Project No&Topic: Obstacle Detection
mobile Robot

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1. Introduction

Our project was designing a simple differential drive mobile robot with an obstacle detection module and control it with human machine interface by motion of a body part. Designed mobile robot is controlled via body parts and is able to detect obstacles from a determined distance and automatically stops.

2. Equipment

1-)NRF24L01: The NRF24L01 wireless module is a low power module that enables wireless communication at 2.4 GHz.NRF24L01 supports the SPI interface.

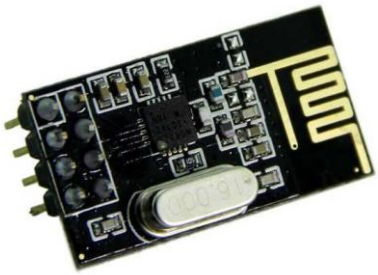

Figure 1 – NRF24L01

2-)NRF24L01 Wireless Module Adapter:NRF24L01 modules are often difficult to use due to the proximity of the pins and the arduino voltage mismatches.The module can be used with a more comfortable pin structure.Thanks to the voltage regulator,5V input can be done.Since the 3.3V output power of Arduino cards is low there is no power problem when fed with 5V.In addition,the bypass capacitors required by the module are available on the board.

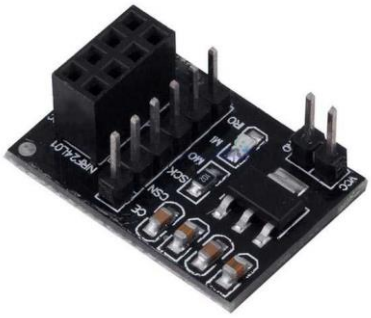

Figure 2 – NRF24L01 Wireless Module Adapter

3-)Motor Driver Module(L298N):L298N DC Motor Drive is a motor driver board prepared to drive two motors between 4.8V-46V.This two-channel motor drive delivers 2A current per channel.

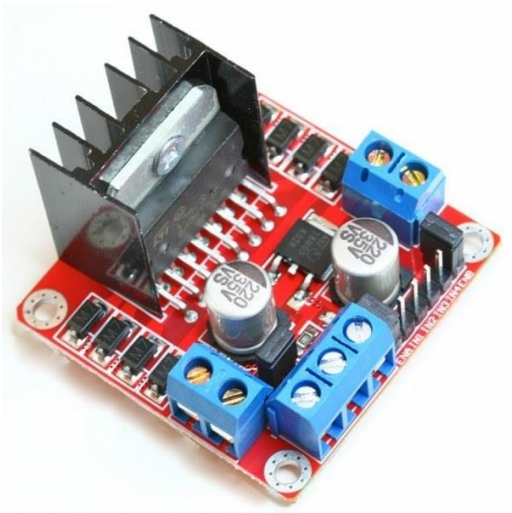

Figure 3 – Motor Driver Module(L298N)

4-)Arduino UNO: Arduino is an open source microcontroller which has 14 digital input/output pins and 6 analog inputs.Arduino Uno contains all of the components required to support a microcontroller.

Figure 4 - Arduino UNO

5-)Arduino NANO: Arduino Nano is an Atmega328 based micrcontroller board.It has 14 digital input/output pins(6 of them can be used as PWM outputs),8 analog inputs,16Mhz crystal,USB socket,ICSP connector and reset button.The board contains everything necessary for the operation of the microcontroller.It can be easily connected to the computer via USB cable,can be operated with adapter or battery.

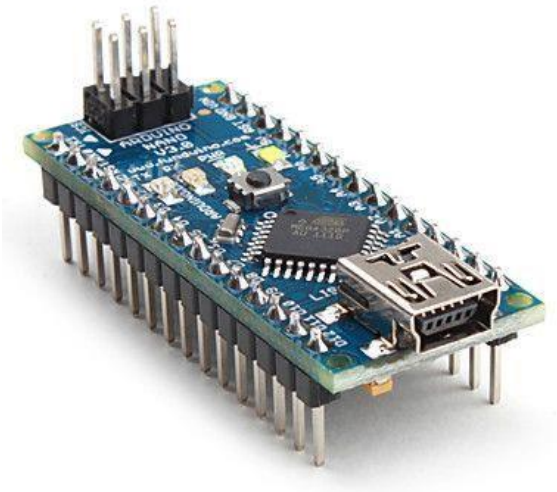

Figure 5 – Arduino NANO

6-)DC Gear Motor and Wheel: DC motor is a machine that converts straight current electrical energy into mechanical energy.When the electric current is applied to the windings inside the motor,it is based on the principle of moving by the effect of the magnetic force formed in the opposite direction to the permanen magnets inside the motor.

Figure 6 – DC Gear Motor and Wheel

7-)HC-SR04:HC-SR04 is an ultrasonic sensor.HC-SR04 is a source that calculates the distance to the object using sonar(Sound Navigation and Ranging)communication.The system called sonar helps us to calculate the distance of the object using sound waves.

Figure 7 – HC-SR04

8-)MPU-6050: The MPU-6050 is a 6-axis IMU sensor board with a 3-axis gyro and a 3-axis angular accelerometer.Since the board has a voltage regulator, it can be operated with a supply voltage of 3 to 5V.The accelerometer and gyro outputs both output I2C from separate channels.It can output 16-bit resolution on each axis.

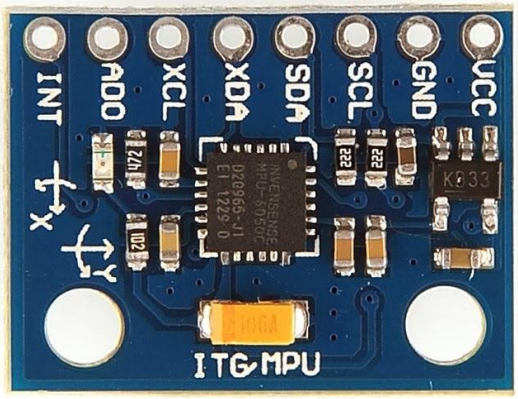

Figure 8 – MPU-6050

9-)Buzzer: Buzzer is a device that provides different audio signals according to the voltage given.

Figure 9 – Buzzer

10-)LED

11-)Battery

12-)Breadboard

3.Software

<u>Hand Code</u>

```
#include <SPI.h>
#include <RF24.h>
#include <Wire.h>
#include <I2Cdev.h>
#include <MPU6050.h>

MPU6050 mpu;
int16_t ax, ay, az;
int16_t gx, gy, gz;
```

```
int data[2];


RF24 radio(9,10);



const uint64_t pipe = 0xE8E8F0F0E1LL;

void setup(void){
  Serial.begin(9600);
  Wire.begin();
  mpu.initialize();
  radio.begin();
  radio.openWritingPipe(pipe);
}

void loop(void){









  data[0] = map(ax, -17000, 17000, 300, 400 ); //Send X axis data
  data[1] = map(ay, -17000, 17000, 100, 200);  //Send Y axis data
  radio.write(data, sizeof(data));
}
```

Obstacle Detection Mobile Robot Code

```
#include <SPI.h>
#include <RF24.h>

#define EchoPin 7
#define TrigPin 8

const int IN1 = 6;
const int IN2 = 5;
const int IN3 = 4;
const int IN4 = 3;

long Time,Lenght;

int data[2];

int Warning = 2;

RF24 radio(9,10);

const uint64_t pipe = 0xE8E8F0F0E1LL;

void setup() {

pinMode(EchoPin,INPUT);
pinMode(TrigPin,OUTPUT);

pinMode(IN1, OUTPUT);
```

```
pinMode(IN2, OUTPUT);
pinMode(IN3, OUTPUT);
pinMode(IN4, OUTPUT);

pinMode(Warning,OUTPUT);

 Serial.begin(9600);
 radio.begin();
 radio.openReadingPipe(1, pipe);
 radio.startListening();
}
void loop(){



  if (radio.available()){

   radio.read(data, sizeof(data));

   if(data[0] > 380){

     forward();

   }

   if(data[0] < 310){
     back();
   }
   if(data[1] > 180){
```

```
    left();
   }
    if(data[1] < 110){
   right();
    }
     if(data[0] > 330 && data[0] < 360 && data[1] > 130 && data[1] < 160){// stop car


     stop_car();
     }

}
}
void forward(){
  digitalWrite(TrigPin,HIGH);
 delayMicroseconds(1000);
 digitalWrite(TrigPin,LOW);

 Time = pulseIn(EchoPin,HIGH);

 Lenght = Time/29.1/2;
 if ( Lenght < 15){
digitalWrite(IN1,LOW);
digitalWrite(IN2,LOW);

digitalWrite(IN3,LOW);
digitalWrite(IN4,LOW);

digitalWrite(Warning,HIGH);
```

```
delay(500);
digitalWrite(Warning,LOW);
delay(500);
}

 else {
    digitalWrite(IN1, HIGH);
    digitalWrite(IN2, LOW);
    digitalWrite(IN3, HIGH);
    digitalWrite(IN4, LOW);
    digitalWrite(Warning,LOW);
 }

}
void back(){
     digitalWrite(IN1, LOW);
    digitalWrite(IN2, HIGH);
    digitalWrite(IN3, LOW);
    digitalWrite(IN4, HIGH);

    digitalWrite(Warning,LOW);
}
void left(){

 digitalWrite(TrigPin,HIGH);
 delayMicroseconds(1000);
 digitalWrite(TrigPin,LOW);

 Time = pulseIn(EchoPin,HIGH);
```

```
 Lenght = Time/29.1/2;
  if ( Lenght < 15){
digitalWrite(IN1,LOW);
digitalWrite(IN2,LOW);

digitalWrite(IN3,LOW);
digitalWrite(IN4,LOW);

digitalWrite(Warning,HIGH);
delay(500);
digitalWrite(Warning,LOW);
delay(500);

}
else{
      digitalWrite(IN1, HIGH);
    digitalWrite(IN2, LOW);
    digitalWrite(IN3, LOW);
    digitalWrite(IN4, HIGH);

    digitalWrite(Warning,LOW);
}
}
void right(){
 digitalWrite(TrigPin,HIGH);
 delayMicroseconds(1000);
 digitalWrite(TrigPin,LOW);

 Time = pulseIn(EchoPin,HIGH);
```

```
 Lenght = Time/29.1/2;
  if ( Lenght < 15){
digitalWrite(IN1,LOW);
digitalWrite(IN2,LOW);

digitalWrite(IN3,LOW);
digitalWrite(IN4,LOW);

digitalWrite(Warning,HIGH);
delay(500);
digitalWrite(Warning,LOW);
delay(500);



}
else{

    digitalWrite(IN1, LOW);
    digitalWrite(IN2, HIGH);
    digitalWrite(IN3, HIGH);
    digitalWrite(IN4, LOW);

    digitalWrite(Warning,LOW);
}
}
void stop_car(){
  digitalWrite(IN1, LOW);
    digitalWrite(IN2, LOW);
    digitalWrite(IN3, LOW);
    digitalWrite(IN4, LOW);
```

```
    digitalWrite(Warning,LOW);
}
```

4. Design and Assembly

We designed a wooden base.The length of edges is 20cm.Also,the base hase 2 wheel housing.We mounted the caster by using metal spacers and mounted the motors on the base.The motor driver is positioned close to the motors.Led and buzzer circuits were placed on the base to see the obstacle detected.The HC-SR04 sensor to be used for obstacle detection was placed on the end of the base.The RF module for communication was placed on the base.The arduino used to control the circuits and modules was placed on the base.Also,battery sockets was placed.Cable connections were made.

The acceleration module and the arduino nano to be used gesture control were installed to the breadboard.One more RF module has been installed to enable communication and data transmission with RF on the car.Cable connections were made.And then,breadboard was placed to the glove.

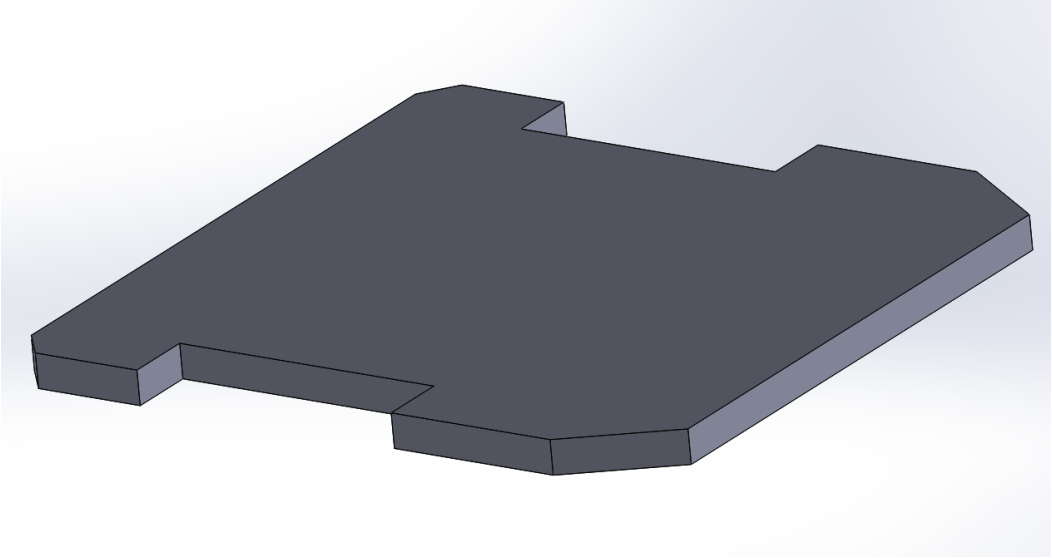

Figure – Wooden Base

5. Results and Discussions

After the mobile robot mechanism is constructed and circuit designs are over we encountered some issues while implementing mechanical and electrical systems together. First issue was cable management we solved this problem by changing design of mobile robot but this caused another problem which is stability of mechanism. Center of gravity of the mobile robot was lapsed to the back due to weight of the batteries. Change in center of the gravity caused the mobile robot to bounce while operating. When the circuit and the mechanism assembly is done we saw some issues on coding. When obstacle detection sensor detects

an obstacle and mobile robot stops it would never move without and outside help we solved this issue by changing some part of the code .

6. Conclusions

At this Project we designed a obstacle detection mobile robot.At this experiment we added a HC-SR04 sensor and a human body interface to remote control via motion with our body parts.For connect to 2 different arduino we use nrf24l01 module.While coding this experiment we learned coding rf module.Also we learned that HC-SR04 calculate the distance with using time.It sends sound from trigpin and it counts the time.Then when it take this sound from echopin the time difference between send and take.It will be our time and it has a formula.Thanks to this formula we can calculate the distance