



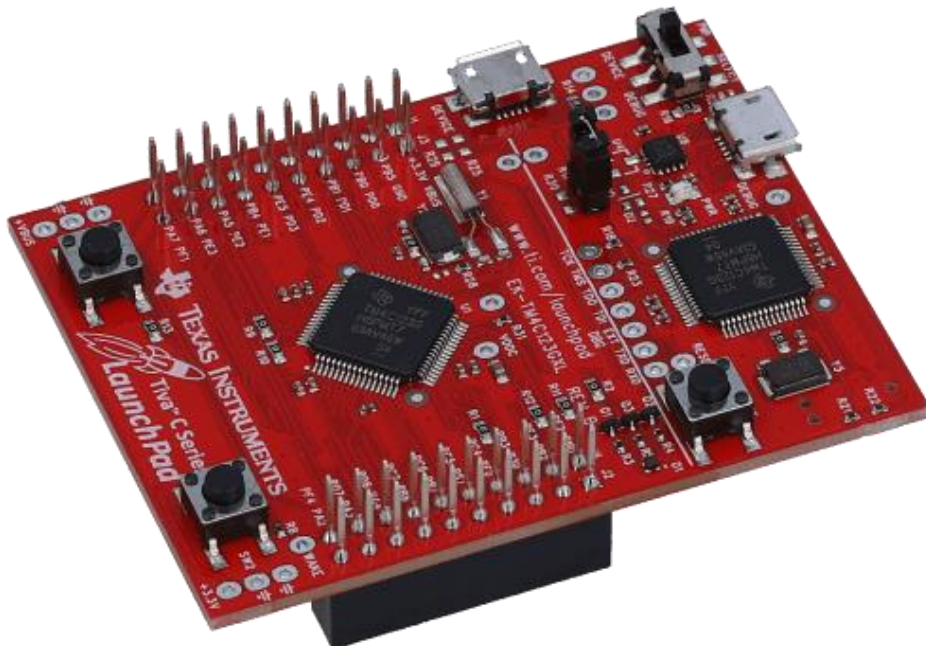
ORTA DOĞU TEKNİK ÜNİVERSİTESİ
MIDDLE EAST TECHNICAL UNIVERSITY

EE447- Introduction to Microprocessors Laboratory With Assembly Programming (Preliminary Work 3)

EXPERIMENTAL WORK NO: 3

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Question 1) Full Step Subroutine

- In this question we created 3 subroutines one for initialization process, one for delay and one for full step function.
- We use main function just call the subroutines and we give GPIO_B DATA as 0x01 to try if our function is work or not. It can be seen in figure 1
- In delay function we arranged it to give 1 miliseconds of delay in each call. It can be seen in figure 2
- In init_func we opened clock for port B and Pb0-Pb3 as input ports and we enabled systick timer to see its effect. While using systick initialization we utilized notes from experiment manuel and we redefined it to 1msec. It can be seen in Figure 3
- F_step function is main part of the this question in this function we defined our direction and we defined our type of rotations. It can be seen in Figure 4.
- Required descriptions written as command line.

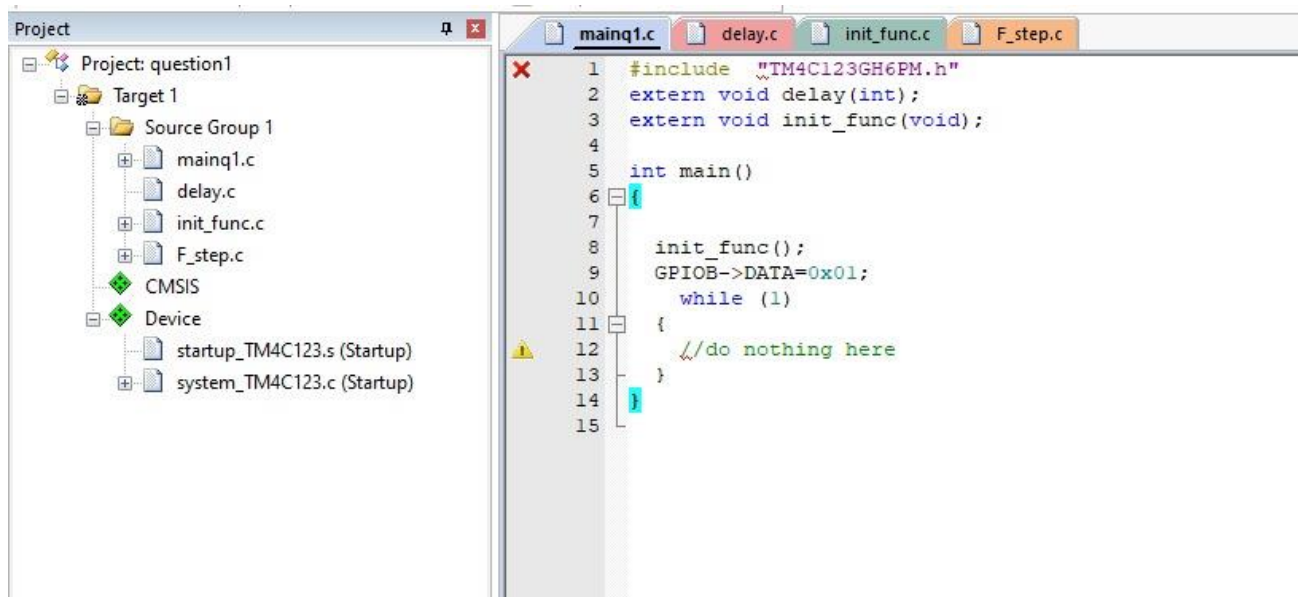


Figure 1: Main function for part1

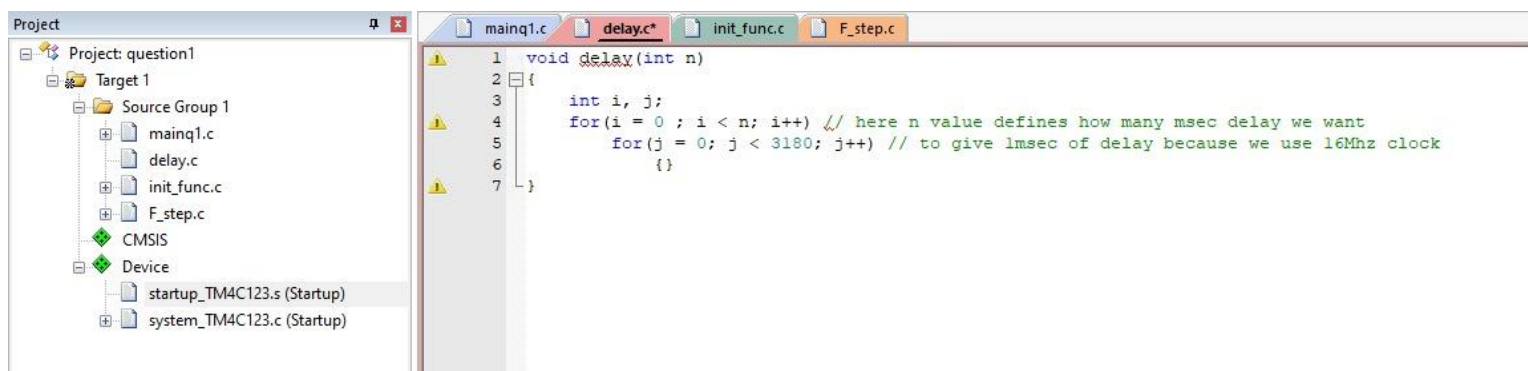


Figure 2:One milisecond delay function

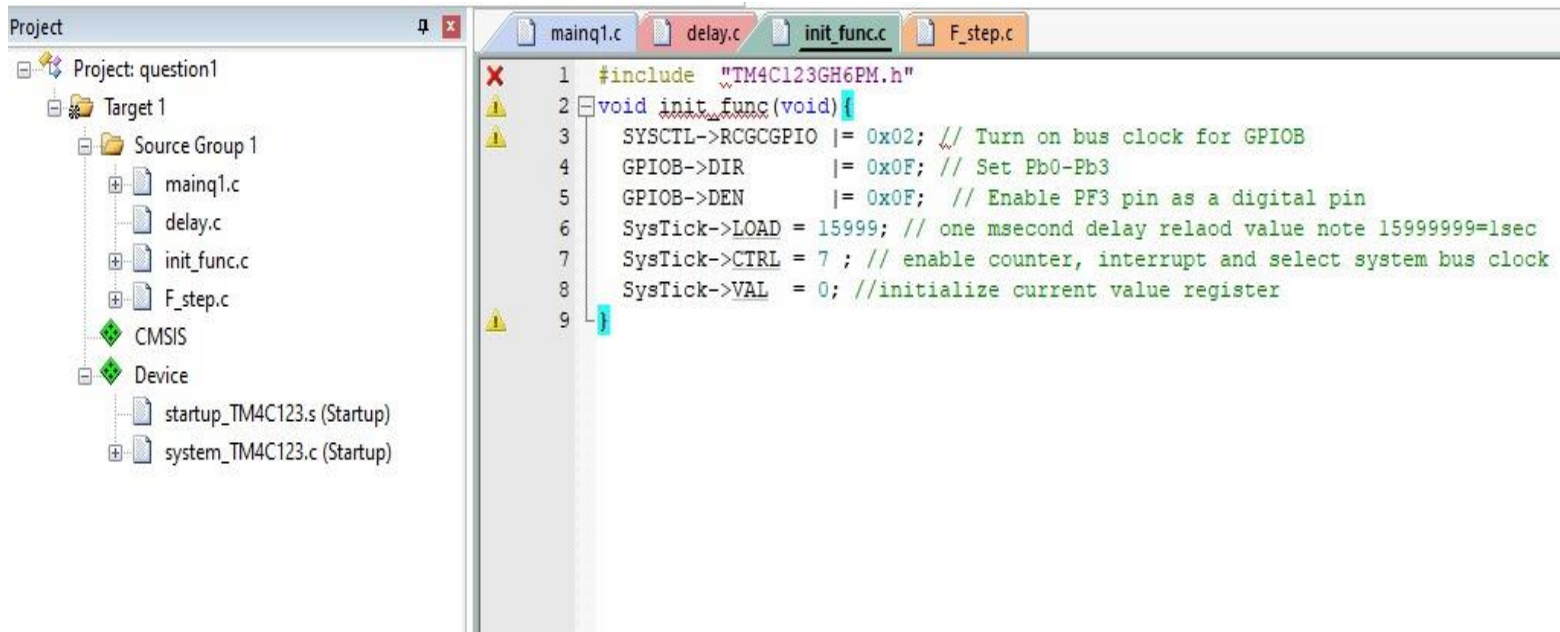


Figure 3: Initialization Function

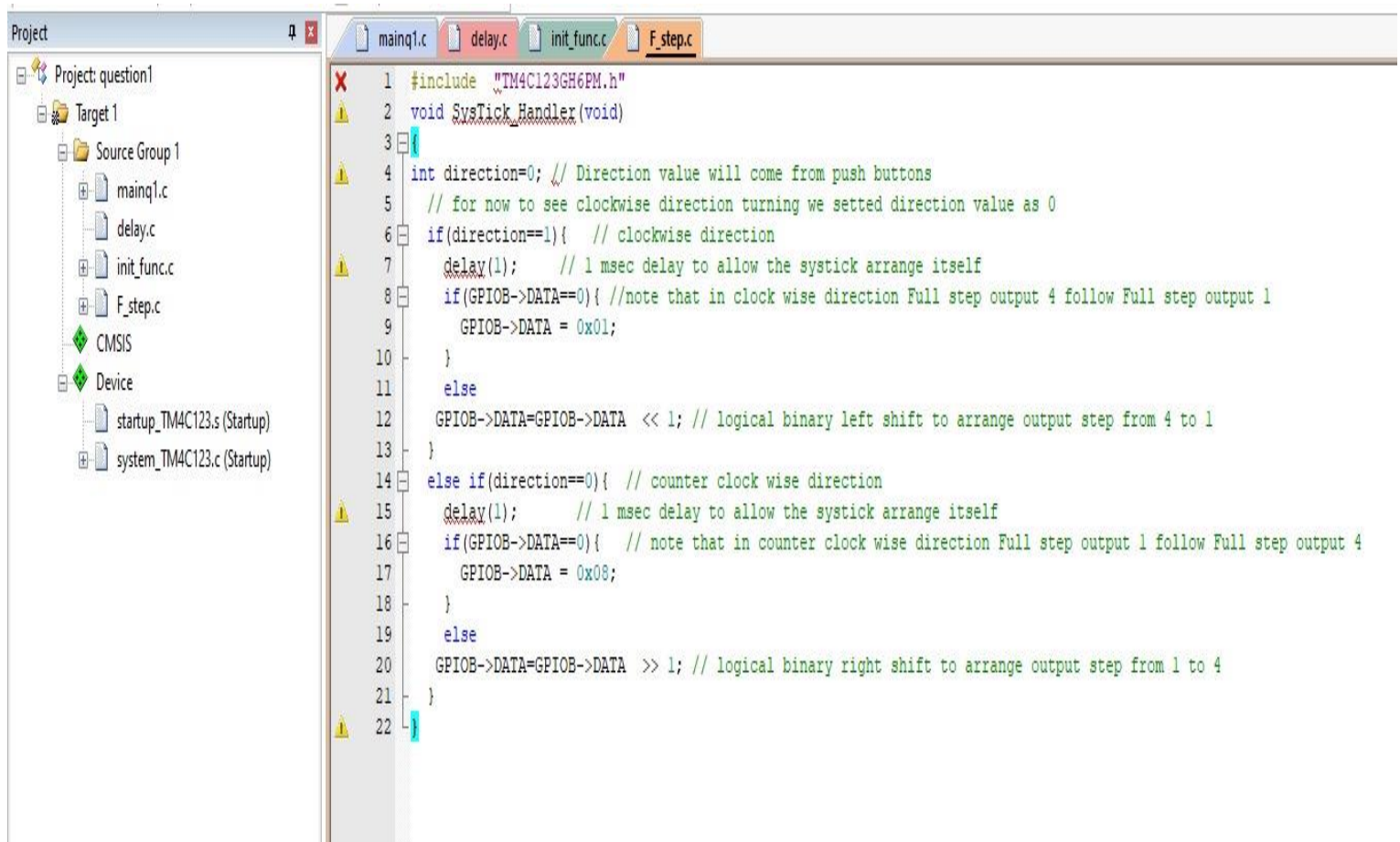
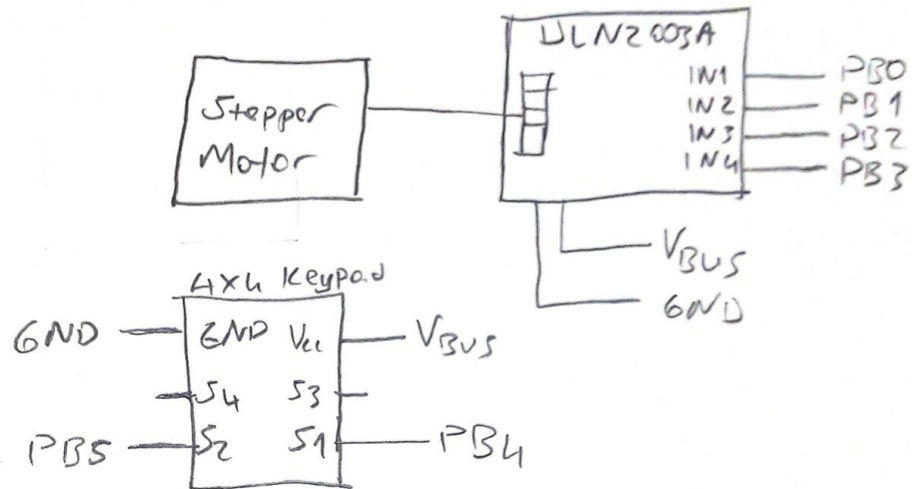


Figure 4: Full Step Function

Question 2)



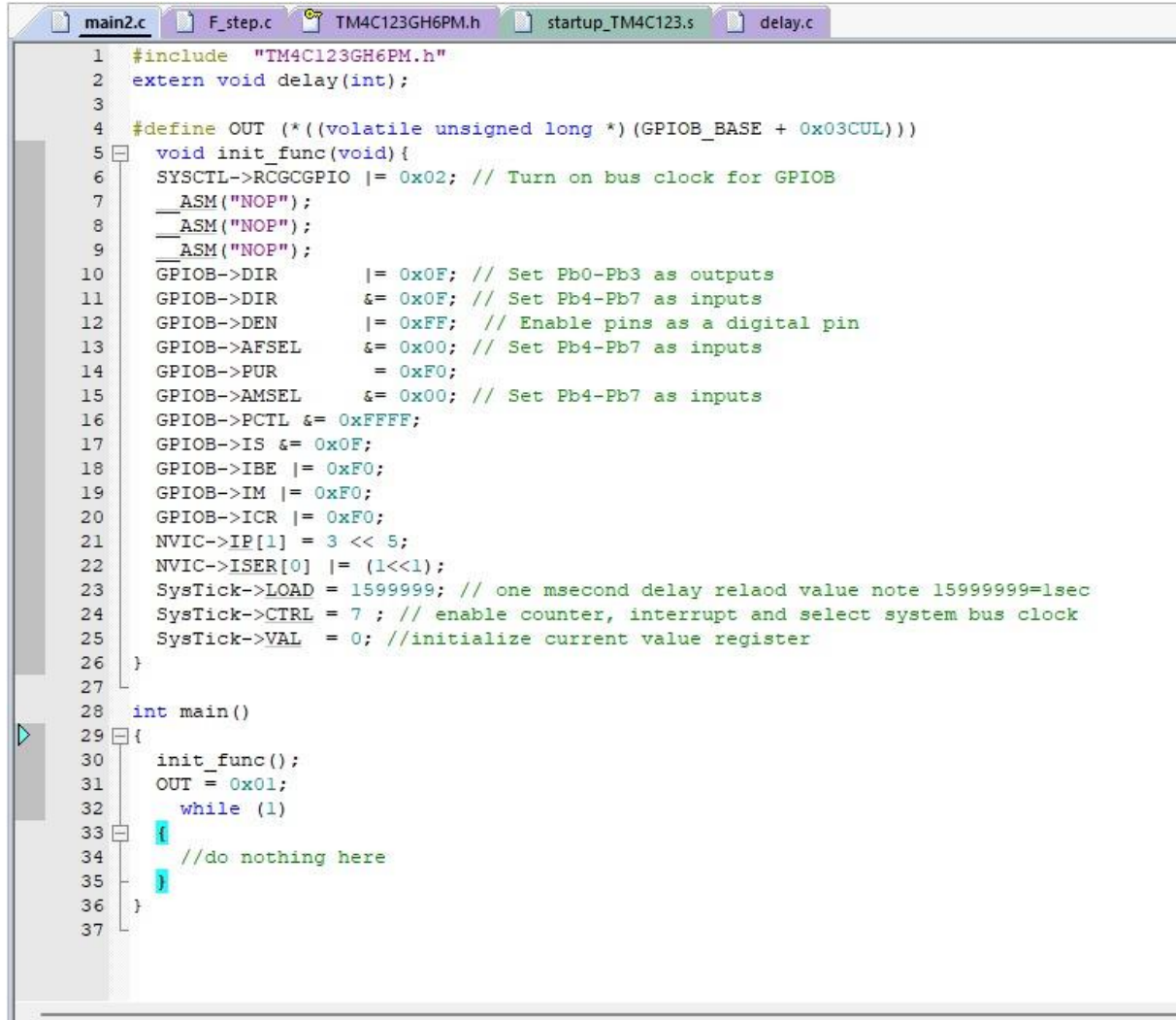
The stated pins are connected to TM4C1236 board

Figure 5: Part 2 Design

S1 is connected to PB4 for clockwise return of the motor and S2 is connected to the PB5 for counter clockwise return of the motor.

Question 3)

In this question, we also set values for our input push buttons in PORT B PB4-PB7. We added a GPIOB_Handler ISR to handle the stepper motor movement for every button released the motor take a step.



```

1  #include "TM4C123GH6PM.h"
2  extern void delay(int);
3
4  #define OUT (*(volatile unsigned long *) (GPIOB_BASE + 0x03CUL))
5  void init_func(void){
6      SYSTICK->RCGCGPIO |= 0x02; // Turn on bus clock for GPIOB
7      __ASM("NOP");
8      __ASM("NOP");
9      __ASM("NOP");
10     GPIOB->DIR      |= 0x0F; // Set Pb0-Pb3 as outputs
11     GPIOB->DIR      &= 0x0F; // Set Pb4-Pb7 as inputs
12     GPIOB->DEN      |= 0xFF; // Enable pins as a digital pin
13     GPIOB->AFSEL     &= 0x00; // Set Pb4-Pb7 as inputs
14     GPIOB->PUR       = 0xF0;
15     GPIOB->AMSEL     &= 0x00; // Set Pb4-Pb7 as inputs
16     GPIOB->PCTL &= 0xFFFF;
17     GPIOB->IS &= 0x0F;
18     GPIOB->IBE      |= 0xF0;
19     GPIOB->IM       |= 0xF0;
20     GPIOB->ICR      |= 0xF0;
21     NVIC->IP[1]     = 3 << 5;
22     NVIC->ISER[0]   |= (1<<1);
23     SysTick->LOAD    = 15999999; // one msecond delay reload value note 15999999=1sec
24     SysTick->CTRL    = 7; // enable counter, interrupt and select system bus clock
25     SysTick->VAL     = 0; //initialize current value register
26 }
27
28 int main()
29 {
30     init_func();
31     OUT = 0x01;
32     while (1)
33     {
34         //do nothing here
35     }
36 }
37

```

Figure 6: Initialization and Main Function of part 3

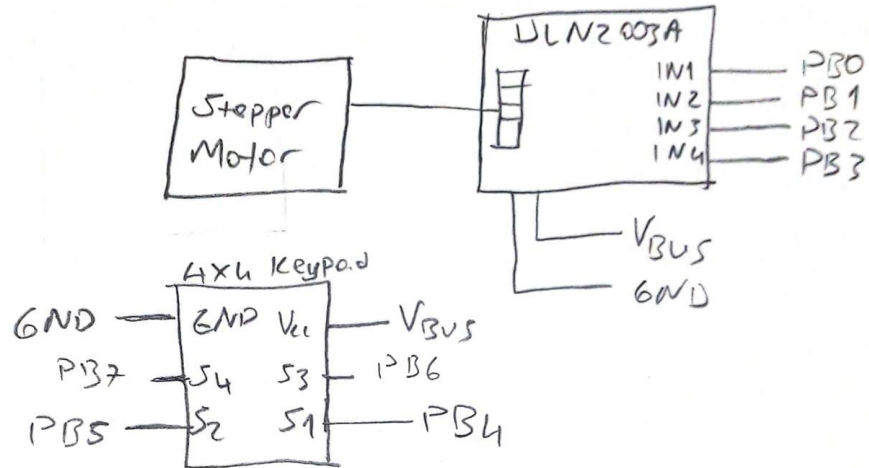

```

1  #include "TM4C123GH6PM.h"
2  #define IN (*((volatile unsigned long *) (GPIOB_BASE + 0x3C0UL)))
3  #define OUT (*((volatile unsigned long *) (GPIOB_BASE + 0x3C4UL)))
4  extern void GPIOB_Handler(void);
5  extern void SysTick_Handler(void);
6  extern void delay(int);
7
8  void GPIOB_Handler(void)
9  {
10     if(IN==0xE0){ // clockwise direction
11         delay(100);
12         if(IN==0xF0){ // detect release
13             if(OUT==8){ //note that in clock wise direction Full step output 4 follow Full step output 1
14                 OUT = 0x01;
15             }
16             else
17                 OUT=OUT << 1; // logical binary left shift to arrange output step from 4 to 1
18             GPIOB->IM |= 0x0F;
19             GPIOB->ICR |= 0xF0;
20         }
21     }
22     else if(IN==0xD0){ // counter clock wise direction
23         delay(100);
24         if(IN==0xF0){ // detect release
25             if(OUT==1){ // note that in counter clock wise direction Full step output 1 follow Full step output 4
26                 OUT = 0x08;
27             }
28             else
29                 OUT=OUT >> 1; // logical binary right shift to arrange output step from 1 to 4
30             GPIOB->IM |= 0x0F;
31             GPIOB->ICR |= 0xF0;
32         }
33     }
34 }
35
36
37 void SysTick_Handler(void){
38     GPIOB->IM |= 0xF0;
39     GPIOB->ICR |= 0xF0;
40 }

```

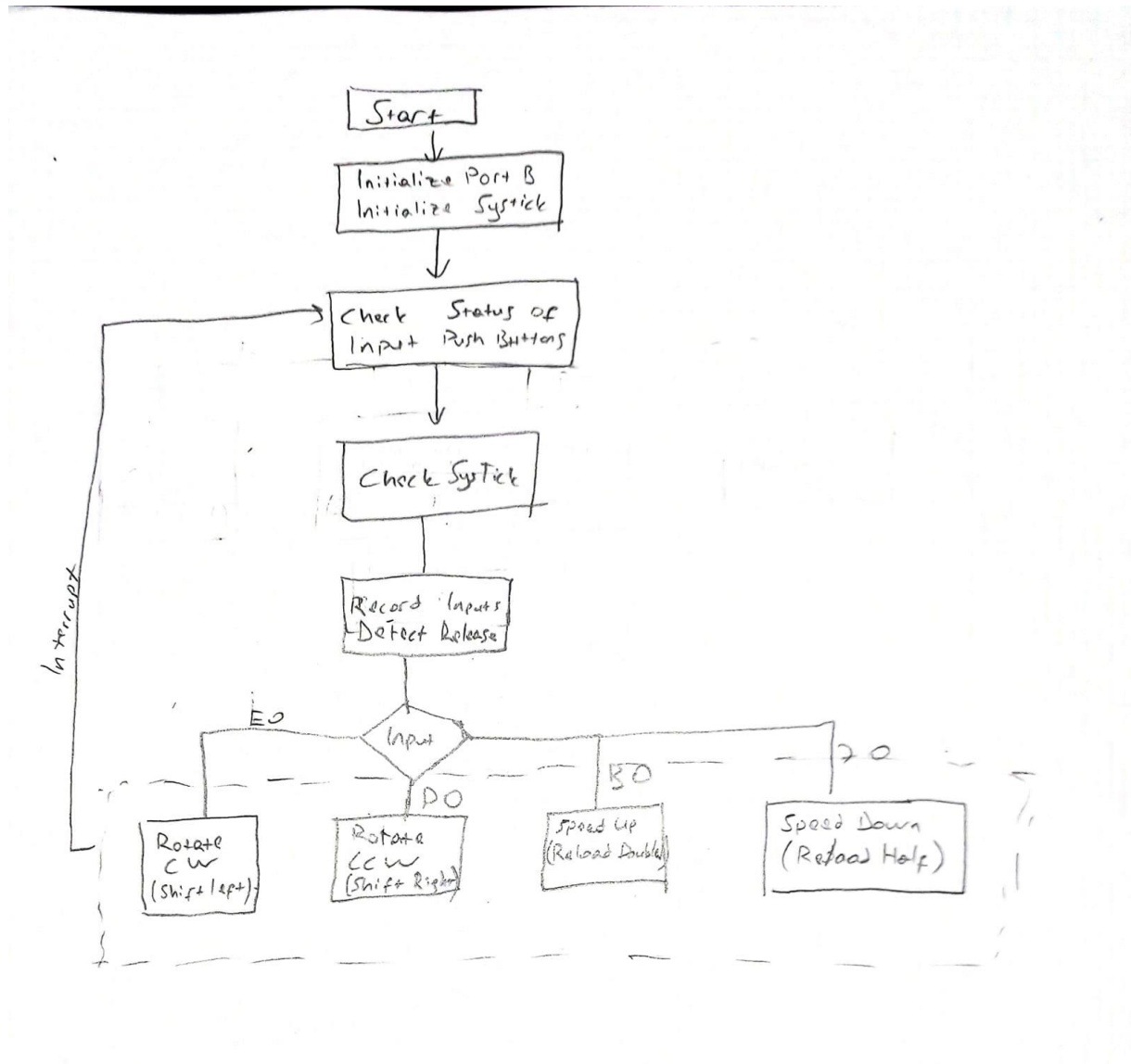
Figure 7: Modified F_step function for part 3

Question 4)



The stated pins are connected to TM4C1236 board

Question 5)



- In this question we tried to give priority to the interrupts but we couldn't do it.