Communication and Electronics Department
Introduction to Mechatronics - EEC 331
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REPORT

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➢ Introduction:

-The aim of the project is to design a very simple automotive vehicle that runs using an Arduino microcontroller. Our vehicle will run using two wheels connected to two motors and a free wheel.

➢ Implementation:

-To implement this project the following hardware tools were used:

- Arduino.
- Two wheels.
- A free wheel.
- Two gear-boxed DC motors.
- Motor driver.
- Ultrasonic sensor.
- Wooden chassis.

- The main idea is that the car will move in a straight line with a constant velocity until the ultrasonic sensor recognizes an obstacle a few centimeters ahead. On recognizing an obstacle, the vehicle should stop moving however, we added a feature where it will move backwards on recognizing an obstacle certain centimeter ahead.

➢ Code:

As mentioned earlier, an Arduino kit was used in implementing the hardware. In the following lines, parts of the code will be explained to demonstrate the software implementation.

The first part of the code is the macros and variables. The macros are used to define each component pin number to enhance the readability of the code. The variable is used for storing duration and distance for the ultrasonic.

```
1                                                    /* MACROS */
2
3   #define min_distance 20
4   #define SPEED        150
5   #define TRIG_PIN     12
6   #define ECHO_PIN     11
7   #define motor1Pin1   10
8   #define motor1Pin2   9
9   #define motor1EN     A0
10  #define motor2Pin1   8
11  #define motor2Pin2   7
12  #define motor2EN     A1
13
14                                                /* Intializing Variables */
15
16  float duration_us = 0 ;
17  float distance    = 0 ;
18
```

The setup function is used to set the pin modes for each component, using the ultrasonic sensor and the constant speed of the motor.

```
void setup()
{

  Serial.begin(9600)         ;   // For serial monitoring.
  intializeMotion()          ;     // Function to set pin directions of the motors for motion.
  speedMotion(SPEED)         ;   // Function that makes the motors run at constant speed.
  pinMode(TRIG_PIN, OUTPUT)  ;   // Making Trigger pin of ultrasonic sensor as output.
  pinMode(ECHO_PIN, INPUT)   ;   // Making Echo pin of ultrasonic sensor as output.

}
```

This is the main code, in the beginning of the loop function, we call the function for the calculations of the distance between the vehicle and any obstacle, if the distance is more than the minimum distance the vehicle will move forward elsewhere it will stop then move backward then move in the left direction.

```
                    /*   Main Code  */
void loop() {

    UltrasonicCalculations();    // Function that makes all calculations required for Ultrasonic sensor.

        /* If the distance between the ultrasonic sensor and an obstacle is larger than 20cm move forward else stop then move backward then stop then move to the left. */

    if (distance > min_distance)
    {
        forwardMotion()     ;
    }

    else
    {
        stopMotion()        ;
        delay(500)          ;
        backwardMotion()    ;
        delay(500)          ;
        stopMotion()        ;
        delay(500)          ;
        leftMotion()        ;
        delay(500)          ;

    }


}
```

The last part of the code is the implementations of the used functions in the main code.

```
                                                    /*  Used functions impelementation.  */

void intializeMotion()     // Function to define pins direction for the motors.
{

  pinMode(motor1Pin1,OUTPUT);
  pinMode(motor1Pin2,OUTPUT);
  pinMode(motor1EN,OUTPUT)   ;
  pinMode(motor2Pin1,OUTPUT);
  pinMode(motor2Pin2,OUTPUT);
  pinMode(motor2EN,OUTPUT)   ;

}

void speedMotion(int speedPWM)    // Giving the motors the same speed.
{
  analogWrite(motor1EN,speedPWM);
  analogWrite(motor2EN,speedPWM);
}

void forwardMotion()            // Moving Forward.
{

  digitalWrite(motor1Pin1,HIGH) ;
  digitalWrite(motor1Pin2,LOW)  ;
  digitalWrite(motor2Pin1,HIGH) ;
  digitalWrite(motor2Pin2,LOW)  ;

}

void backwardMotion()         // Moving Backward.
{

  digitalWrite(motor1Pin1,LOW)  ;
  digitalWrite(motor1Pin2,HIGH) ;
  digitalWrite(motor2Pin1,LOW)  ;
  digitalWrite(motor2Pin2,HIGH) ;

}

void leftMotion()            // Moving Left about center of gravitiy (Not rotating around a fixed wheel).
{

  digitalWrite(motor1Pin1,HIGH) ;
  digitalWrite(motor1Pin2,LOW)  ;
  digitalWrite(motor2Pin2,HIGH) ;
  digitalWrite(motor2Pin1,LOW)  ;

}

void stopMotion()           // STOP.
{
  digitalWrite(motor1Pin1,LOW);
  digitalWrite(motor1Pin2,LOW);
  digitalWrite(motor2Pin1,LOW);
  digitalWrite(motor2Pin2,LOW);
}


void UltrasonicCalculations()   // Calculations of the ultrasonic sensor.
{

  digitalWrite(TRIG_PIN, HIGH);
  delayMicroseconds(10);
  digitalWrite(TRIG_PIN, LOW);
  duration_us = pulseIn(ECHO_PIN, HIGH);

  distance = 0.017 * duration_us; // Converting the duration into distance.(Distance= 0.5 X Speed of Sound X time .)

  Serial.print("distance: ");
  Serial.print(distance);
  Serial.println(" cm");

}
```