H-bridge and robot (Control dc motor (12v)) :

In this experiment we will learn how to control two 12v DC motor by using H-bridge module

H-bridge :

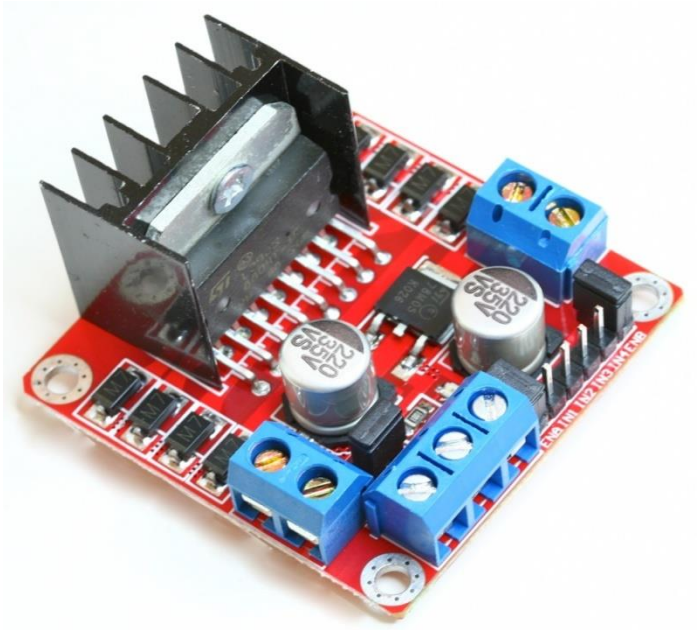


Figure : Dual H-bridge .

An H-Bridge is a circuit that can drive a current in either polarity and be controlled by Pulse Width Modulation (PWM).

H-Bridge is typically used in controlling motors speed and direction.

In this experiment we need :

1- Two dc motor .
2-Dual H-bridge to drive the motors .
3-Arduino board.
4-Wires .
5-Battery 12v .

See connection diagram :

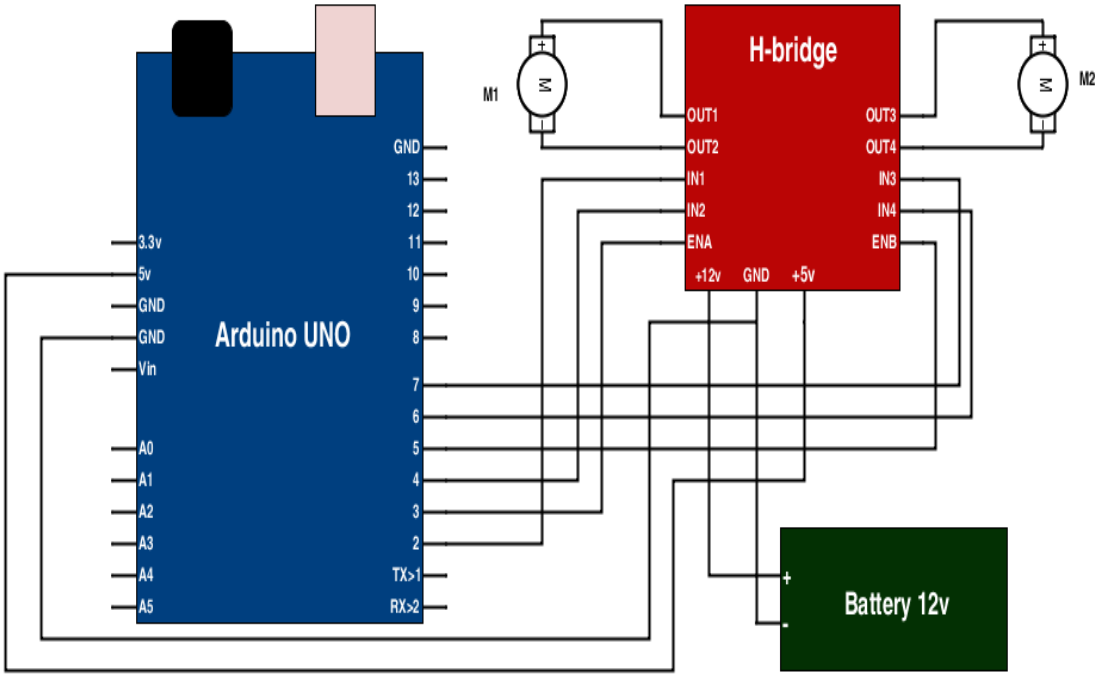


Figure : control two dc motor connection diagram .

We can add to the component four wheel or two wheel , and kit (fitting pieces on it) to control small car forward , backward ,and rotation in both direction .

Like this :

Figure : four wheeled Robot kit .

Note that we connect each two motor together as one motor

Figure : Four wheeled robot .

Now let`s move to the code :

```
int IN1=2;
int IN2=4;
int ENA=3;


int IN3=7;
int IN4=6;
int ENB=5;
int Speed=255;
void setup() {
  pinMode (IN1, OUTPUT);
 pinMode (IN2, OUTPUT);
 pinMode (ENA, OUTPUT);
 pinMode (IN3, OUTPUT);
 pinMode (IN4, OUTPUT);
 pinMode (ENB, OUTPUT);
 Serial.begin(9600);
}
void loop()
{
  forward();
  delay(1000);
  left();
  delay(1000);
backward();
  delay(1000);
```

```
right();
   delay(1000);
   Stop();
   delay(1000);   }
void left(){
  analogWrite (ENA, Speed);
  analogWrite (ENB, Speed);
  digitalWrite (IN1, 0);
  digitalWrite (IN2, 1);
  digitalWrite (IN3, 0);
  digitalWrite (IN4, 1);
}
void right(){
  analogWrite (ENA, Speed);
  analogWrite (ENB, Speed);
  digitalWrite (IN1, 1);
  digitalWrite (IN2, 0);
  digitalWrite (IN3, 1);
  digitalWrite (IN4, 0);
}
void Stop(){
 analogWrite (ENA, 0);
  analogWrite (ENB, 0);
  digitalWrite (IN1, 0);
  digitalWrite (IN2, 0);
  digitalWrite (IN3, 0);
  digitalWrite (IN4, 0);  }
```

```
void forward(){
  analogWrite (ENA, Speed);
  analogWrite (ENB, Speed);
  digitalWrite (IN1, 0);
  digitalWrite (IN2, 1);
  digitalWrite (IN3, 1);
  digitalWrite (IN4, 0);
}
void backward(){
 analogWrite (ENA, Speed);
  analogWrite (ENB, Speed);
  digitalWrite (IN1, 1);
  digitalWrite (IN2, 0);
  digitalWrite (IN3, 0);
  digitalWrite (IN4, 1);
}
```

Wireless connection robot :

In this project we will control four wheeled robot wirelessly by using two 433MHZ wireless module to go forward ,backward and rotation (right and left).

433 MHZ wireless module :

HC-12 wireless serial port communication module(433Mhz transceiver) Its working frequency band is 433.4-473.0MHz , and the communication distance is 1,000m in open space.

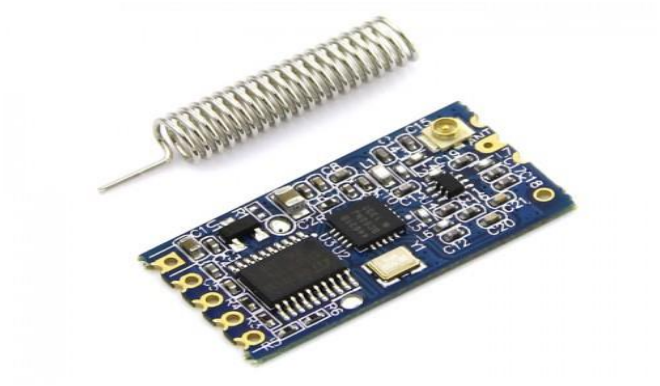


Figure : 433MHZ wireless module.

In this experiment you will need :

1-four wheel robot.
2-dual H-bridge to drive the motors .
3-two arduino Uno .
4-wires .
5-battery 12v .
6- two 433Mhz wireless module .

To connect the 433Mhz transceiver to arduino you have to connect vcc pin to 5v pin in arduino, GND pin to GND pin in arduino , RXD pin to TX pin in arduino and TXD pin to RX pin in arduino.

** Note that : before you upload arduino code you must disconnect RX,TX wires from arduino pins.

First : we connect 433 MHz (Transmitter) to arduino Mega and upload the program

Transmitter code :

```
void setup() {
Serial.begin(9600);
}
void loop() {
Serial.println('F');
delay(2000);
Serial.println('B');
delay(2000);
Serial.println('R');
delay(2000);
Serial.println('l');
delay(2000);
}
```

```
int x ;
int IN1=2;
int IN2=4;
int ENA=3;

int IN3=5;
int IN4=7;
int ENB=6;
int Speed=200;
```

```
void setup() {
 pinMode (IN1, OUTPUT);
  pinMode (IN2, OUTPUT);
  pinMode (ENA, OUTPUT);
  pinMode (IN3, OUTPUT);
  pinMode (IN4, OUTPUT);
  pinMode (ENB, OUTPUT);
  Serial.begin(9600);
 }
void loop() {
 x=Serial.read();
 if (x== 'F') {
   forward();
  }
if (x== 'B') {
  backward();
 }
 if (x=='R') {
   right();   }
}
void right(){
  analogWrite (ENA, Speed);
  analogWrite (ENB, Speed);
  digitalWrite (IN1, 1);
  digitalWrite (IN2, 0);
  digitalWrite (IN3, 1);
  digitalWrite (IN4, 0);   }
```

```
void forward(){
  analogWrite (ENA, Speed);
  analogWrite (ENB, Speed);
  digitalWrite (IN1, 0);
  digitalWrite (IN2, 1);
  digitalWrite (IN3, 1);
  digitalWrite (IN4, 0);
}
void backward(){
 analogWrite (ENA, Speed);
  analogWrite (ENB, Speed);
  digitalWrite (IN1, 1);
  digitalWrite (IN2, 0);
  digitalWrite (IN3, 0);
  digitalWrite (IN4, 1);
}
```

See connection diagram :

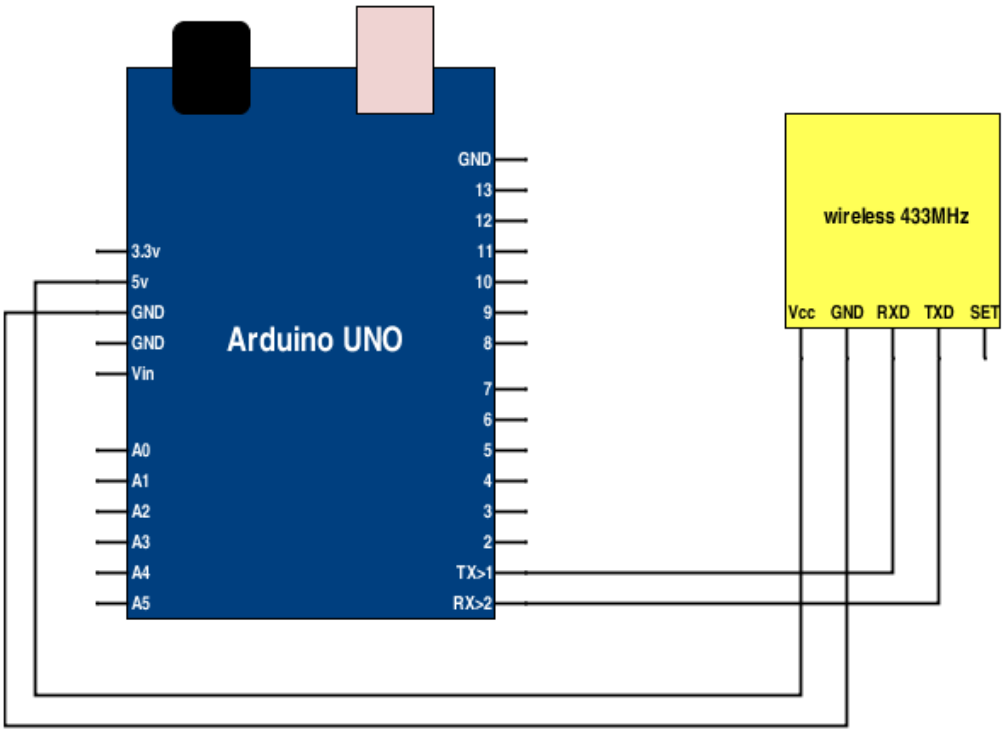


Figure : Transmitter connection diagram .

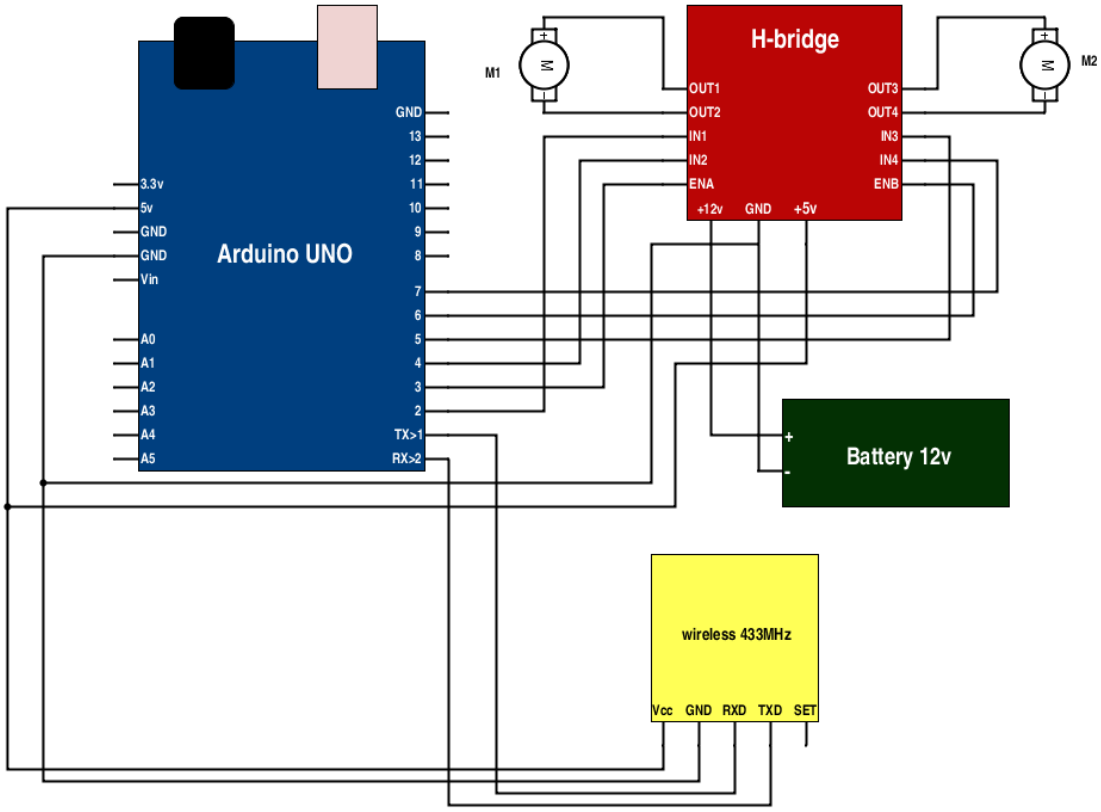


Figure : receiver connection diagram .

Obstacle avoiding robot (ultrasonic sensor) :

In this project we will build a robot its mission is obstacle avoiding depending on distance which measured by using three ultrasonic sensors .

** we define Ultrasonic sensor in chapter (4).

**See Ultrasonic connection diagram in figure 4-8.

In this experiment we need :

1-four wheel robot .
2-dual H-bridge to drive the motors .
3-arduino uno.
4- three ultrasonic .
5- three ultrasonic holder .
6-wires .
7-battery 12v .

Now let`s move to the code :

```
#include <Ultrasonic.h>

int IN1=3;

int IN2=4;

int ENA=10;


int IN3=5;

int IN4=6;

int ENB=11;

int Speed=255;

int sens1,sens2,sens3;

Ultrasonic ultrasonic1(2,7);

Ultrasonic ultrasonic2(8,9);

Ultrasonic ultrasonic3(13,12);
```

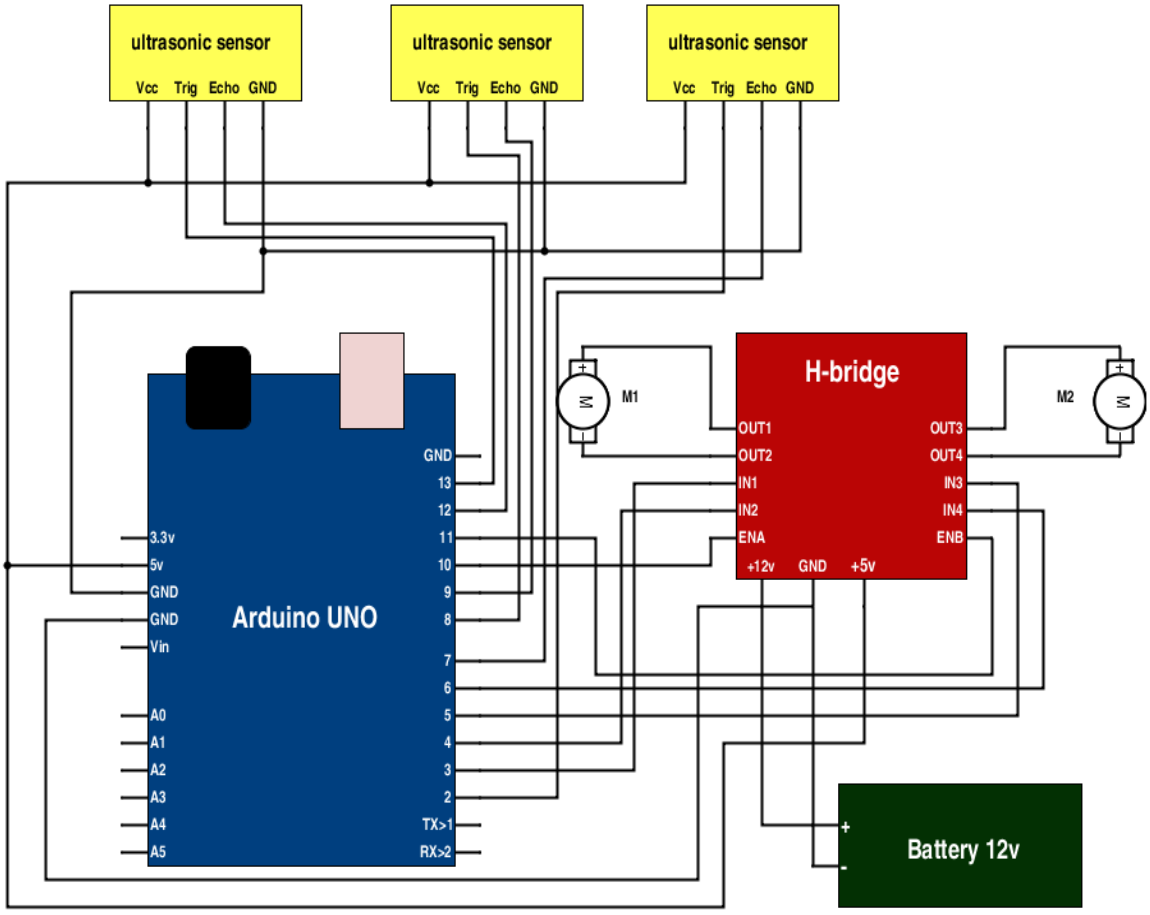
```
void setup() {
   pinMode (IN1, OUTPUT);
  pinMode (IN2, OUTPUT);
  pinMode (ENA, OUTPUT);
  pinMode (IN3, OUTPUT);
  pinMode (IN4, OUTPUT);
  pinMode (ENB, OUTPUT);
  Serial.begin(9600);
}
void loop()
{
  sens1=ultrasonic1.Ranging(CM);
  sens2=ultrasonic2.Ranging(CM);
  sens3=ultrasonic3.Ranging(CM);
  if ((sens1<25)&& (sens2<25)&& (sens3<25)){
  left();}
  if ((sens1>25)&& (sens2>25)&& (sens3>25)){
    forward();}
}
void left(){
  analogWrite (ENA, Speed);
  analogWrite (ENB, Speed);
  digitalWrite (IN1, 0);
  digitalWrite (IN2, 1);
  digitalWrite (IN3, 0);
  digitalWrite (IN4, 1);
}
```

```
void right(){
  analogWrite (ENA, Speed);
  analogWrite (ENB, Speed);
  digitalWrite (IN1, 1);
  digitalWrite (IN2, 0);
  digitalWrite (IN3, 1);
  digitalWrite (IN4, 0);   }
void Stop(){
 analogWrite (ENA, 0);
  analogWrite (ENB, 0);
  digitalWrite (IN1, 0);
  digitalWrite (IN2, 0);
  digitalWrite (IN3, 0);
  digitalWrite (IN4, 0);    }
void forward(){
  analogWrite (ENA, Speed);
  analogWrite (ENB, Speed);
  digitalWrite (IN1, 0);
  digitalWrite (IN2, 1);
  digitalWrite (IN3, 1);
  digitalWrite (IN4, 0);  }
void backward(){
 analogWrite (ENA, Speed);
  analogWrite (ENB, Speed);
  digitalWrite (IN1, 1);
  digitalWrite (IN2, 0);
  digitalWrite (IN3, 0);
  digitalWrite (IN4, 1);   }
```

See connection diagram :

See connection diagram :

Figure : obstacle avoiding robot connection diagram .



Line follower robot :

we will build a robot its mission is line follower ; which follows a specific path depending on its color to arrive to its goal by using three TCRT500 sensor .

TCRT5000 sensor is ideal to use for a line follower robot.

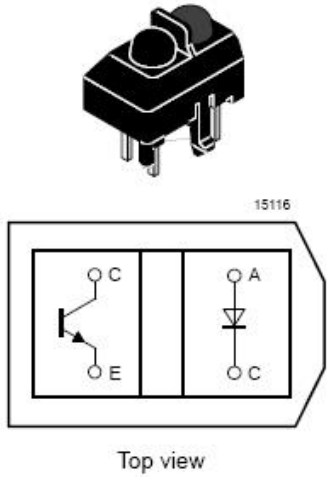


Figure : TCRT5000 sensor .

Typical use with Arduino uses a 220 ohm resistor from +5V to the LED (A to Resistor and C to Gnd), and a 10K resistor from Gnd to E of the Phototransistor and C of the Phototransistor to +5V. The Phototransistor E connection then goes to an Arduino digital input. A "High" = 1 on the Arduino means an object is close to the sensor and reflecting infrared light.

In this experiment we need :

1-four wheel robot.
2-dual H-bridge to drive the motors .
3-arduino .
4-wires .
5-battery 12v .

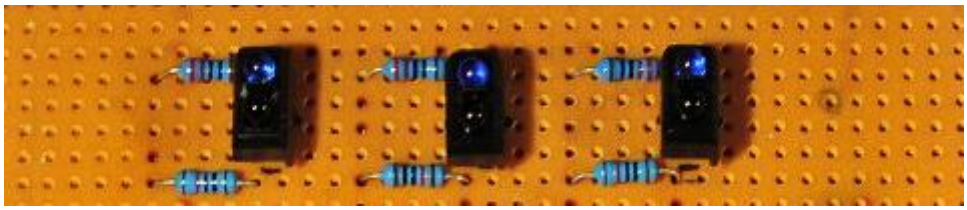
6- three TCRT5000 sensor .

7- three 220 ohm resistance .

8- three 10k ohm resistance .

9- strip board .

See connection diagram :



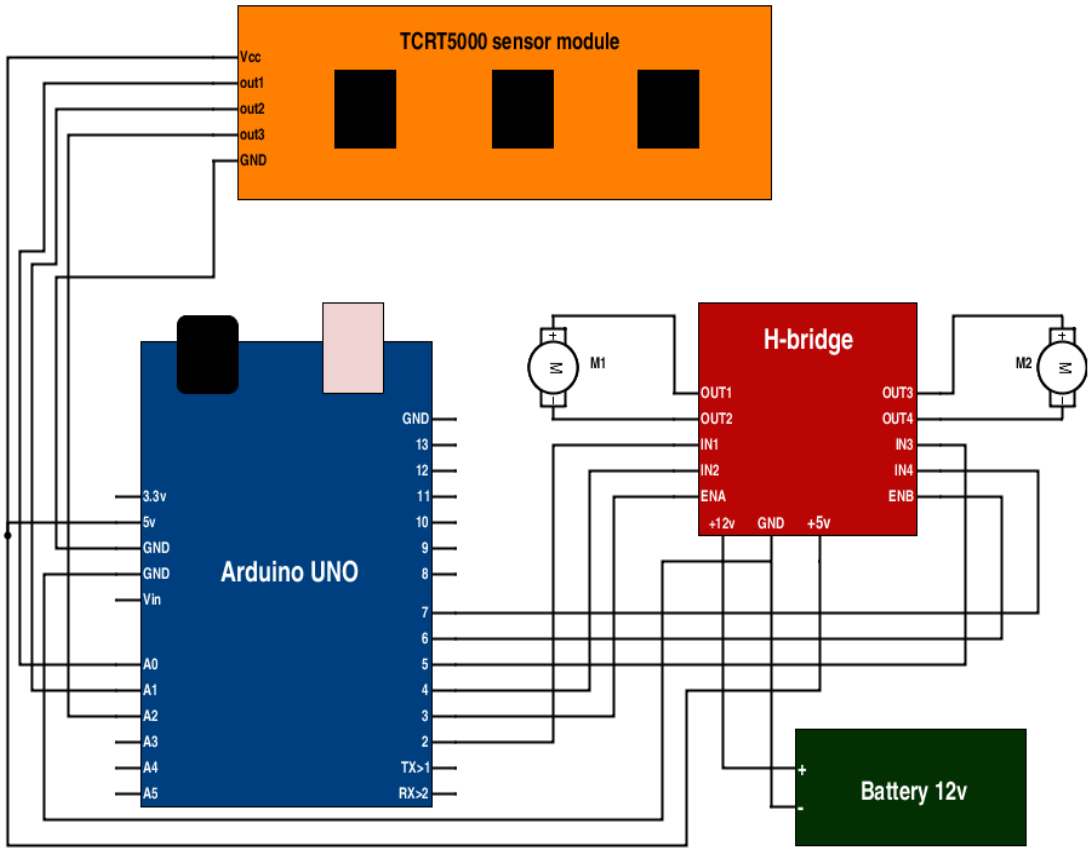


Figure : line follower robot connection diagram.

Now let`s move to the code :

```
int ENA=3;
int IN1=2;
int IN2=4;

int ENB=6;
int IN3=5;
int IN4=7;

int Lsens_pin=13;
int Rsens_pin=12;



int Lsens=0;
int Rsens=0;



void setup ()
{
  pinMode(ENA,OUTPUT);
  pinMode(IN1,OUTPUT);
  pinMode(IN2,OUTPUT);
  pinMode(IN3,OUTPUT);
  pinMode(IN4,OUTPUT);
  pinMode(ENB,OUTPUT);
}
```

```
void loop(){

sensor();

 if ((Lsens==1)&&(Rsens==1)){
   forward();
 }

 if ((Lsens==0)&&(Rsens==1)){
   left();
 }

 if ((Lsens==1)&&(Rsens==0)){
   right();
 }

}
void sensor(){
  Lsens=analogRead(Lsens_pin);
  Rsens=analogRead(Rsens_pin);
}
```

```
void forward(){
 analogWrite(ENA,255);
 analogWrite(ENB,255);
 digitalWrite(IN1,1);
 digitalWrite(IN2,0);
 digitalWrite(IN3,1);
 digitalWrite(IN4,0);
}
void left(){
  analogWrite(ENA,255);
 analogWrite(ENB,255);
 digitalWrite(IN1,1);
 digitalWrite(IN2,0);
 digitalWrite(IN3,0);
 digitalWrite(IN4,1);
}
void right(){
  analogWrite(ENA,255);
 analogWrite(ENB,255);
 digitalWrite(IN1,0);
 digitalWrite(IN2,1);
 digitalWrite(IN3,1);
 digitalWrite(IN4,0);
}
```

Fire Fighting robot :

we will learn building a robot its mission is firefighting depending on analog reading from 5-channel flame detector module .

A 5 channel flame detector module used to detect flame in larger area(>120 degree) It detects the fire with 5 flame sensors which are arranged with 30 degrees. This module outputs analog signal, which would be more precisely, and also digital signal which would be more easy to use.

Figure : five channel flame detector module .

In this experiment we need :

1-four wheel robot.
2-dual H-bridge to drive the motors .
3-arduino .
4-wires .
5-battery 12v .

6- five channel flame detector module .

See connection diagram :

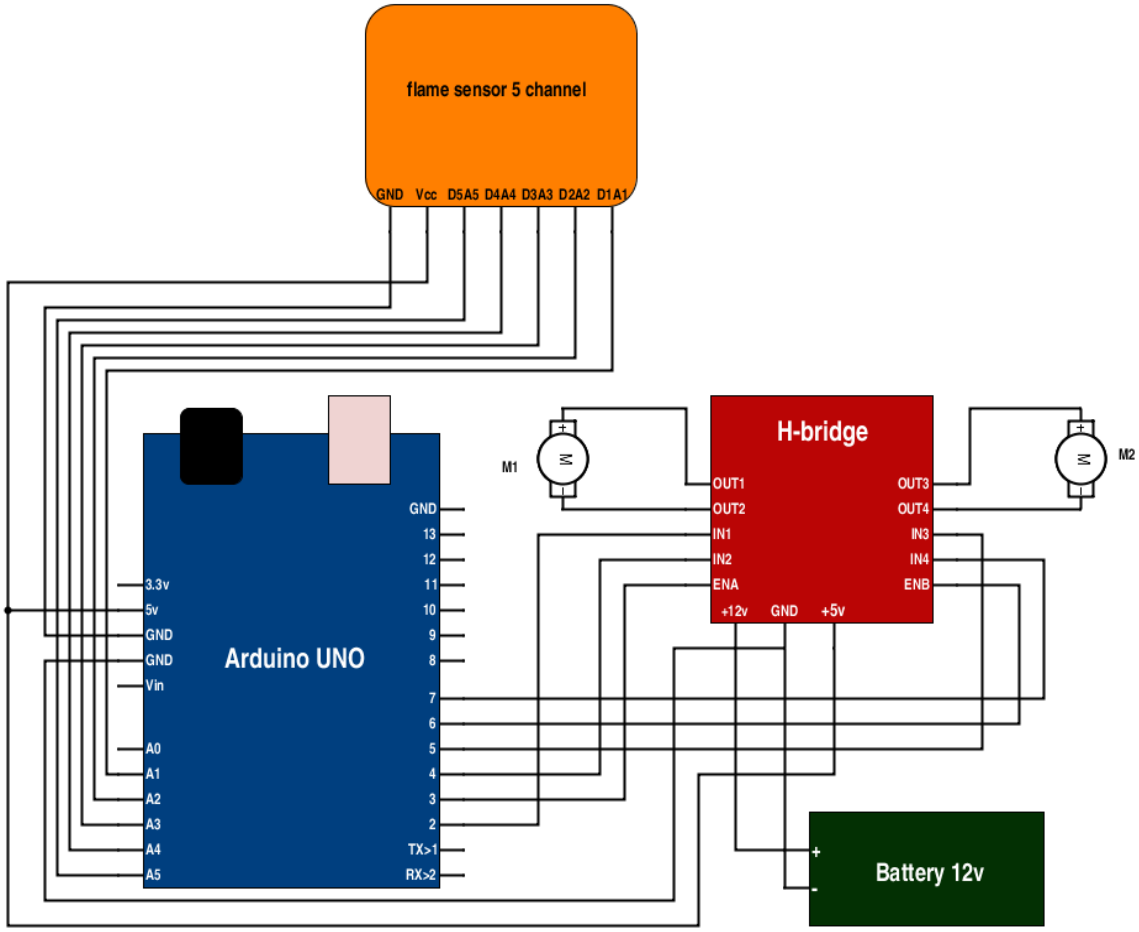


Figure : fire fighting robot connection diagram.

Now let`s move to the code :

```
int ENA=3;

int IN1=4;

int IN2=5;


int ENB=6;

int IN3=7;

int IN4=8;
```

```
int senl=A0;
int senr=A4;
int senm=A2;

int lsen=0;
int rsen=0;
int msen=0;

void setup ()
{

  pinMode(ENA,OUTPUT);
  pinMode(IN1,OUTPUT);
  pinMode(IN2,OUTPUT);
  pinMode(IN3,OUTPUT);
  pinMode(IN4,OUTPUT);
  pinMode(ENB,OUTPUT);
}
void loop(){

sensor();

    if (lsen>rsen & lsen>msen){//fire on left of the robot
       left(); }
    if (rsen>msen & rsen>lsen){//fire on right of the robot
       right(); }
    if (msen>rsen & msen>lsen & msen<1003){//fire in front of the robot
       forward(); }
```

```
 if (msen>1003){ //fire is too close
      Stop(); }
   if (lsen<300 &msen<300 & rsen<300){ //fire is behind the robot
      right(); }


}
void sensor(){
 lsen=analogRead(senl);
 msen=analogRead(senm);
 rsen=analogRead(senr);


}
void forward(){
 analogWrite(ENA,255);
 analogWrite(ENB,255);
 digitalWrite(IN1,1);
 digitalWrite(IN2,0);
 digitalWrite(IN3,1);
 digitalWrite(IN4,0);
}
void backward(){
 analogWrite(ENA,255);
 analogWrite(ENB,255);
 digitalWrite(IN1,0);
 digitalWrite(IN2,1);
 digitalWrite(IN3,0);
 digitalWrite(IN4,1);
}
```

```
void Stop(){
 analogWrite(ENA,0);
 analogWrite(ENB,0);
 digitalWrite(IN1,0);
 digitalWrite(IN2,0);
 digitalWrite(IN3,0);
 digitalWrite(IN4,0);
}
void left(){
 analogWrite(ENA,255);
 analogWrite(ENB,255);
 digitalWrite(IN1,1);
 digitalWrite(IN2,0);
 digitalWrite(IN3,0);
 digitalWrite(IN4,1);
}
void right(){
 analogWrite(ENA,255);
 analogWrite(ENB,255);
 digitalWrite(IN1,0);
 digitalWrite(IN2,1);
 digitalWrite(IN3,1);
 digitalWrite(IN4,0);
}
```

Smart parking project :

In this project we will learn building a smart parking robot which follows a specific path using two ir sensor and measuring distance by using three ultrasonic sensor to take the right place in the parking

In this project you will need :

1. Arduino Uno .
2. Three Ultrasonic sensor .
3. Two IR sensor module .
4. Four wheeled robot kit .
5. Battery 12v.
6. Wires .

See connection diagram :

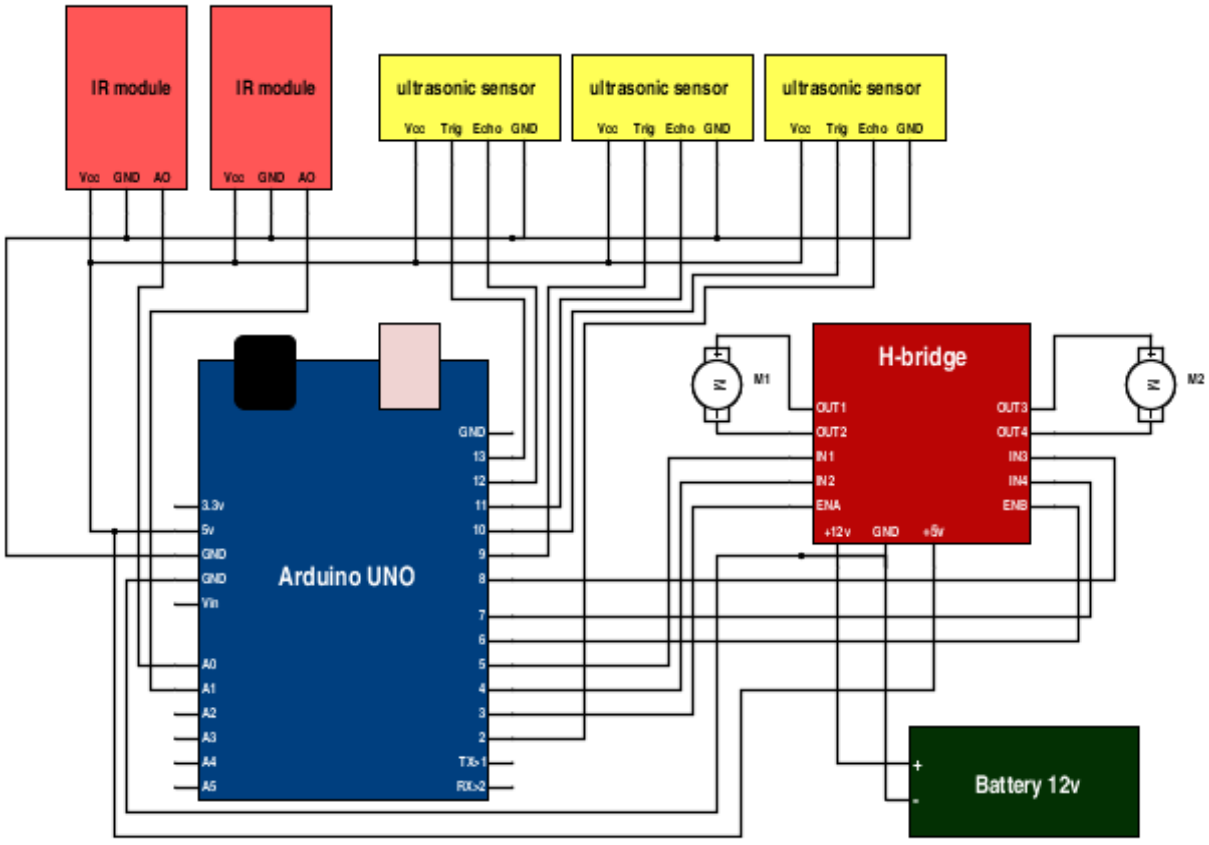


Figure : smart parking project connection diagram .

Now let`s move to the code :

```
#include <Ultrasonic.h>

Ultrasonic front(13,12);

Ultrasonic mid(9,11);

Ultrasonic back(10,2);

int IN1=5;

int IN2=4;

int ENA=3;

int IN3=8;

int IN4=7;

int ENB=6;


int x,y,z;

int right2;

int left2;

int mid2;

int speed2=85;

int run=0;

void setup() {

  Serial.begin(9600);

  pinMode (IN1, OUTPUT);

  pinMode (IN2, OUTPUT);

  pinMode (ENA, OUTPUT);

  pinMode (IN3, OUTPUT);

  pinMode (IN4, OUTPUT);

  pinMode (ENB, OUTPUT);

}
```

```
void loop()
{
  sense();
  if ((x<10) && (y>20) && (z>20)){
    Stop();
    delay(1000);
    right();
    delay(350);
    backward();
    delay(350);
    left();
    delay(350);
    forward();
    delay(200);
    run=10;
    Stop();
  }
  while (run==10){
    Stop();  }
   if ((right2>700) && (left2>700)){
   forward(); }
  if ((right2<300)&&(left2>700)) {
    left(); }
  if ((right2>700)&&(left2<300)) {
    right();
  }
}
```

```
void sense(){
  x=front.Ranging(CM);
  y=mid.Ranging(CM);
  z=back.Ranging(CM);
  right2=analogRead(A0);
  mid2=analogRead(A1);
  left2=analogRead(A2);
}
void backward(){
  analogWrite (ENA, speed2);
  analogWrite (ENB, speed2);
  digitalWrite (IN1, 0);
  digitalWrite (IN2, 1);
  digitalWrite (IN3, 0);
  digitalWrite (IN4, 1);
}
void forward(){
  analogWrite (ENA, speed2);
  analogWrite (ENB, speed2);
  digitalWrite (IN1, 1);
  digitalWrite (IN2, 0);
  digitalWrite (IN3, 1);
  digitalWrite (IN4, 0);
}
void Stop(){
  analogWrite (ENA, 0);
  analogWrite (ENB,0);
  digitalWrite (IN1, 0);
```

```
  digitalWrite (IN2, 0);
  digitalWrite (IN3, 0);
  digitalWrite (IN4, 0);
}
void left(){
  analogWrite (ENA, speed2);
  analogWrite (ENB, speed2);
  digitalWrite (IN1, 0);
  digitalWrite (IN2, 1);
  digitalWrite (IN3, 1);
  digitalWrite (IN4, 0);
}
void right(){
  analogWrite (ENA, speed2);
  analogWrite (ENB, speed2);
  digitalWrite (IN1, 1);
  digitalWrite (IN2, 0);
  digitalWrite (IN3, 0);
  digitalWrite (IN4, 1);
}
```

Gloves project :

In this project we will learn building a Robotic hand controlled by gloves wirelessly , which allow to you to control robotic hand like human hand by using flex sensors and wireless in gloves which you wear in your hand .

X-bee module :

x-bee module is wireless module with 2.4 GHz for worldwide deployment

and Fast 250 kbps RF data rate to the end node .

Figure : X-Bee .

In this project you will need :

1. Two Arduino Uno .
2. Five Flex sensor
3. Five 47k ohm resistance .
4. Two X-bee .
5. Five servo motor .
6. Strip board .
7. Voltage regulator .
8. Battery 12v.
9. Soldering iron .
10. Solder wires .
11. Wires .

See connection diagram :

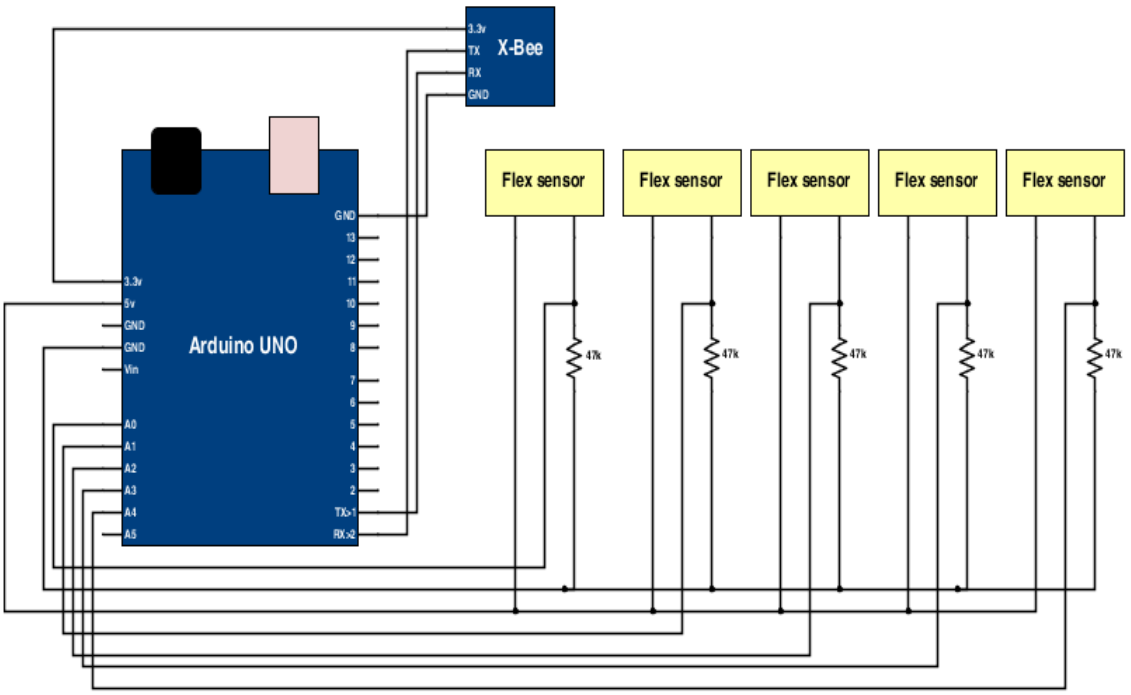


Figure : Gloves project / Transmitter side .

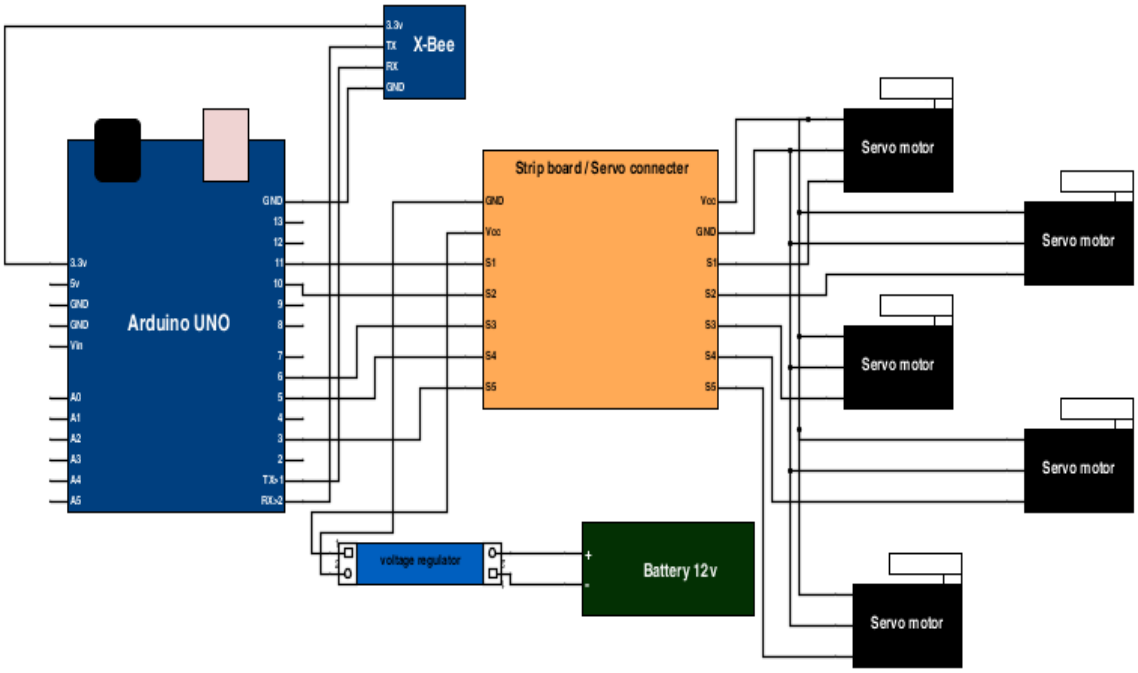


Figure : Gloves project / Receiver side .

Now let`s move to the code :

Transmitter code :

```
int val1,val2,val3,val4,val5;

void setup() {

Serial.begin(9600);

}

void loop() {

val1 = analogRead(0);

val2 = analogRead(1);

val3=  analogRead(2);

val4=  analogRead(3);

val5=  analogRead(4);


val1=map(val1,700,960,0,180);

val2=map(val2,700,960,0,180);

val3=map(val3,700,960,0,180);

val4=map(val4,700,960,0,180);

val5=map(val5,700,960,0,180);


Serial.write(">");


Serial.write(val1);

Serial.write(val2);

Serial.write(val3);

Serial.write(val4);

Serial.write(val5);

delay(30);

}
```

Receiver code :

```
#include<Servo.h>
byte start;
int val1,val2,val3,val4,val5;
Servo thumb;
Servo index;
Servo middle;
Servo annular;
Servo pinky;
void setup() {
  Serial.begin(9600);   }
void loop()  {
 if (Serial.available()) {
  start=Serial.read();
  if (start=='>') {
   val1=Serial.read();
   val2=Serial.read();
   val3=Serial.read();
   val4=Serial.read();
   val5=Serial.read();  }
delay(30);    }
  thumb.write(val1);
 index.write(val2);
 middle.write(val3);
 annular.write(val4);
 pinky.write(val5);
}
```