**Lebanese American University**

**School of Engineering**



**Microprocessors**

**COE 324 – Section 32**

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**Final Project**

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*December 3rd, 2018*

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# Task1

First, we must configure the buttons:

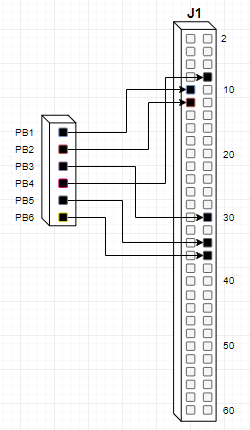
* PB1 🡺 PP0

Figure 1 Push buttons connections to J1

* PB2 🡺 PP1
* PB3 🡺 PP2
* PB4 🡺 PP7
* PB5 🡺 PP4
* PB6 🡺 PP5

Their configuration is very similar to the push buttons on the microprocessor board except for replacing every #$03 with #$B7 to enable the pins on J1 instead of SW1 and SW2.

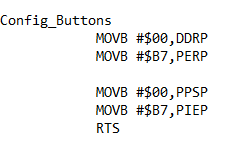
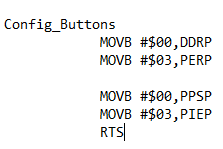
To explain the PB step:

Figure 2 SW1 & SW2 configuration code sample

Figure 3 PB1 -> PB6 configuration code sample

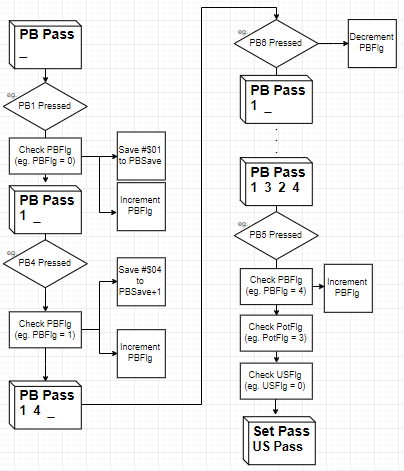
NB: The login PB step is the same except for the flag (PassSetFlg) that indicates we are in the login.

Figure 4 PB step diagram

# Task2

The potentiometer configuration is the same as Lab 7. As for the potentiometer step:

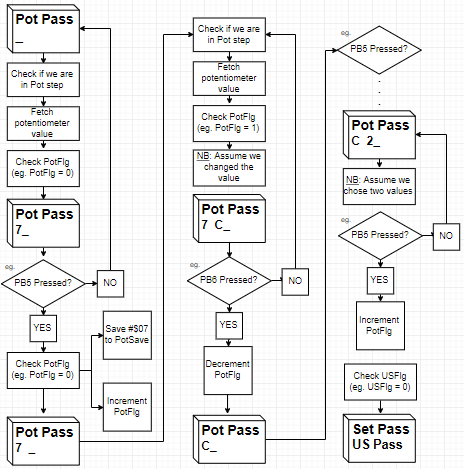
NB: The login Pot step is the same except for the flag (PassSetFlg) that indicates we are in the login.

Figure 5 Pot step diagram

# Task3

First, we must configure the ultrasonic sensor:

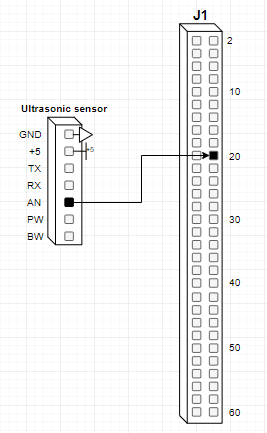
* AN 🡺 AN01

Figure 6 Ultrasonic sensor connections to J1

The configuration is very similar to the potentiometer configuration except for sending #$21 to ATD0CTL5 instead of #$25, because we are setting scan mode on AN01 instead of AN05. We also need to read the value from the register ATD0DR1H instead of ATD0DR5H.

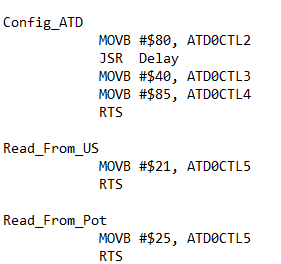


Figure 7 ATD configuration code sample

To explain the US step:

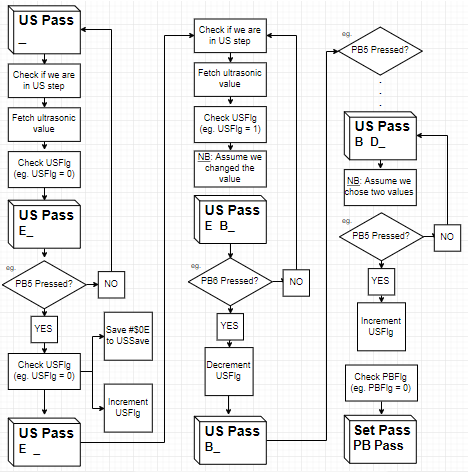
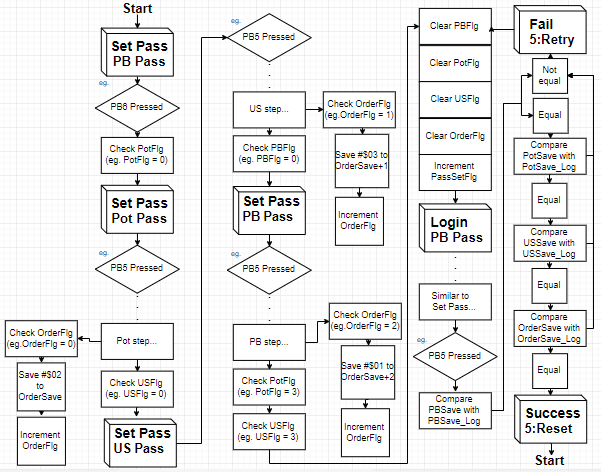
NB: The login US step is the same except for the flag (PassSetFlg) that indicates we are in the login.

Figure 8 US step diagram

# Task4 + Bonus

Now to put together the whole project:

Figure 9 Project diagram



# Some Explanations

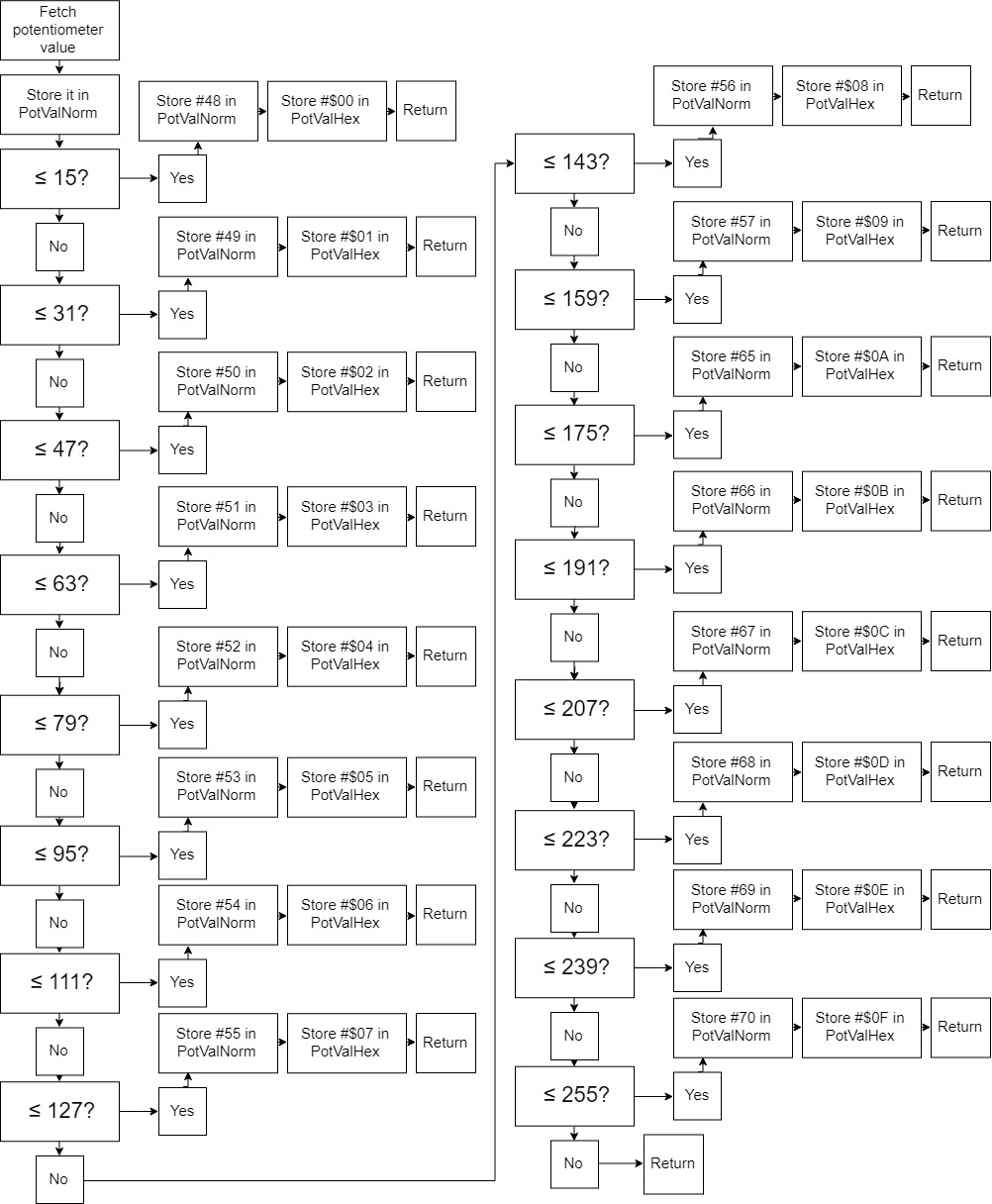
1. Normalizing the potentiometer value from 0 🡺 255 to 0 🡺 F:

Figure 10 Potentiometer value normalization diagram

1. Normalizing the ultrasonic sensor value from 4 🡺 8 to A 🡺 E:

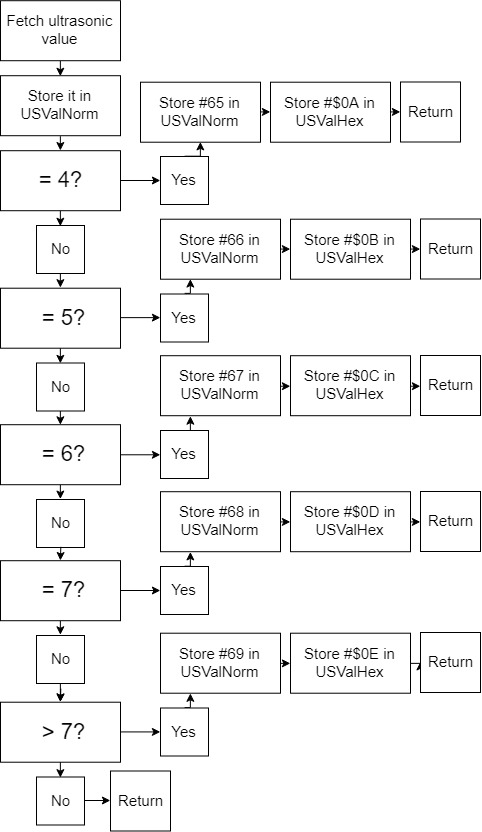


Figure 11 Ultrasonic sensor value normalization diagram

1. The project is divided into 14 steps illustrated in the step table below:

Table 1 Step Table

|  |  |
| --- | --- |
| **Step No(Hex)** | **Step Description** |
| $00 | Set Pass, PB Pass |
| $01 | Set Pass, Pot Pass |
| $02 | Set Pass, US Pass |
| $03 | PB Pass Registration |
| $04 | Pot Pass Registration |
| $05 | US Pass Registration |
| $06 | Login, PB Pass |
| $07 | Login, Pot Pass |
| $08 | Login, US Pass |
| $09 | PB Pass Check |
| $0A | Pot Pass Check |
| $0B | US Pass Check |
| $0C | Failed Authentication |
| $0D | Succeeded Authentication |

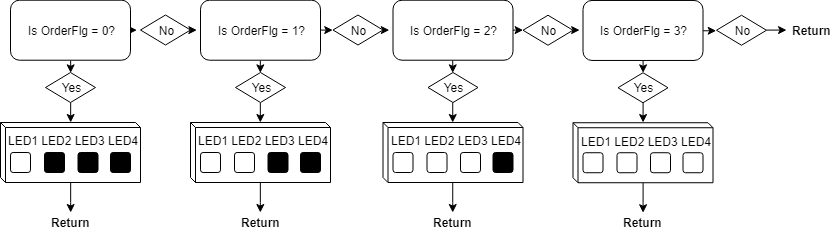
1. The LEDs light up in a certain way depending on the step. We used OrderFlg to know at which step we are since it only changes once a step is completed:

Figure LEDs diagram

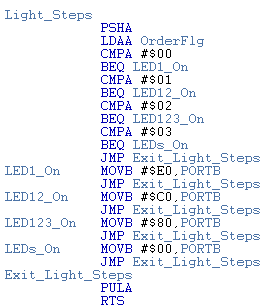


Figure LEDs code sample

# References

APS12OS User Guide

MC9S12DT256 Device User Guide (MC9S12DT256.pdf)

MC3S12RG128 Data Sheet (Interrupt Registers Reference.pdf)

Axiom Manufacturing: schematic CSMB12D AXM-0436

MC9S12XS256 Reference Manual

CPU 12 Reference Manual