E3-257 EMBEDDED SYSTEMS DESIGN (ASSIGNMENT – 06)

BASATI SIVAKRISHNA (22976)

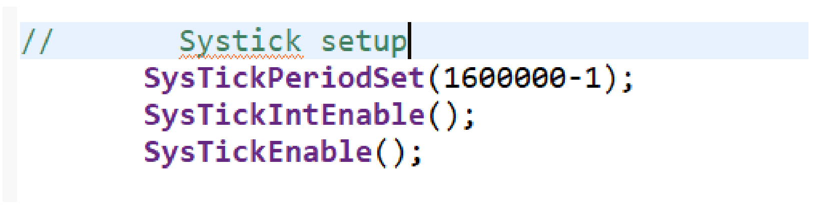
M. Tech (EPD).

Code Explanation:

1. STOPWATCH TIMER:

❖ Configure the Systick timer.

- Load the value into Systick `1600000-1` load register, enable the timer and start interrupts using followed APIs.

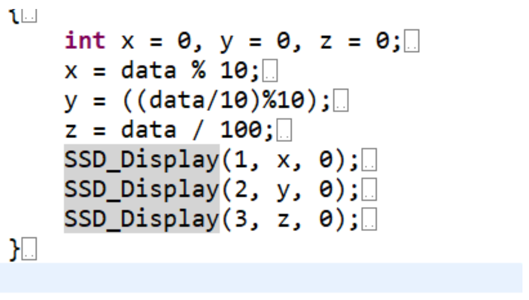


```
//          Systick setup
        SysTickPeriodSet(1600000-1);
        SysTickIntEnable();
        SysTickEnable();
```

- Now add the Handler in startup file according to its interrupt vector
- And define the handler to increment count for sec and msec accordingly.

❖ Update Seven Segment Display.

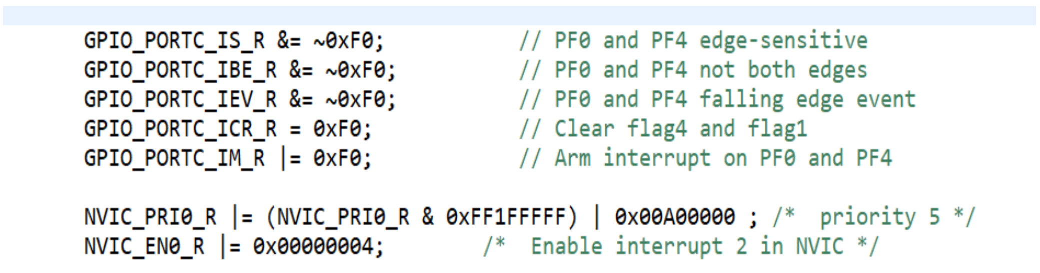
- Blink the SSD for every 50mSec to see the data without any flickering.
- Divide the given number into 4 digits and pass it to `SSD_Display().`



```
{
    int x = 0, y = 0, z = 0;
    x = data % 10;
    y = ((data/10)%10);
    z = data / 100;
    SSD_Display(1, x, 0);
    SSD_Display(2, y, 0);
    SSD_Display(3, z, 0);
}
```

❖ SW1 and SW2 Interrupt Configuration.

- Setup the GPIO registers as shown below to configure as falling edge interrupts.

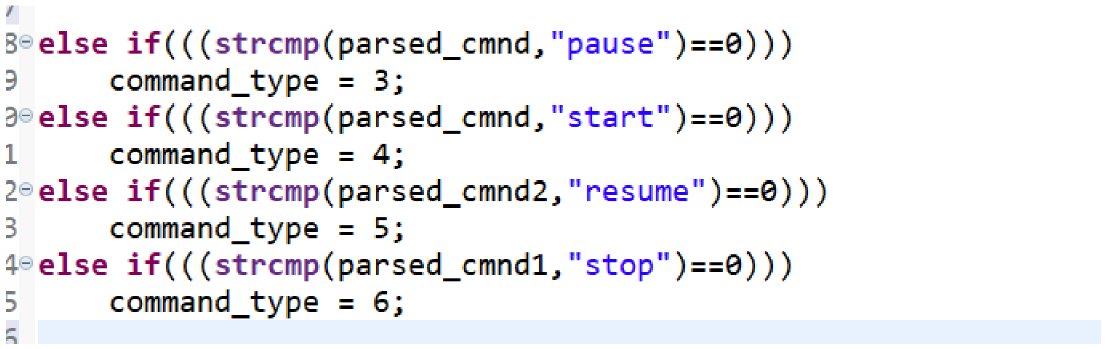


```
GPIO_PORTC_IS_R &= ~0xF0;          // PF0 and PF4 edge-sensitive
GPIO_PORTC_IBE_R &= ~0xF0;         // PF0 and PF4 not both edges
GPIO_PORTC_IEV_R &= ~0xF0;         // PF0 and PF4 falling edge event
GPIO_PORTC_ICR_R = 0xF0;           // Clear flag4 and flag1
GPIO_PORTC_IM_R |= 0xF0;           // Arm interrupt on PF0 and PF4

NVIC_PRI0_R |= (NVIC_PRI0_R & 0xFF1FFFFF) | 0x00A00000 ; /*  priority 5 */
NVIC_EN0_R |= 0x00000004;        /*  Enable interrupt 2 in NVIC */
```

- Add the handler function in the startup file and define the handler function to set variables according to the button pressed.
- Clear the interrupt flag for particular GPIO pin at the end of the ISR.

❖ UART Commands

- Following commands are taken from the uart terminal and will be executed accordingly.

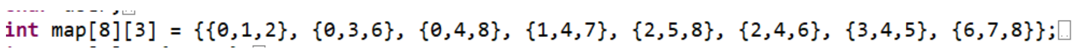


```
else if(((strcmp(parsed_cmnd,"pause")==0)))
    command_type = 3;
else if(((strcmp(parsed_cmnd,"start")==0)))
    command_type = 4;
else if(((strcmp(parsed_cmnd2,"resume")==0)))
    command_type = 5;
else if(((strcmp(parsed_cmnd1,"stop")==0)))
    command_type = 6;
```

2. <u>TIC TAC TOE:</u>

❖ 4 X 4 Keypad initialization.

- Configure Port E (0,1,2,3) pins as output pins and drive them to logic 0’.
- Configure the Port C pins as interrupts and make a flag true when any of the Port C buttons are pressed (Low to High).
- Once interrupt is triggered scan all the Port C inputs by giving different outputs at port E.
- Make the particular element in ttt[9] array as ‘X’ or ‘0’ according to the user.
- Once more than 4 elements are filled in ttt array then check for winning conditions. These are the possible winning conditions for the user.

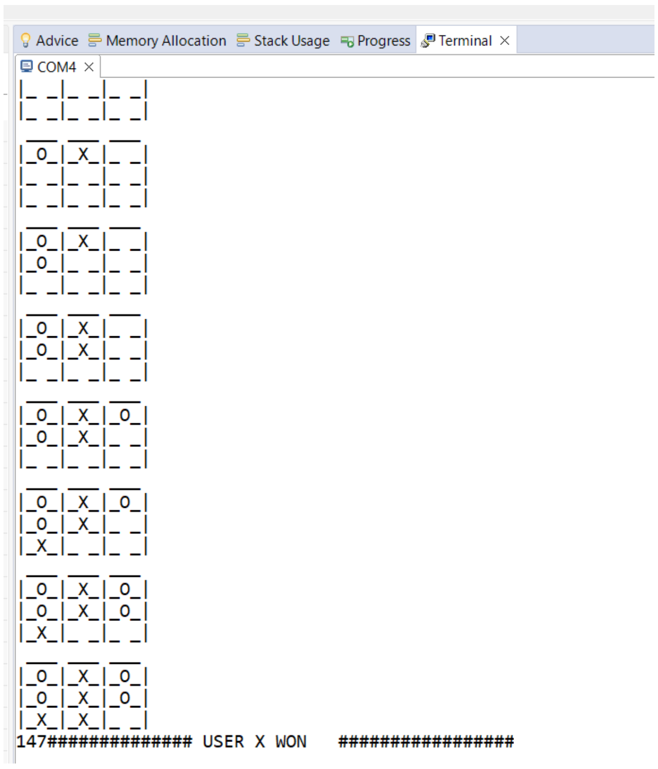


```
int map[8][3] = {{0,1,2}, {0,3,6}, {0,4,8}, {1,4,7}, {2,5,8}, {2,4,6}, {3,4,5}, {6,7,8}};
```

- To detect the win or draw case, we need to check whether following elements in the array are same or not. If they are same then user with particular symbol (“X” or “0”) will be declared as winner.
- If there is no winner till the 9 entries, then match will be draw and new game will start.
- If user enters the input at already existing input or user presses button from another rows, then console will print invalid input.

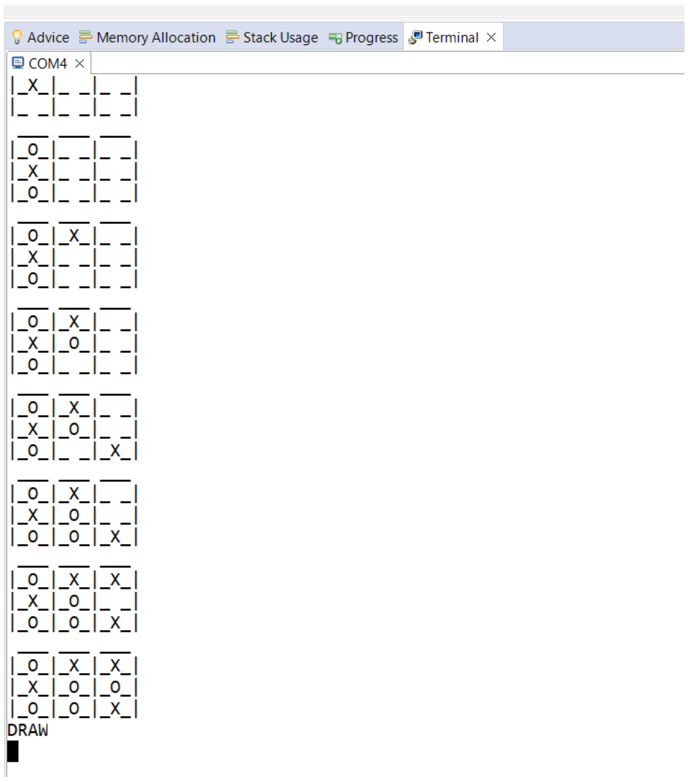
Results:

Winning Condition:



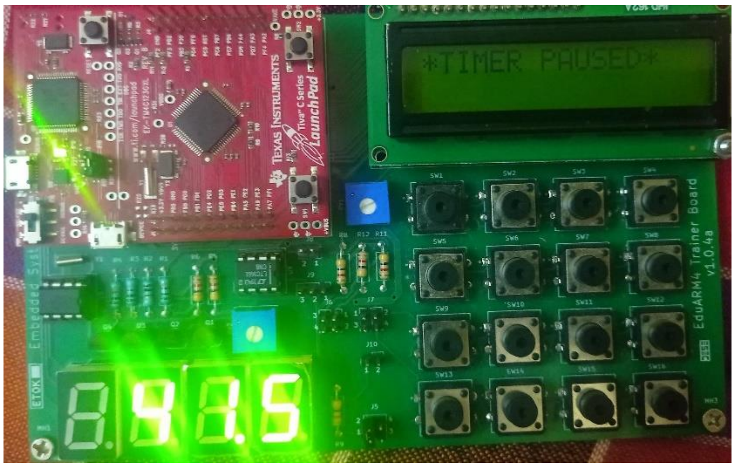
```
|_ _|_ _|_ _|
|_ _|_ _|_ _|

 ___ ___ ___
|_O_|_X_|_ _|
|_ _|_ _|_ _|
|_ _|_ _|_ _|

 ___ ___ ___
|_O_|_X_|_ _|
|_O_|_ _|_ _|
|_ _|_ _|_ _|

 ___ ___ ___
|_O_|_X_|_ _|
|_O_|_X_|_ _|
|_ _|_ _|_ _|

 ___ ___ ___
|_O_|_X_|_O_|
|_O_|_X_|_ _|
|_ _|_ _|_ _|

 ___ ___ ___
|_O_|_X_|_O_|
|_O_|_X_|_ _|
|_X_|_ _|_ _|

 ___ ___ ___
|_O_|_X_|_O_|
|_O_|_X_|_O_|
|_X_|_ _|_ _|

 ___ ___ ___
|_O_|_X_|_O_|
|_O_|_X_|_O_|
|_X_|_X_|_ _|
147############### USER X WON   ##################
```

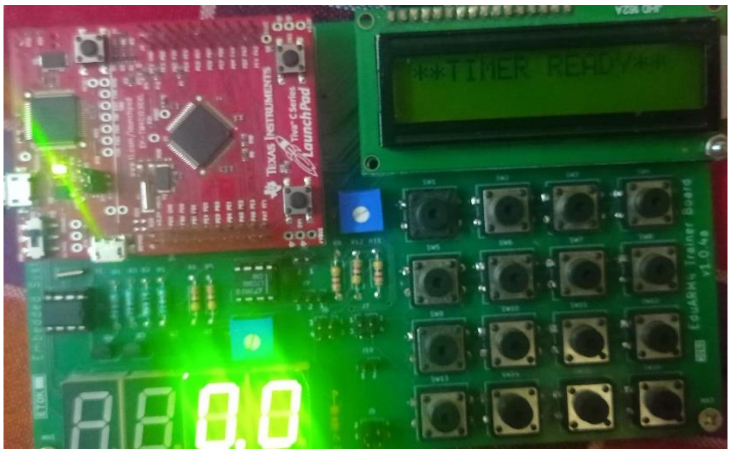
DRAW condition:

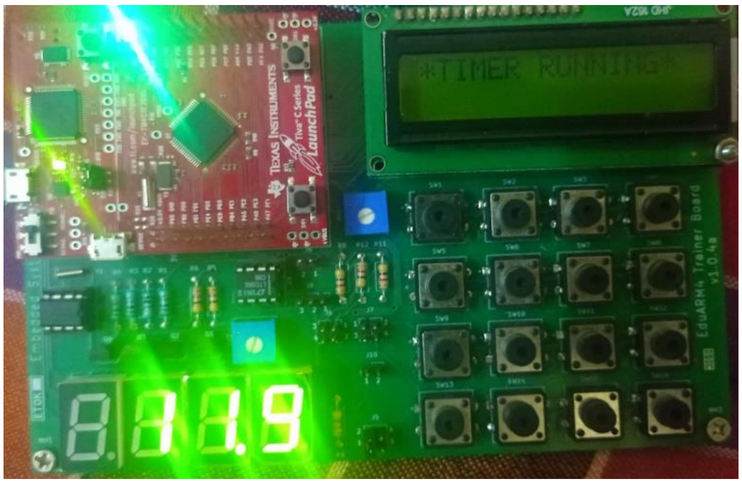


```
|_X_|_ _|_ _|
|_ _|_ _|_ _|

 ___ ___ ___
|_O_|_ _|_ _|
|_X_|_ _|_ _|
|_O_|_ _|_ _|

 ___ ___ ___
|_O_|_X_|_ _|
|_X_|_ _|_ _|
|_O_|_ _|_ _|

 ___ ___ ___
|_O_|_X_|_ _|
|_X_|_O_|_ _|
|_O_|_ _|_ _|

 ___ ___ ___
|_O_|_X_|_ _|
|_X_|_O_|_ _|
|_O_|_ _|_X_|

 ___ ___ ___
|_O_|_X_|_ _|
|_X_|_O_|_ _|
|_O_|_O_|_X_|

 ___ ___ ___
|_O_|_X_|_X_|
|_X_|_O_|_ _|
|_O_|_O_|_X_|

 ___ ___ ___
|_O_|_X_|_X_|
|_X_|_O_|_O_|
|_O_|_O_|_X_|
DRAW
█
```

STOPWATCH:







Note: LCD light has turned off for the reflection adjustments.