```c
/*  ENEL 387 Lab Project */
/* Author - Ammar Alvi & Shannon D'Souza, April 5, 2020 */

#include "stm32f10x.h"
#include "AFIO.h"
#include "clocks.h"
#include "GPIO.h"
#include "UTIL.h"
#include "TIM.h"
#include "UART.h"
#include "Sensors.h"


uint8_t cntr = 0;     //Global counter value to be used to count the number of stripes
uint8_t nav = 1, avoid = 0;     //Variables that control the state of the car
int main(void)
{

  sys_clockInit();    //Initilizing system clock
  GPIO_clockInit();   //Initializing GPIO clock
  AFIO_clockInit();   //Initializing AFIO clock
  TIM1_clockInit();   //Initializing Timer 1 clock
  USART3_clockInit(); //Initializing USART 3 clock
  AFIO_config();      //Configuring the AFIO pins
  GPIO_config();      //Configuring GPIO pins


  EXTI->IMR |= EXTI_IMR_MR12;   //Unmasking the interrupt at pin 12
  EXTI->FTSR |= EXTI_FTSR_TR12; //Setting intterrupt to trigger at rising edge

  //Programming the NVIC interrupt set enable to enable EXTI15_10 at position 40
  NVIC->ISER[1] |= NVIC_ISER_SETENA_8;

  TIM1_PWM_init();    //Initializing the 4 PWM outputs for TIMER 1
  UART3_init();       //Initializing the UART Tx ouput for HC-05 Bluetooth module

  uint8_t pb = 0;     //Variable to track state of blue pushbutton

  while(1)
  {
    //If the Blue push button on descovery board is pressed
    if(GPIOA->IDR & GPIO_IDR_IDR0)
    {
      pb = 1;             //Indicating blue push button was pressed
      UART3_TX_str("Button Pressed\n"); //Ouptut to bluetooth terminal screen

      //Keep looping until the input from the IR Sensor no longer detects white paper
      while((GPIOB->IDR & GPIO_IDR_IDR12) != GPIO_IDR_IDR12)
      {
        //If the Front Right sensor measures distance less than 4cm
        if((FrontRightUSLen() < 40))
        {
          TIM1_TurnLeft();              //Turn left
        }
        //If Front Right and Middle Right sensor measure greater than 7cm
        else if((FrontRightUSLen() > 70) && (RightUSLen() > 70))
        {
          TIM1_TurnRight();             //Turn Right
        }
        else
        {
          TIM1_ForwardAdj(5);           //Go forward at 75% speed
        }

      }
    }

    //Because the Blue Push buton was pressed enter this loop
    while(pb)
    {
      //Output the to bluetooth terminal that car is now navigating around the couch
      UART3_TX_str("Navigating Around Couch...\n");
```

```
73
74          //Navigation loop which is true only when the couch is navigating (nav = 1)
75          while(nav)
76          {
77
78            //If the infared sensor detects a white surface, while navigating
79            if((GPIOB->IDR & GPIO_IDR_IDR12) != GPIO_IDR_IDR12)
80            {
81              TIM1_Brake();         //Stop the car
82
83              //Indicate that the navigation is complete
84              UART3_TX_str("Start Position sensed, navigation complete!!\n");
85              //End the program
86              return 0;
87            }
88
89            //If the Front Right sensor measures distance less than 4cm
90            if((FrontRightUSLen() < 40))
91            {
92              TIM1_TurnLeft();    //Too close to couch, turn left
93            }
94            //If Front Right and Middle Right sensor measure greater than 7cm
95            else if((FrontRightUSLen() > 70) && (RightUSLen() > 70))
96            {
97              TIM1_TurnRight();   //Too far from couch, turn right
98            }
99            else{
100             TIM1_ForwardAdj(4); //Go forward at 80% speed
101           }
102
103           //The front sensor detects something at less than 10cm
104           if(FrontUSLen() < 100)
105           {
106             TIM1_Brake(); //Brake
107             //Output to Bluetooth to indicate that Object was detected
108             UART3_TX_str("Going around the obstacle...\n");
109             //Indicating the change in state of navigation to avoiding state
110             nav = 0;
111             avoid = 1;
112           }
113
114         }
115         //Turn left until the front sensor no longer detects the object
116         TIM1_TurnLeft();
117         while(FrontUSLen() < 1000) {}
118         //This delay was set to make the car turn extra to avoid crashing of car
119         delay(4000000);
120         //At this point the car should have turned left facing away from the couch
121         //Loop until the Front Right and Middle right no longer sense the object
122         while((RightUSLen() < 1000) && (FrontRightUSLen() < 1000))
123         {
124           //If the Front Right or Middle Right sensor detect the object
125           if((RightUSLen() < 100) || (FrontRightUSLen() < 100))
126           {
127             TIM1_TurnLeft();    //Turn left
128           }
129           else{
130             TIM1_ForwardAdj(7); //Go forward at 65% speed
131           }
132
133         }
134
135         //Start to turn Right when the Middle Right sensor doesn't detect the object
136         TIM1_TurnRight();
137
138         cntr = 0;     //Set the stripe counter to 0
139         //The number of stripes will be counted using interrups during this loop
140         //Avoiding loop is true only if the car is in avoiding state (avoid = 1)
141         while(avoid)
142         {
143           //If the Front Right sensor gets closer than 6cm
144           if(FrontRightUSLen() < 60)
```

```
145           {
146             TIM1_TurnLeft();  //Turn left
147           }
148           //If the Front Right Sensor and Middle Right sensor detect...
149           //...distance greater than 7cm
150           else if((FrontRightUSLen() > 70) && (RightUSLen() > 70))
151           {
152             TIM1_TurnRight();   //Turn Right
153           }
154           else{
155             TIM1_ForwardAdj(7); //Go forward at 65% speed
156           }
157
158           //If the front sensor detects a distance less than 10cm
159           if(FrontUSLen() < 100)
160           {
161             //Object has been avoided and couch has been detected
162             //Car brakes
163             TIM1_Brake();
164             //Change the state of the car from avoiding to navigating..
165             //...to exit the loop
166             avoid = 0;
167             nav = 1;
168           }
169
170         }
171         //Send the number of stripes counted by the IR sensor....
172         //...corresponding with the box number to bluetooth
173         UART3_TX_str("Box #");
174         UART3_TX_Byte(to_ascii(cntr));
175         UART3_TX_str(" was detected\n");
176
177         //Turn left until the front sensor doesn't detect the couch anymore
178         TIM1_TurnLeft();
179         while(FrontUSLen() < 1000) {}
180         delay(3000000);       //Extra delay is added to ensure approx 90 degree turn
181
182       }
183
184     }
185   }
186
187
188   //Exception handler for GPIOB12 (EXTI12)
189   //This is called when IR detects a white color
190   void EXTI15_10_IRQHandler(void)
191   {
192     //This delay was added out of neccessity to avoid initial bouncing error
193     delay(50000);
194     EXTI->PR |= EXTI_PR_PR12; // Clear the pending interrupt bit
195     //If the car is not navtigating and the IR sensor detects white surface
196     if((nav == 0)&&(GPIOB->IDR & GPIO_IDR_IDR12) != GPIO_IDR_IDR12)
197     {
198       cntr++;   //Increment counter
199
200       //Wait for the IR sensor to detect non white surface
201       while((GPIOB->IDR & GPIO_IDR_IDR12) != GPIO_IDR_IDR12){}
202
203     }
204     //Delay added to avoid input from bouncing of sensor inputs
205     delay(50000);
206   }
207
208
```