VALUE OF SUBTRACTION TO THE NEXT OP
CLR A
INC R0  ; INCREAMENT COUNTER
MOV R1,5AH ; SAVE THE VALUE OF  SUBTRACTION
SJMP AGAINNN
FINISH:
LCALL READ_KEY
LJMP ADVANCED


;----------------functions-------------------------

READ_KEY:
CHECK_1:                        ;CHECK IF A BUTTON WAS PRESSED
CLR RO1
CLR RO2
CLR RO3
CLR RO4
;DEPOUNCE
MOV A,KEYPAD_PORT
ANL A,#0FH
CJNE A,#0FH,CHECK_1
CHECK_2:                        ;MAYBE IT WAS JUST A SPIKE NOISE SO, WAIT FOR
DEBOUNCE AND CHECK AGAIN
ACALL DELAY                      ;DEPOUNCE DELAY
MOV A,KEYPAD_PORT
ANL A,#0FH
CJNE A,#0FH,CHECK_ROW
SJMP CHECK_1                     ;NOT PRESSED

CHECK_ROW:                      ;CHECK IN WHICH ROW THE PRESSED BUTTON IS
CLR RO1
SETB RO2
SETB RO3
SETB RO4
```

```
MOV A,KEYPAD_PORT
CJNE A,#01111111B,ROW_1

SETB RO1
CLR RO2
SETB RO3
SETB RO4
MOV A,KEYPAD_PORT
CJNE A,#10111111B,ROW_2

SETB RO1
SETB RO2
CLR RO3
SETB RO4
MOV A,KEYPAD_PORT
CJNE A,#11011111B,ROW_3

SETB RO1
SETB RO2
SETB RO3
CLR RO4
MOV A,KEYPAD_PORT
CJNE A,#11101111B,ROW_4

LJMP CHECK_1

ROW_1:                          ;PUT THE ADDRESS OF THE RIGHT ROW IN DPTR
MOV DPTR,#ROW1
SJMP FIND
ROW_2:
MOV DPTR,#ROW2
SJMP FIND
ROW_3:
MOV DPTR,#ROW3
SJMP FIND
ROW_4:
MOV DPTR,#ROW4
SJMP FIND

FIND:
MOV R1,#4                       ;FIND IN WHICH COLUMN THE PRESSED BUTTON IS
RRC A
JNC MATCH
INC DPTR
DJNZ R1, FIND
SJMP READ_KEY
```

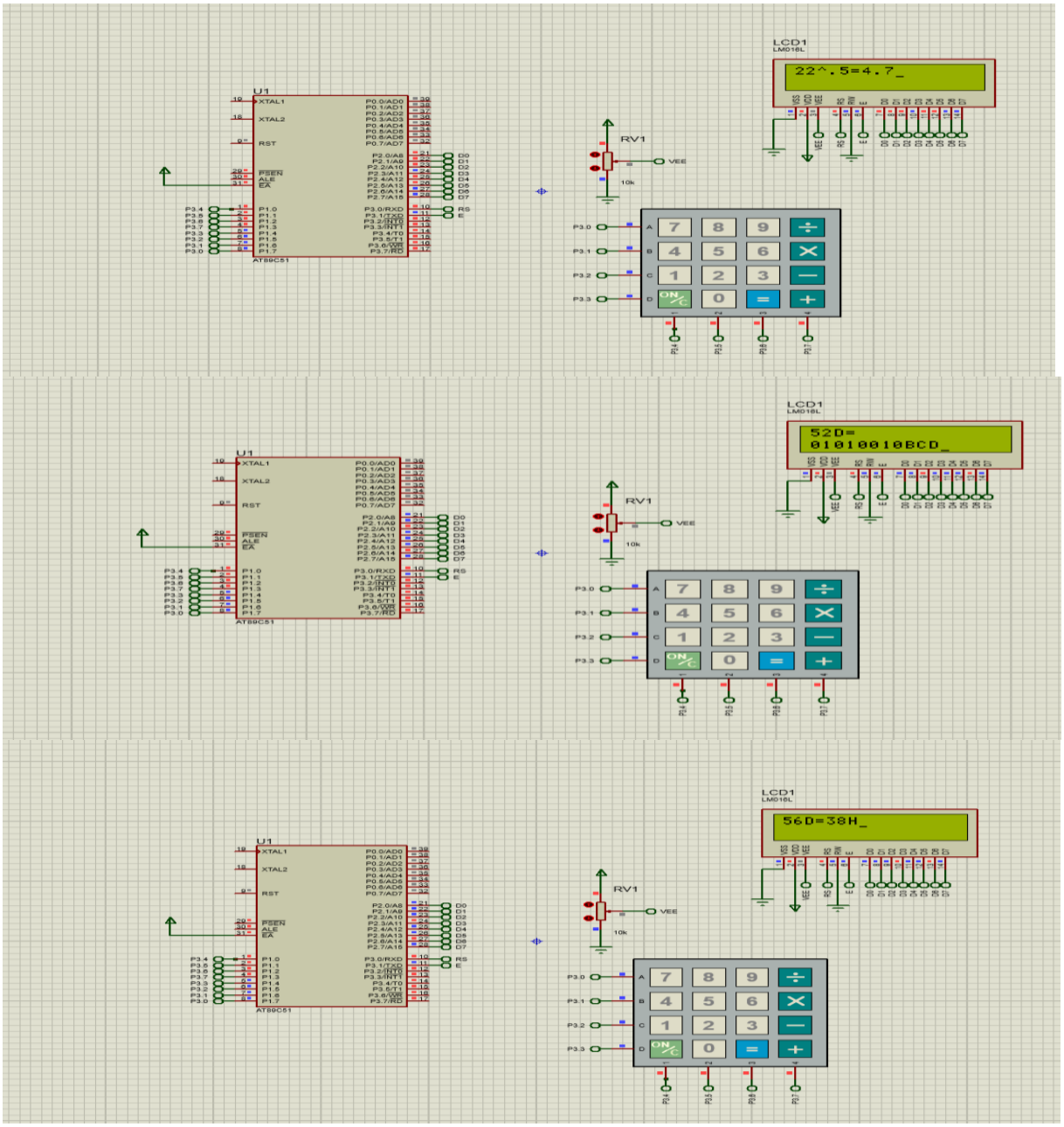
```
MATCH:                          ;TAKE THE NUBER AND WRITE IT ON THE LCD
CLR A
MOVC A,@A+DPTR
CJNE A,#'C',PPO
LCALL LCD_INIT
LJMP HERE                       ;RESET CALCULATOR
PPO:
RET
ERROR:                          ;PRINT THE ERROR MESSAGE
LCALL LCD_INIT
MOV DPTR,#ERR
AGAIN_2:
CLR A
MOVC A,@A+DPTR
JZ HOO
LCALL LCD_DATA
INC DPTR
SJMP AGAIN_2
HOO:
LCALL READ_KEY                  ;TO STOP MESSAGE ON SCREEN
LJMP NORMAL
ERROR2:                         ;PRINT THE ERROR MESSAGE
LCALL LCD_INIT
MOV DPTR,#ERR
AGAIN_22:
CLR A
MOVC A,@A+DPTR
JZ HOO2
LCALL LCD_DATA
INC DPTR
SJMP AGAIN_22
HOO2:
LCALL READ_KEY                  ;TO STOP MESSAGE ON SCREEN
LJMP ADVANCED
PRINT:
MOV B,#10           ;165---->1,5,6
DIV AB              ;GET FIRST DIGIT FROM RIGHT
MOV R4,B            ;SAVE DIGIT IN R4
MOV B,#10
DIV AB              ;GET SECOND DIGIT
MOV R5,A            ;A=LAST DIGIT ****SAVE DIGIT IN R5 TO USE IT IN SECOND
CHECK
JZ NO1              ;IF NUMBER =012  --->DON'T PRINT 0
ADD A,#30H          ;DIGIT !=0 SO PRINT DIGIT
LCALL LCD_DATA
```

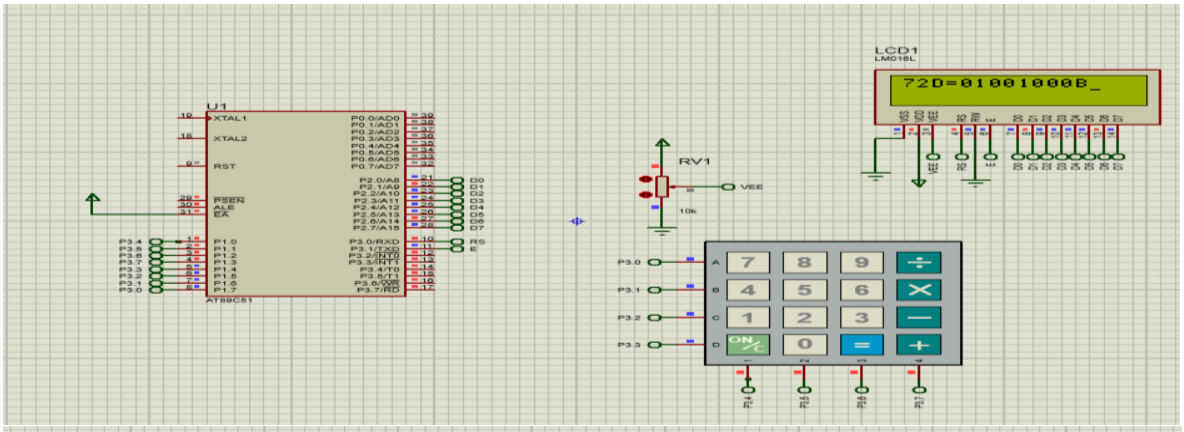
```
NO1:
MOV A,B              ;B CONTAIN SECOND DIGIT
JNZ NO2              ;IF DIGIT =0---->WE HAVE TWO CONDITIONS PRINT IT OR NO (001)-
-->WON'T PRINT   (101)WILL PRINT
MOV A,R5             ;CHECK LAST DIGIT IF =0 OR NOT
JZ NO3
MOV A,B
NO2:                 ;DIGIT !=ZERO SO PRINT IT ANY WAY   (010)--->WILL PRINT 1   (210)-
-->WILL PRINT 1
ADD A,#30H
LCALL LCD_DATA
NO3:
MOV A,R4             ;FIRST DIGIT WILL BE PRINTED IN ALL CINDITIONS
ADD A,#30H
LCALL LCD_DATA
RET

;-----------------------------------------LCD INTERFACING---------------------------------

LCD_INIT:
MOV A,#38H                      ;2 LINES AND 5*7 MATRIX
ACALL LCD_COMMAND
MOV A,#0EH                      ;DISPLAY ON, CURSOR BLINKING
ACALL LCD_COMMAND
MOV A,#01H                      ;CLEAR DISPLAY SCREEN
ACALL LCD_COMMAND

RET

LCD_COMMAND:                        ;APPLY A COMMAND TO THE LCD
MOV LCD_PORT,A
CLR Rs
SETB E
CLR E
ACALL DELAY
RET

LCD_DATA:                       ;WRITE TO THE LCD
MOV LCD_PORT,A
SETB Rs
SETB E
CLR E
ACALL DELAY
RET

DELAY:                      ;USED FOR BOTH LCD AND DEBOUNCING DELAY
```

```
MOV R3,#255
LOOP2: MOV R2,#100
LOOP1: DJNZ R2,LOOP1
DJNZ R3,LOOP2
RET
;------------------------FUNCTION CHACK VALUE IN BYTE AND RETURN (0 IF DIGIT , 1 IF'
=' ,.............)IN R7
CHECK_BYTE:
MOV R7,#0            ;ASSUME THAT BYTE CONTAIN DIGIT --->IF TRUE VALUE WON'T
CHANGE
CJNE A,#'=',CHECK_ADD
MOV R7,#1
SJMP GO11
CHECK_ADD:
CJNE A,#'+',CHECK_SUB
MOV R7,#2
SJMP GO11
CHECK_SUB:
CJNE A,#'-',CHECK_MUL
MOV R7,#3
SJMP GO11
CHECK_MUL:
CJNE A,#'*',CHECK_DIV
MOV R7,#4
SJMP GO11
CHECK_DIV:
CJNE A,#'/',GO11
MOV R7,#5
GO11:
RET
;--------------------------FUNCTION TO PACK SECOND NUMBER ALSO CHECK IF INPUT IS
ERROR-------------
PACING_SECOND:
INC R0               ;LOCATION OF FIRST DIGIT IN SECOND NUMBER
MOV A,@R0            ;MOV BYTE TO ACCUMILATOR
ACALL CHECK_BYTE
MOV A,R7
JZ PACK_DIGIT1       ;IF VALUE EQUAL ZERO THEN BYTE CONTAINS DIGIT
LJMP ERROR           ;IF BYTE CONTAINS SIGN THEN IT IS AN ERROR FORMAT
PACK_DIGIT1:
MOV A,@R0
ANL A,#0FH
MOV R2,A             ;SAVE VALUE IN R2 TEMPORARY
INC R0               ;GET SECOND DIGIT IN SECOND NUMBER
MOV A,@R0
ACALL CHECK_BYTE
```

```
CJNE R7,#0,CHECK_NEXT_DIGIT  ;SECOND BYTE SHOULD BE (= OR DIGIT)
ANL A,#0FH                   ;SECOND BYTE IS A DIGIT SO WILL CONTINUE IN PACKING
MOV R3,A                     ;SAVE VALUE OF A IN R3 TEMPORARY
MOV A,R2                     ;N2=10*R2+R3
MOV B,#10
MUL AB                      ;10*R2
ADD A,R3                     ;10*R2+R3
MOV R4,A
INC R0
MOV A,@R0
ACALL CHECK_BYTE
MOV A,R7
CJNE A,#1,ERRROR
MOV A,R4
SJMP END_PACKING2           ;WE GET NUMBER SO END PACKING
ERRROR:
LJMP ERROR
                ;CHECKING IF SECOND BYTE IS NOT A DIGIT
CHECK_NEXT_DIGIT:
CJNE R7,#1,ERROR_FORMAT2    ;IF BYTE CONTAIN ANY SIGN EXCEPT (= OR DIGIT )-
-------->ERROR
MOV A,R2                    ;SECOND BYTE IS =   --->SO NUMBER IS ONLY R2
SJMP END_PACKING2
ERROR_FORMAT2:
LJMP ERROR
END_PACKING2:
RET

;----------------------FUNCTION TO PRINT ANY BYTE WITHOUT ANY ADDITIONAL
ZEROES IN LEFT----------


                    ;INITIAL MESSAGE

MESSAGE: DB 'CASIO',0
                            ;KEYBOARD BUTTONS
ROW1: DB '1','2','3','/'
ROW2: DB '4','5','6','*'
ROW3: DB '7','8','9','-'
ROW4: DB 'C','0','=','+'

                            ;ERROR MESSAGE
ERR: DB 'ERROR',0
SQUARE : DB 1,4,9,16,25,36 ,49,64,81,100,121,144,169,196,225

END
```

Proteus simulation

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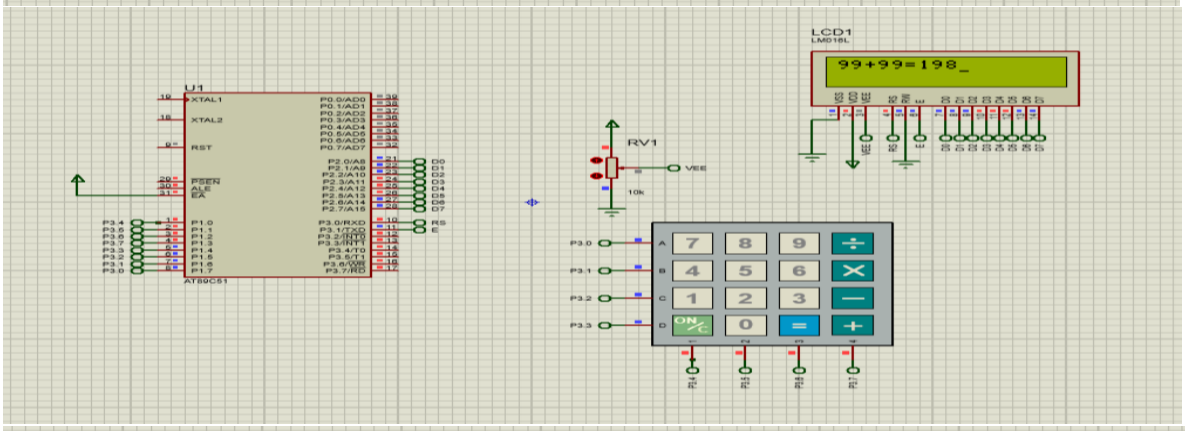
LMD16L
72D=01001000B_
U1
XTAL1
XTAL2
RST
PSEN
ALE
EA
AT89C51
RV1
VEE
10k
7 8 9 ÷
4 5 6 ×
1 2 3 —
ON/C 0 = +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LMD16L
99+99=198_
U1
XTAL1
XTAL2
RST
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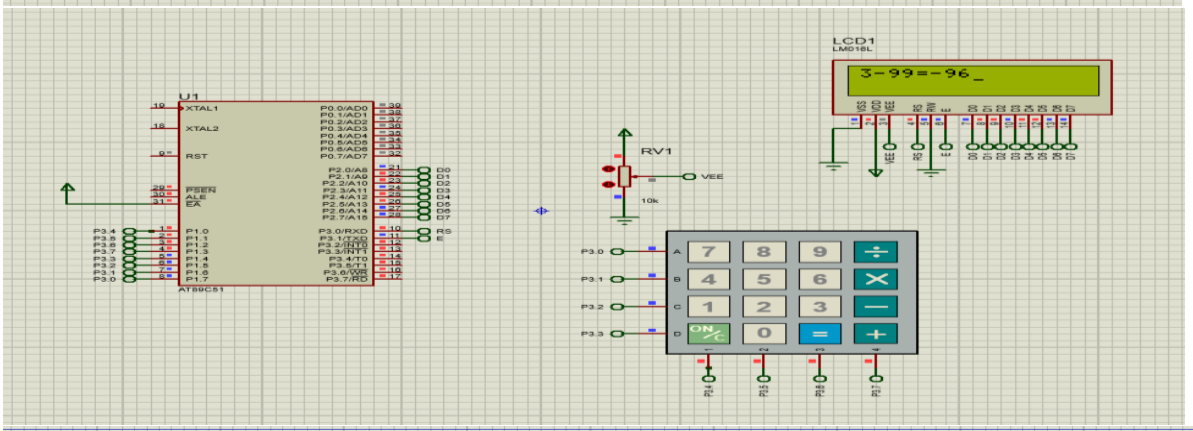
7 8 9 ÷
4 5 6 ×
1 2 3 —
ON/C 0 = +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3-99=-96_
U1
XTAL1
XTAL2
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ALE
EA
AT89C51
RV1
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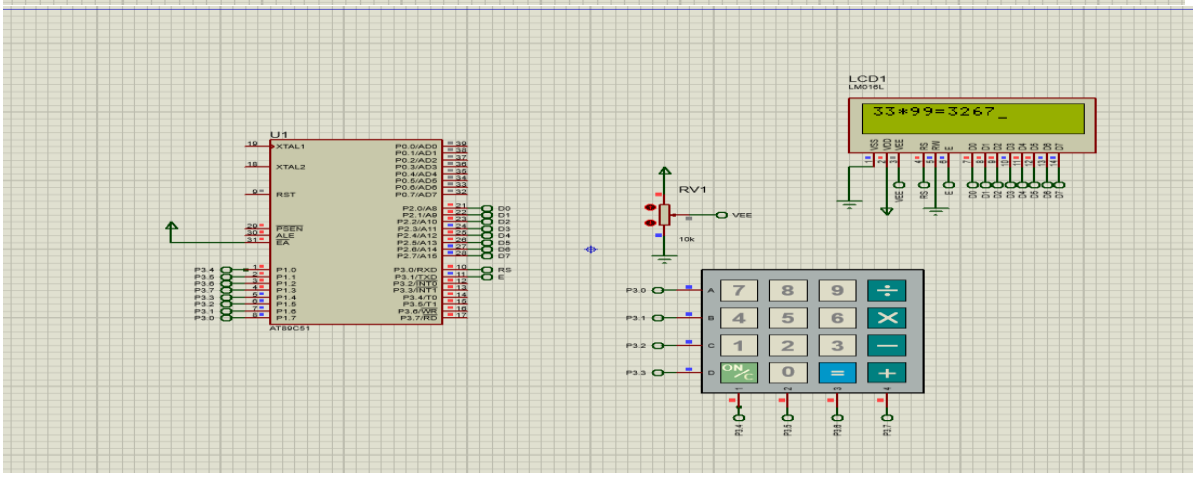
7 8 9 ÷
4 5 6 ×
1 2 3 —
ON/C 0 = +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XTAL1
XTAL2
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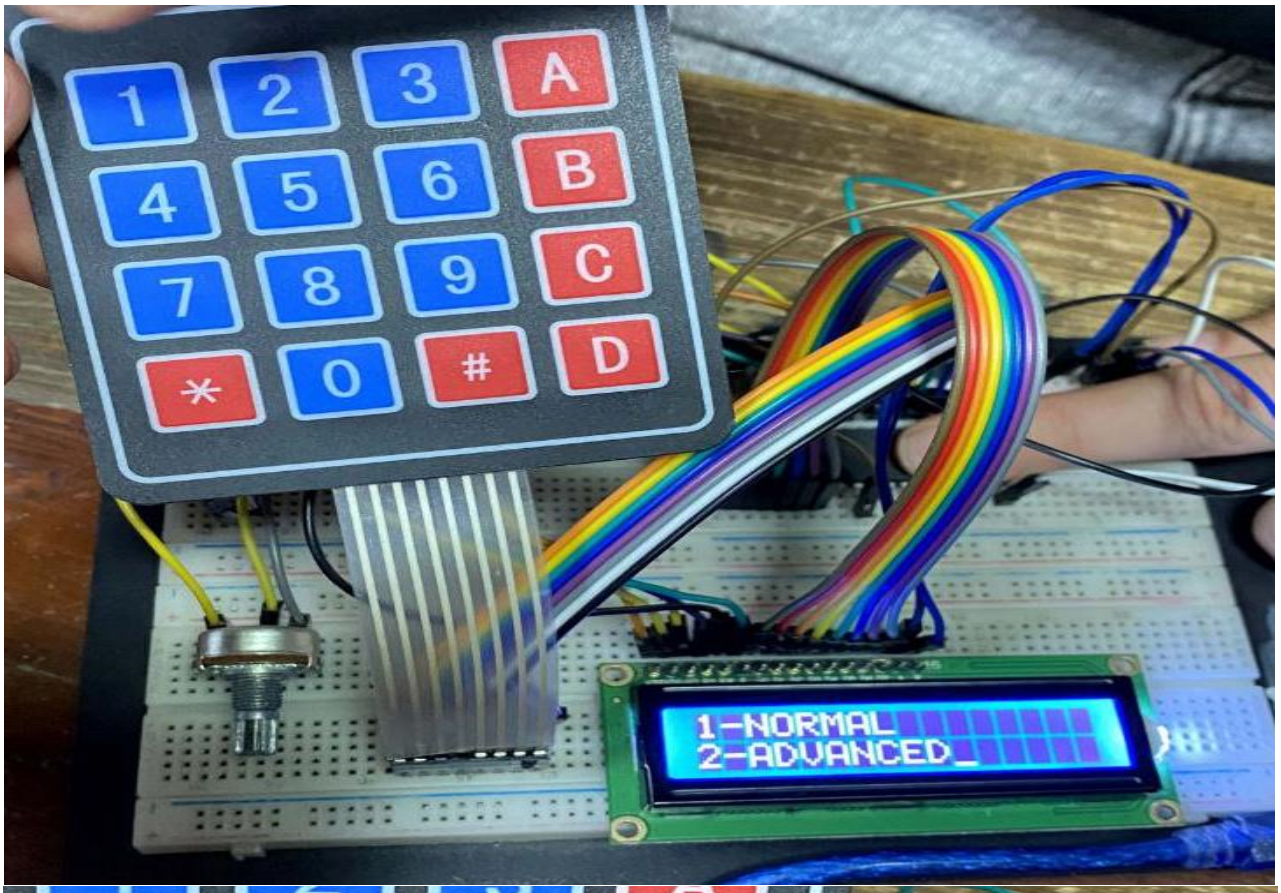
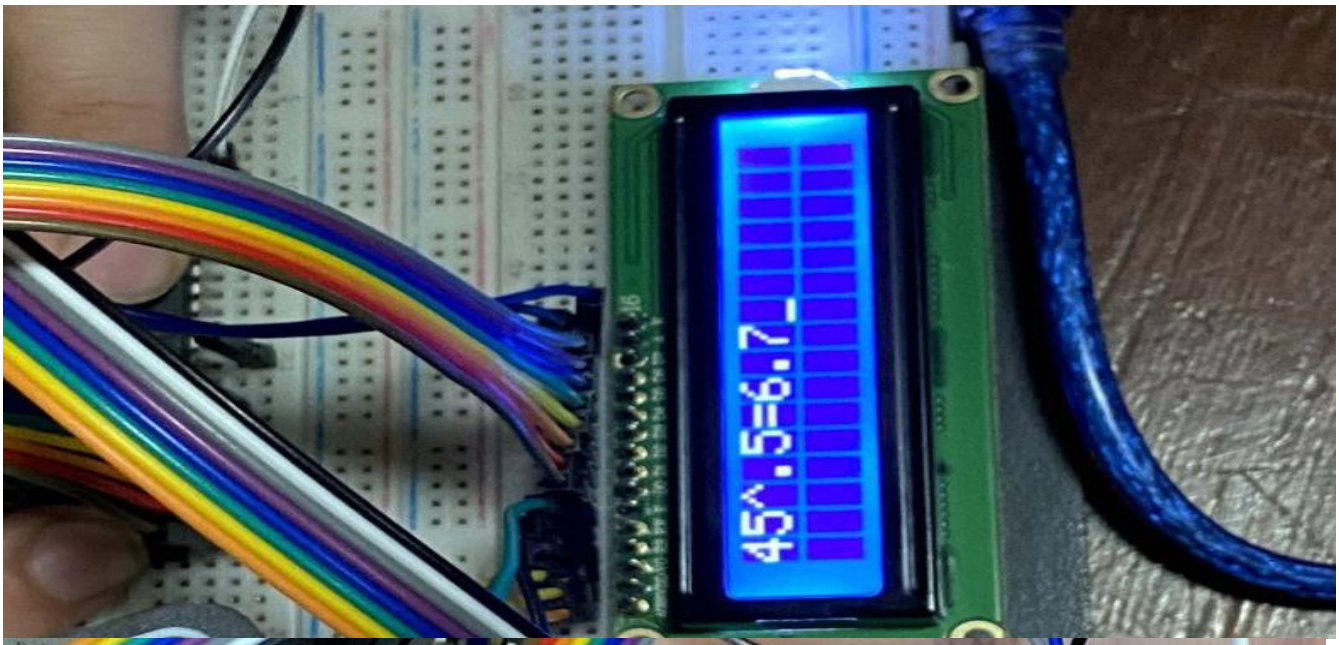
10k
7 8 9 ÷
4 5 6 ×
1 2 3 —
ON/C 0 = +

Hardware

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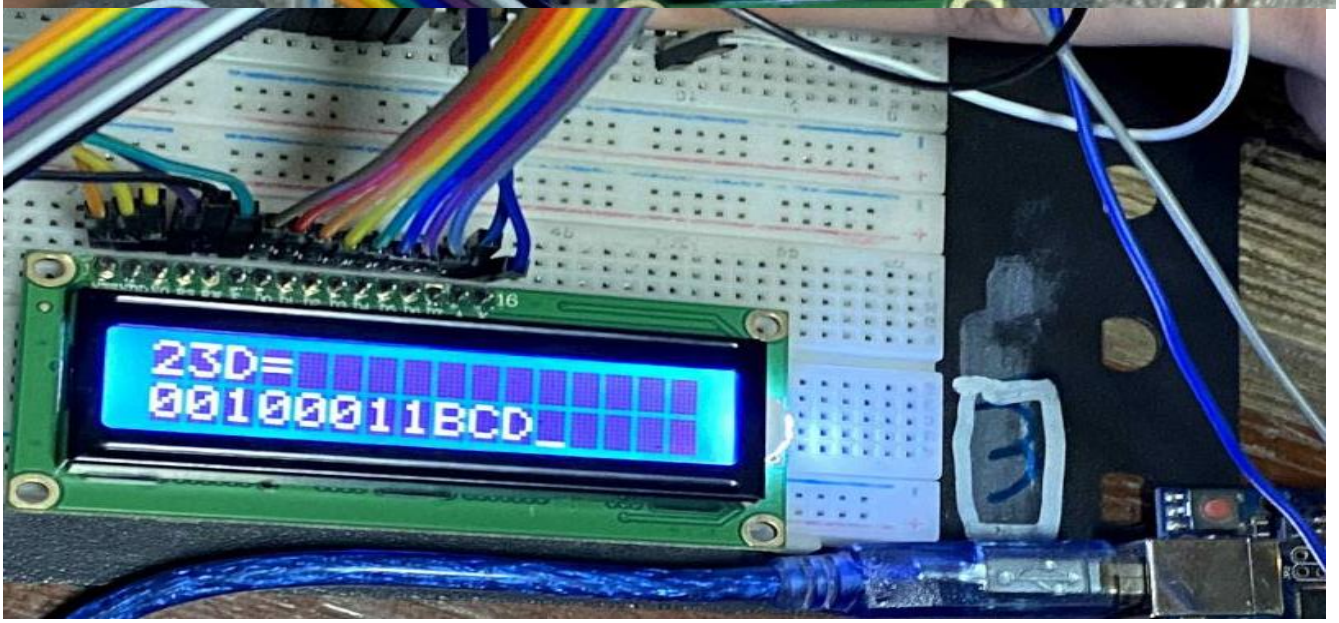
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