Project HW2

By Humoud Al Saleh 210113623

Table of Contents

OVERVIEW

In this phase introduced the usage of the LCD, the Keypad, and the UART unit. My idea is to divide the different functionality that is needed into procedures then call each function as needed. I believe that this will ease up the programming and the debugging process.

The user will be prompted to choose whether to encrypted or decrypted. If the user presses 1 then the decryption operation will be executed. If anything else is pressed then the encryption procedure will be invoked.

At the end of each message entered, the system automatically enters a #(23H) this will help the other procedures with knowing when the message ends.

There are no restrictions on the length of the messages entered. However, entering symbols and numbers is not allowed.

Note that this program was implemented with a crystal of 11.0592MHz and a baud rate of 4800bps.

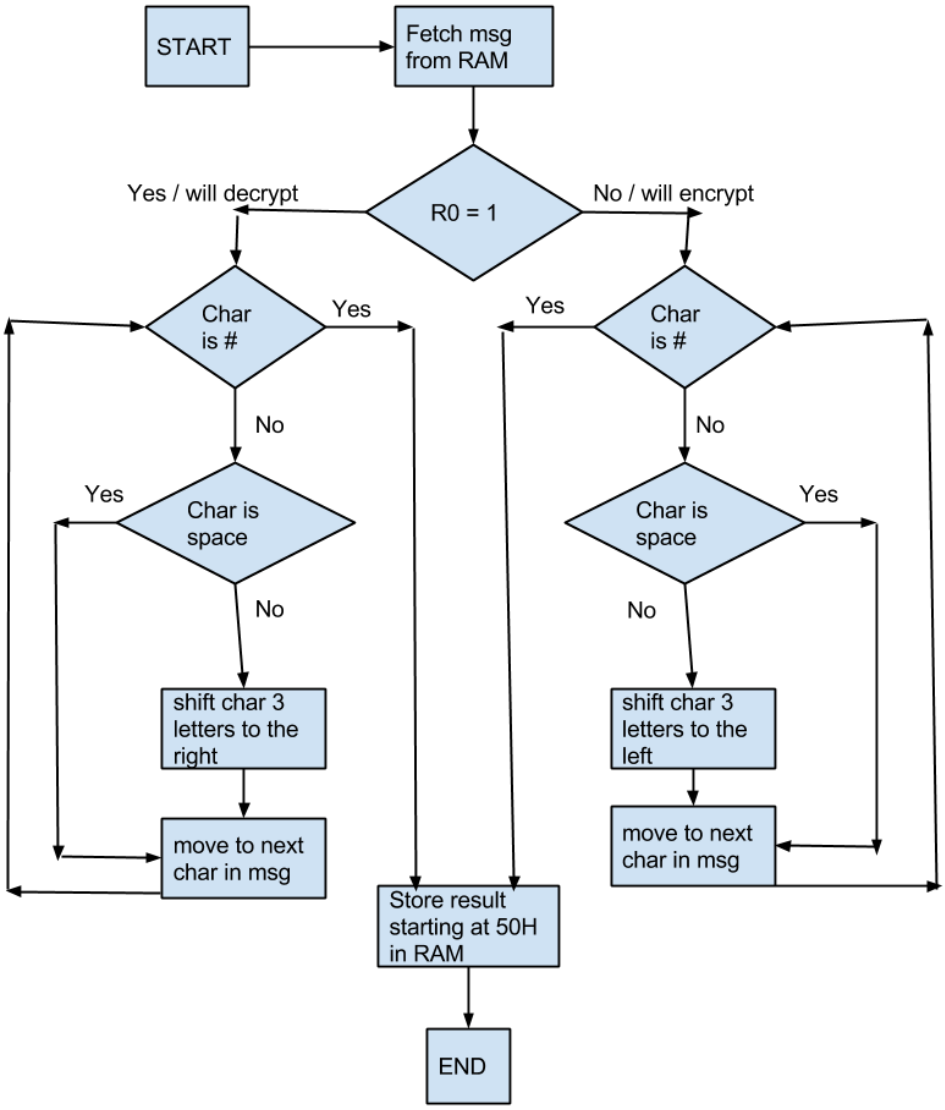
Functionality

Everything in this phase works **except** the last part, the part where I am required to display the result of the encryption/decryption on the LCD. The result is stored successfully in RAM starting at memory address 50H. The only problem is outputting the result into the LCD. I tried everything I could think of. I was unsuccessful.

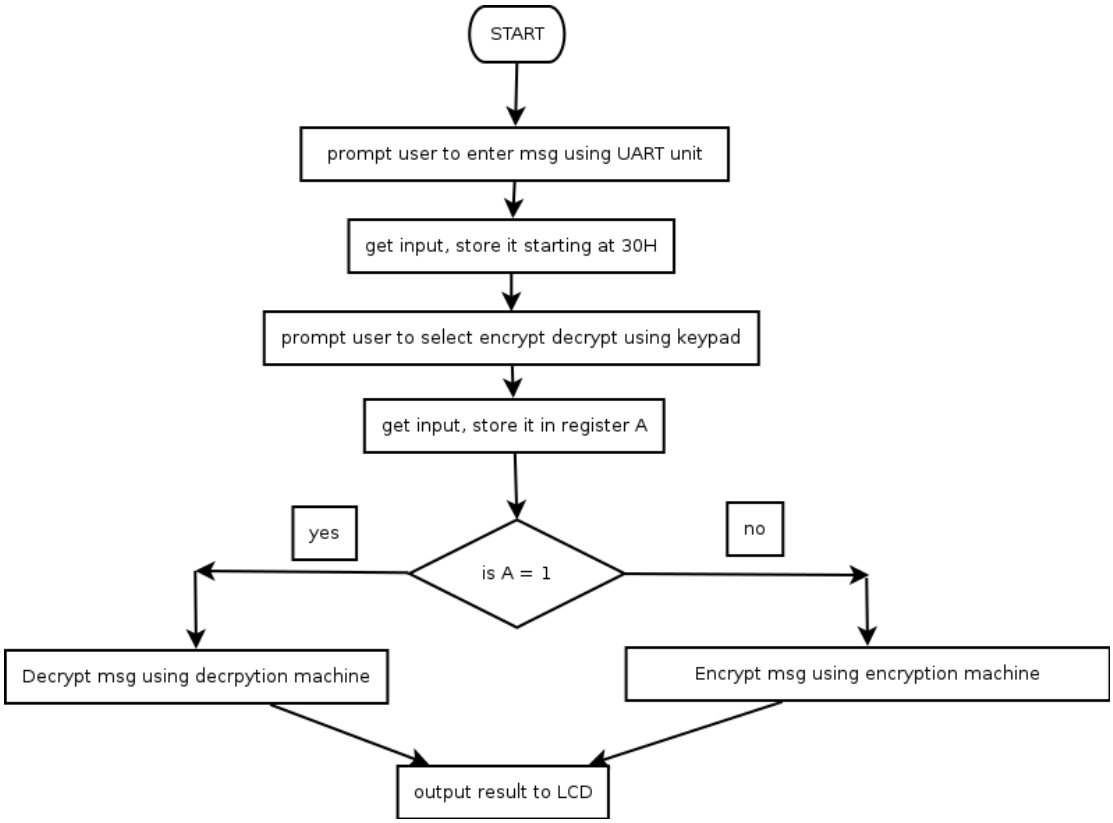
Algorithm

Here are some flow charts. I have included them separately in PNG format as well because I thought it maybe of convenience.

Here is the encryption/decryption machine:



Here is the main flowchart:



Appendix

Source code:

```
                    ORG 00H
MAIN:
        MOV A,#1
        ACALL START_Display                 ; PROMPT USER TO ENTER
MESSAGE
        LCALL START_SERIAL                  ; RECIEVE MESSAGE & STORE
IT IN 30H
        CLR A
        ACALL START_Display                 ; CLEAR DISPLAY THEN,
                                                ; PROMPT USER TO
SELECT ENCRYPT/DECRYPT
        ; KEYPAD
        CALL CHECK
        CALL WhichRow
        CALL GET_KEY
        ; RESULT IS NOW IN REGISTER A

        LCALL CLEAR_LCD
        LJMP START_MACHINE                  ; LET THE MACHINE WORK
                                                ; RESULT STARTS @
50H
DISPLAY_RESULT:
        LCALL READ_FROM_R0                  ; OUTPUT TO DISPLAY
<<<DOES NOT WORK>>>
STOP_PROG:
        SJMP STOP_PROG                      ; INFINITE LOOP
;---------------------------------START OF LCD PROCEDURES--------
START_Display:
        SETB P1.3
        CJNE A,#0,FIRST_TIME
SECOND_TIME:
        ACALL CLEAR_LCD
        MOV DPTR,#MESSAGE2
        SJMP DISPLAY
FIRST_TIME:
        ACALL INIT_DISPLAY
        MOV DPTR,#MESSAGE
        SJMP DISPLAY
READ_FROM_R0:                       ; DISPLAY FROM R0
        MOV R0,#50H
        MOV A,@R0
READ_A:
        CJNE A,#23H,R0_TO_LCD
        RET
R0_TO_LCD:
        MOV A,#'H'
```

```
        LCALL SendData
        INC R0
        MOV A,@R0
        SJMP READ_A
CLEAR_LCD:
        CLR A
        MOV A,#1
        ACALL SendCmd           ; THIS SHOULD CLEAR THE DISPLAY
        RET
DISPLAY:
        CLR A
        MOVC A,@A+DPTR
        CJNE A,#0,CONT
        LJMP STOP

CONT:
        LCALL SendData
        INC DPTR
        SJMP DISPLAY
; -------  procedure init_display -------
INIT_DISPLAY:
        CLR P1.3
        ANL P1,#00000111B       ; ZERO ALL BITS EXCEPT THE LAST ONE,
AND P1.3=0 => RS=0 => Send Cmd
        ORL P1,#00100000B       ; P1=0010 DDDD WHERE D = DON'T CARE

        SETB P1.2               ;
        CLR P1.2                ; send high nibble
        ACALL delay             ; wait


        SETB P1.2               ; (set function)        <<EXCEPTION>>
        CLR P1.2                ; send high nibble (2nd time)

        ANL P1,#00000111B       ; ZERO ALL BITS EXCEPT THE LAST ONE,
AND P1.3=0 => RS=0 => Send Cmd
        ORL P1,#10000000B       ; P1=1000 DDDD WHERE D = DON'T CARE
        SETB P1.2               ;
        CLR P1.2                ; send low nibble
        ACALL delay             ; wait

        ANL P1,#00001111B ; (Turn ON LCD - high nibble) ~ 0 0 0 0 --> 0 0 0 0
        SETB P1.2               ;
        CLR P1.2                ; send high nibble

        ANL P1,#11110111B       ; clear bits 1-3
        ORL P1,#11110000B       ; set bits 7-4, (Turn ON LCD - low nibble) ~> 1
D C B --> 1 1 1 1, display ON, Cursor ON, Blink ON
        SETB P1.2               ;
```

```
        CLR P1.2            ; send low nibble
        ACALL delay         ; wait

        ANL P1,#00001111B ; (set entry mode - high nibble) ~ 0 0 0 0 --> 0 0 0 0

        SETB P1.2           ;
        CLR P1.2            ; send high nibble

        ORL P1,#01100000B       ; (set entry mode - low nibble) ~> 0 1 I/D S --
> 0 1 1 0
        SETB P1.2           ; cursor direction right, No display shift
        CLR P1.2            ; sent low nibble
        ACALL delay         ; wait
        RET

; -------  procedure delay -------
delay:
        MOV R3, #50
        DJNZ R3, $
        RET
; -------  procedure SEND CHAR -------
SEND_CHAR:
        MOV C, ACC.7 ;
        MOV P1.7, C         ;
        MOV C, ACC.6 ;
        MOV P1.6, C         ; FIRST 4 BITS
        MOV C, ACC.5 ;
        MOV P1.5, C         ;
        MOV C, ACC.4 ;
        MOV P1.4, C

        SETB P1.2           ;
        CLR P1.2            ; send high nibble

        MOV C, ACC.3 ;
        MOV P1.7, C         ;
        MOV C, ACC.2 ;
        MOV P1.6, C         ; SECOND 4 BITS
        MOV C, ACC.1 ;
        MOV P1.5, C         ;
        MOV C, ACC.0 ;
        MOV P1.4, C

        SETB P1.2           ;
        CLR P1.2            ; send low nibble
        ACALL delay         ; wait
        RET
; -------  end procedure sendcharacter -------
```

```
SendCmd:
        CLR P1.3            ; P1.3=0 => RS=0 => Because we are sending a Cmd
        ACALL SEND_CHAR     ; SEND_CHAR will send every bit in the accumalator
        RET

SendData:
        SETB P1.3           ; P1.3=1 => RS=1 => Because we are sending a Cmd
        ACALL SEND_CHAR     ; SEND_CHAR will send every bit in the accumalator
        RET

STOP:
        RET

;----------------------------------END OF LCD PROCEDURES---------

;----------------------------------START OF SERIAL PROCEDURES----

START_SERIAL:
        CLR SM0                 ;
        SETB SM1            ; put serial port in 8-bit UART mode
        SETB REN            ; enable recieving of serial port

        MOV TMOD, #20H          ; put timer 1 in 8-bit auto-reload interval
timing mode
        MOV TH1, #0FAH          ; put -3 in timer 1 high byte (timer will
overflow every 3 us)
        MOV TL1, #0FAH          ; put same value in low byte
        SETB TR1            ; start timer 1
        MOV R0,#30H             ; location to store received string
LOOP:
        JNB RI, LOOP        ; wait for character to be received
        CLR RI              ;
        MOV A,SBUF          ; read character
        CJNE A,#0DH, STORE      ; if not end of line, store it
                            ; END OF string
        MOV @R0,#23H            ; store receive character in memory
        SJMP FINISH_RECIEVE
START_PRINTING_SERIAL:
        MOV R0,#30H             ; else, start sending
PRINT:
        MOV A,@R0           ; read character from memory
        MOV SBUF,A          ; send it to serial port
LOOP2:  JNB TI,LOOP2            ; wait till transmission finish
        CLR TI              ;
        INC R0              ; increment pointer
        DJNZ R1,PRINT           ; check if end of string (# of char)
        SJMP $

STORE:
```

```
        MOV @R0,A           ; store receive character in memory
        INC R0              ; update memory pointer
        SJMP LOOP           ; repeat

FINISH_RECIEVE:
        RET
;-------------------------------END OF SERIAL PROCEDURES-----

;-------------------------------START OF KEYPAD PROCEDURES------

GET_KEY:
        RLC A                   ;skip D7 data (unused)
GET:
        RLC A               ;see if any CY bit low
        JNC MATCH           ;if zero, get the key number
        INC DPTR            ;point to next col. address
        SJMP GET            ;keep searching
MATCH:
        CLR A               ;set A=0 (match is found)
        MOVC A,@A+DPTR      ;get key number from table, store result in A
        INC A
        RET
;------------
NoKeyPressed:
    MOV P0,#01110000B     ; GROUND all rows
    MOV A,P0            ;  read all col.
    ANL A,#01110000B      ;  masked unused bits
    CJNE A,#01110000B,NoKey   ; check til all keys released, is any col. == 0?
    SJMP NoKeyPressed
NoKey:
    RET
;-------------
CHECK:
    MOV P0,#01110000B     ; GROUND all rows
    MOV A,P0            ;  read all col.
    ANL A,#01110000B      ;  masked unused bits
    CJNE A,#01110000B,CHECK   ; check til all keys released, is any col. == 0?
DOUBLE_CHECK:
    MOV A,P0            ;see if any key is pressed
    ANL A,#01110000B    ;mask unused bits
    CJNE A,#01110000B,PRESSED  ;key pressed, await closure
    SJMP DOUBLE_CHECK
PRESSED:
    RET
;-------------
WhichRow:       ;find which key is is pressed
     MOV P0,#01111110B      ;ground row 0
     MOV A,P0           ;read all columns
     ANL A,#01110000B       ;mask unused bits
```

```
    CJNE A,#01110000B,ROW_0  ;key row 0, find the col.
    MOV P0,#01111101B       ;ground row 1
    MOV A,P0                ;read all columns
    ANL A,#01110000B        ;mask unused bits
    CJNE A,#01110000B,ROW_1  ;keyrow 1, find the col.
    MOV P0,#01111011B       ;ground row 2
    MOV A,P0                ;read all columns
    ANL A,#01110000B        ;mask unused bits
    CJNE A,#01110000B,ROW_2  ;key row 2, find the col.
    MOV P0,#01110111B       ;ground row 3
    MOV A,P0                ;read all columns
    ANL A,#01110000B        ;mask unused bits
    CJNE A,#01110000B,ROW_3  ;keyrow 3, find the col.
    RET                 ;if none, false input, return

ROW_0: MOV DPTR,#KCODE0        ;set DPTR=start of row 0
    RET             ;find col. key belongs to
ROW_1: MOV DPTR,#KCODE1        ;set DPTR=start of row 1
    RET             ;find col. key belongs to
ROW_2: MOV DPTR,#KCODE2        ;set DPTR=start of row 2
    RET             ;find col. key belongs to
ROW_3: MOV DPTR,#KCODE3        ;set DPTR=start of row 3
    RET
;-------------------------------END OF KEYPAD PROCEDURES------

;-------------------------------START OF ENCRYPTING/DECRYPTING MACHINE------

START_MACHINE:
        MOV R0,#30H                 ; POINT TO START OF RECIEVED MESSAGE
        MOV R1,#50H                 ; STORE RESULT
        MOV A,@R0
        CJNE A,#31H,DO_ENCRYPT          ; IF NOT 1, encrypt
        MOV A,@R0                               ; MOVE FIRST VALUE INTO A
        LCALL DECRYPT
        LJMP DISPLAY_RESULT
DO_ENCRYPT:
        MOV A,@R0
        LCALL ENCRYPT
        LJMP DISPLAY_RESULT

DECRYPT:
        SJMP CHECKEND      ; CHECK IF AT END OF MSG
CONTEN:                                 ; CONT. DECRYPTING
        ACALL SHIFTRIGHT
DECRESULT:                  ; STORE RESULT OF DECRYPTION
        MOV @R1,A                   ; STORE RESULT IN RAM
        INC R1                      ; INC TO STORE IN NEXT RAM LOCATION
        INC R0                      ; POINT TO NEXT CHAR
        CLR A
```

```
        MOV A,@R0   ; FETCH NEXT CHAR
        SJMP DECRYPT

SHIFTRIGHT:
        CJNE A,#58H,NOTX
        MOV A,#41H
        RET
NOTX: CJNE A,#59H,NOTY
        MOV A,#42H
        RET
NOTY: CJNE A,#5AH,NOTZ
        MOV A,#43H
        RET
NOTZ: CJNE A,#78H,LNOTy
        MOV A,#61H
        RET
LNOTy:      CJNE A,#79H,LNOTx
        MOV A,#62H
        RET
LNOTx:      CJNE A,#7AH,LNOTz
        MOV A,#63H
        RET
LNOTz:
        ADD A,#3H
        RET

ENCRYPT:
        SJMP CHECKEND     ; CHECK IF AT END OF MSG
CONTDE:                                 ; CONT. ENCRYPTING
        ACALL SHIFTLEFT
ENCRESULT:                  ; STORE RESULT OF ENCRYPTION
        MOV @R1,A                   ; STORE RESULT IN RAM
        INC R1                      ; INC TO STORE IN NEXT RAM LOCATION
        INC R0                      ; POINT TO NEXT CHAR
        CLR A
        MOV A,@R0   ; FETCH NEXT CHAR
        SJMP ENCRYPT

SHIFTLEFT:
        CJNE A,#41H,NOTA
        MOV A,#58H
        RET
NOTA: CJNE A,#42H,NOTB
        MOV A,#59H
        RET
NOTB: CJNE A,#43H,NOTC
        MOV A,#5AH
        RET
NOTC: CJNE A,#61H,LNOTa
```

```
        MOV A,#78H
        RET
LNOTa:  CJNE A,#62H,LNOTb
        MOV A,#79H
        RET
LNOTb:  CJNE A,#63H,LNOTc
        MOV A,#7aH
        RET
LNOTc:
        CLR C                   ; CLEAR CARRY TO MAKE SURE IT IS NOT
INCLUDED IN  THE CALCULATION
        SUBB A,#3H
        RET

CHARSPACE:              ; IF THE CHARACTER IS SPACE
        MOV @R1,A               ; STORE RESULT IN RAM
        INC R1                  ; INC TO STORE IN NEXT RAM LOCATION
        INC R0                  ; POINT TO NEXT CHAR
        CLR A
        MOV A,@R0       ; FETCH NEXT CHAR
        CJNE R0,#1,ENCRYPT          ; JMP TO  ENCRYPTION
        SJMP DECRYPT                    ; JMP TO  DECRYPTION

CHECKEND:
        CJNE A,#23H,CHECKSPACE
        MOV @R1,#23H                    ; ADD # AT END
        SJMP FINISH     ; REACHED END

CHECKSPACE:                                     ; NOT AT END, IS IT A
SPACE?
        CJNE A,#20H,CONT1
        SJMP CHARSPACE
CONT1:
        CJNE R0,#1,CONTEN       ; CONTINUE ENCRYPTION
        SJMP CONTDE                     ; CONTINUE DECRYPTION
FINISH:
        RET

;----------END MACHINE----------




;FOR PROMPTING
MESSAGE: DB "ENTER A MESSAGE"
            DB 00H
MESSAGE2: DB "Press 1 to Decrypt or else to Encrypt"
            DB 00H
;ASCII LOOK-UP TABLE FOR EACH ROW
```

```
KCODE3: DB    1,2,3    ;ROW 3
KCODE2: DB    4,5,6    ;ROW 2
KCODE1: DB    7,8,9    ;ROW 1
KCODE0: DB    10,0,11  ;ROW 0

END
```