SMART CAR TUTORIAL

PRANAV DHRUV TANDON
DELHI PUBLIC SCHOOL NOIDA

Materials:

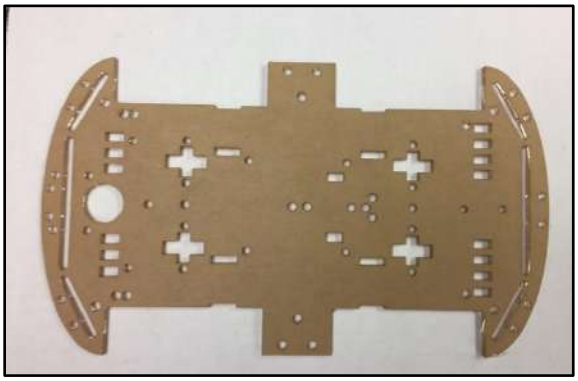

Figure 1: Clear Plexiglas Chassis Base [1]

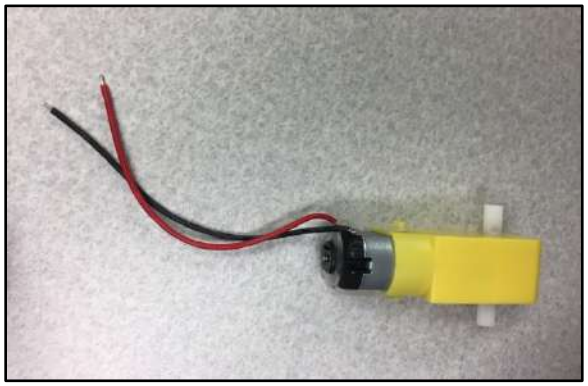

Figure 2: Drive Motors with Wires [4]

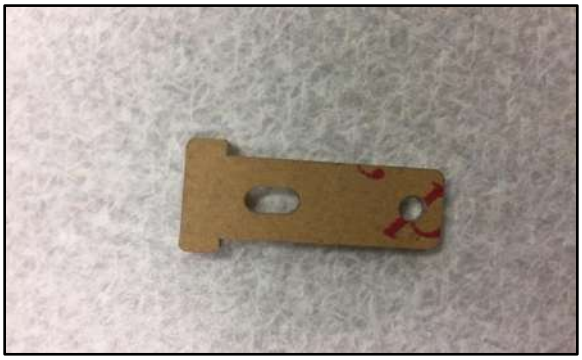

Figure 3: Clear Plexiglas Motor Mounting Brackets [8]

Figure 4: 3Mx30 Screws [8], 3M Hex Nuts [8]

Figure 5: 3Mx40 Hex Standoffs [6]

Figure 6: Wheels with Rims [4]

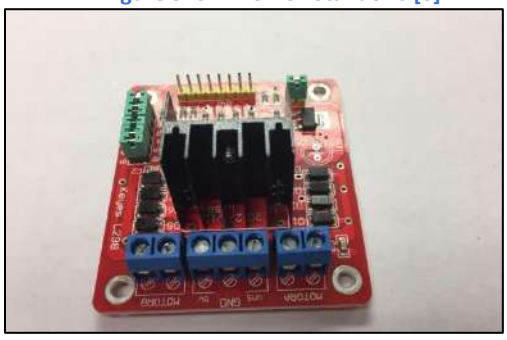

Figure 7: Motor Drive Board

Figure 8: Line Detector

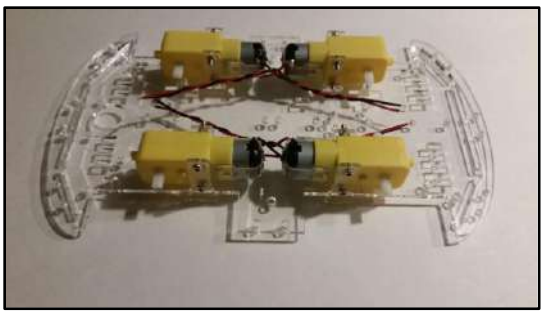

Figure 5: Smart Car Chassis Base [1]

Figure 6: Assorted Fasteners

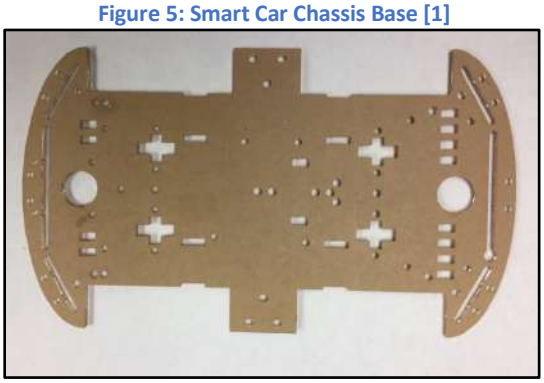

Figure 7: Plexiglas Chassis Top [1]

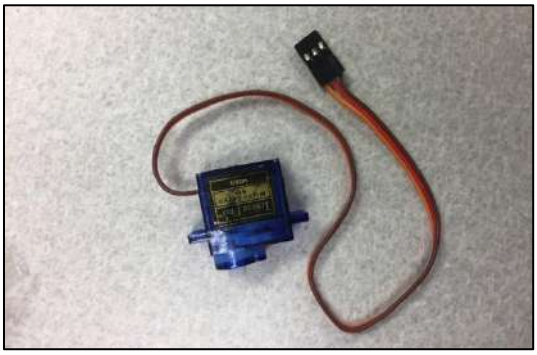

Figure 8: Servo Motor [1]

Figure 9: Ultrasonic Sensor [1]

Figure 10: Plexiglas Servo Motor Bracket [1]

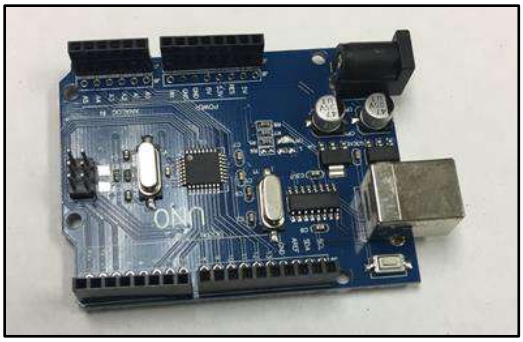

Figure 11: Arduino Uno [1]

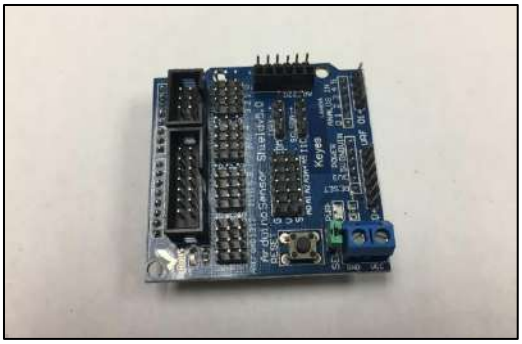

Figure 12: Arduino Sensor Shield Board [1]

Figure 13: Servo Motor Horn [1]

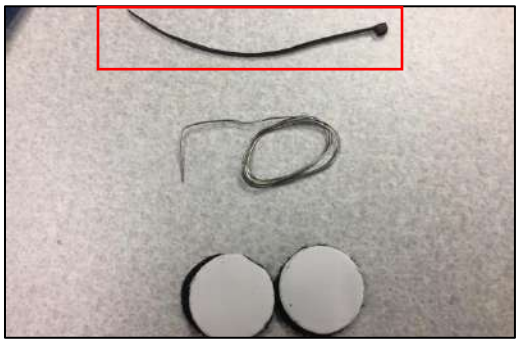

Figure 14: Zip Tie

Figure 15: USB Wire Set Up

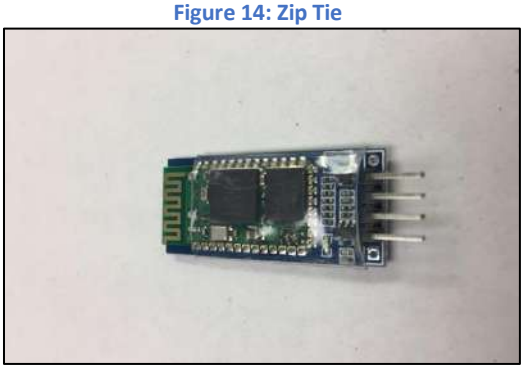

Figure 16: Bluetooth Interface

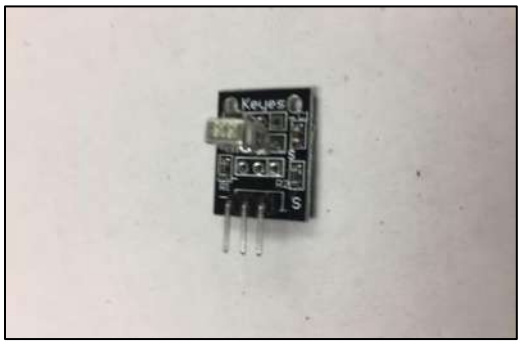

Figure 17: Infrared Sensor

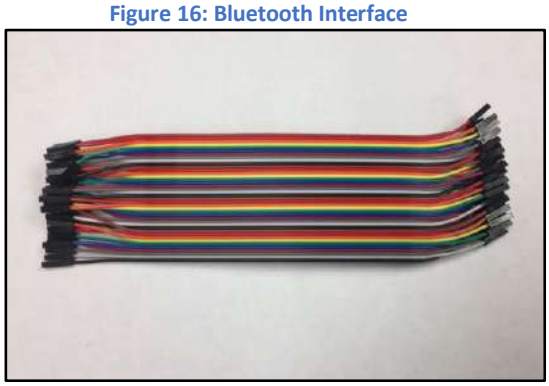

Figure 184: Jumper Cables

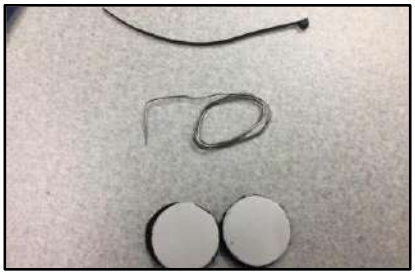

Figure 15: Velco Dots

Figure 16: Battery Pack

Part List Smart Car V1					
Item	***Description***	***Quantity***	***Item***	***Description***	***Quantity***
1	Clear Plexiglas Chassis Base	1	21	Black Nylon Screws 3Mx10	10
2	Clear Plexiglas Chassis Top	1	22	Black Nylon Hex Nuts 3M	20
3	Clear Plexiglas Motor Mounts	8	23	Black Nylon Screws 2MX10 IR	1
4	Drive Motor with Wires	4	24	Black Nylon Hex Nut 2M IR	2
5	Rims and Tires	4	25	Wire 6 inches 20 gauge	1
6	.1 uF Noise Suppression Capacitor	4	26	Zip Tie	1
7	USB Connector	2	27	Velcro Set	2
8	USB Connector Housing Bottom	2	28	Arduino Uno	1
9	USB Connector Housing Top	2	29	Motor Drive Board	1
10	3MM Hex Nuts Metal	8	30	Line Detector	1
11	3MX30 Philips Head Screws Metal	8	31	Sensor Shield Board	1
12	3MX40 Hex Standoffs Metal	6	32	IR Sensor	1
13	3MX8 Philips Head Screws Metal	12	33	Bluetooth Interface	1
14	Ultrasonic Sensor	1	34	Arduino/Computer Adapter Cable	1
15	Servo Motor Bracket	1	35	Battery Pack	1
16	Servo Motor	1	36	USB Charger Cord/Plug	1
17	Screws Metal 2MX12	4	37	IR Remote	1
18	Metal Hex Nut 2M	4	38	Red & Black DuPont Wires	2
19	Servo Motor Horn	1	39	Multicolored DuPont Wires	1
20	Metal Mounting Self-Taping Screws	2			

Method:

All protective brown paper must be peeled off the Plexiglas components.

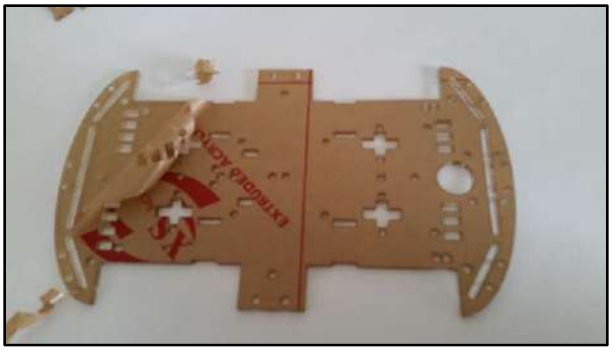

Figure 17: Peeling Coating off Plexiglas

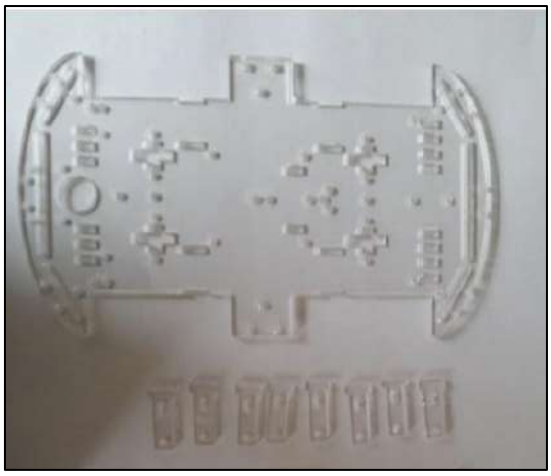

Figure 18: Parts with Coating Removed

To begin attaching motors to the chassis, first the motor wires must be twisted together. Twisting the wires together will remove future clutter in the assembly.

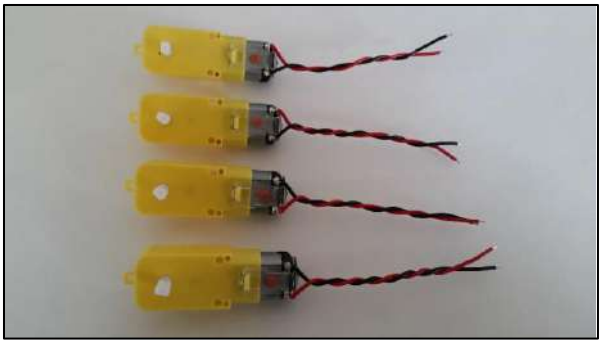

Figure 19: Motors with Wires Twisted Together

Begin aligning motors to the Plexiglas Chassis Base as shown below. Note that the wire terminals face the interior of the chassis, while the raised yellow bumps face out. Use two [2] 3Mx30 Phillips head screws

and two [2] Plexiglas Mounting Brackets to affix a motor in place. Each screw slots through one bracket, through the motor, and into the second bracket, which inserts through a slot in the Plexiglas Chassis base. Use two [2] 3M hex nuts on the interior to secure everything in place.

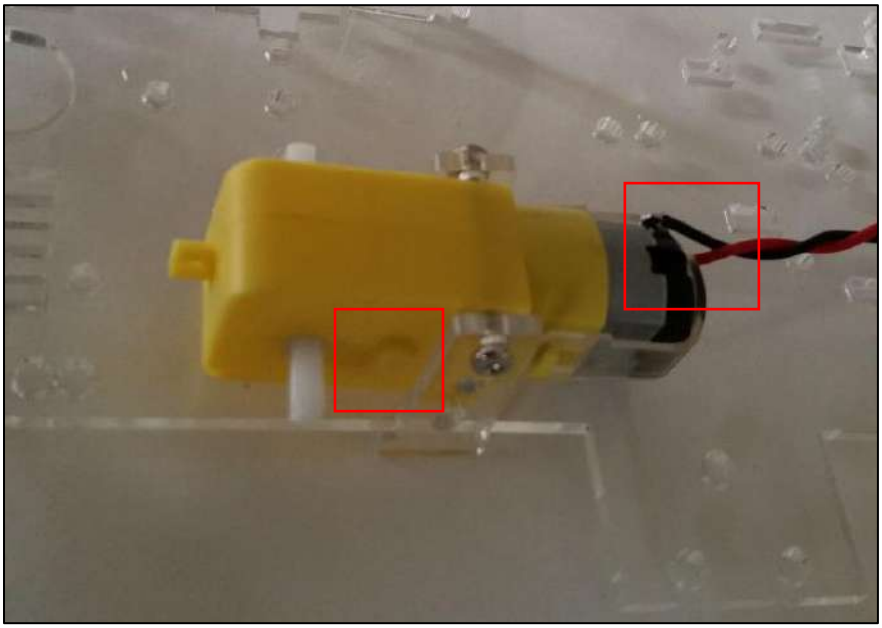

Figure 20: Motor Mounted to Plexiglas Chassis Base

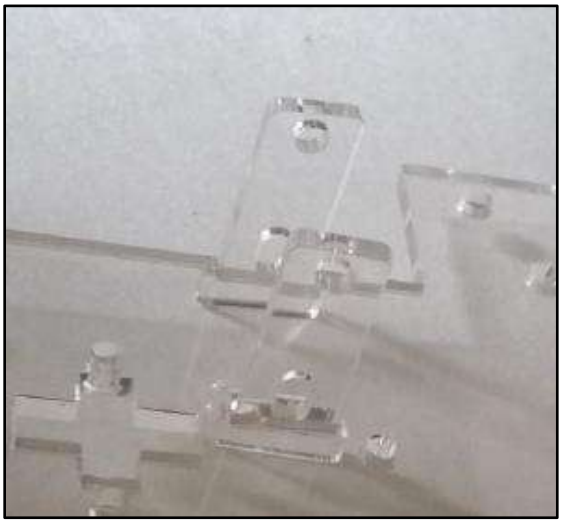

Figure 21: Clear Plexiglas Mounting Brackets Aligned without a Motor

Once all four motors have been mounted. Make sure each motor has its wires facing inwards and the plastic bump facing outwards. It is helpful to mark each motor [front left, front right, back left, back right] to help easily orient the project correctly.

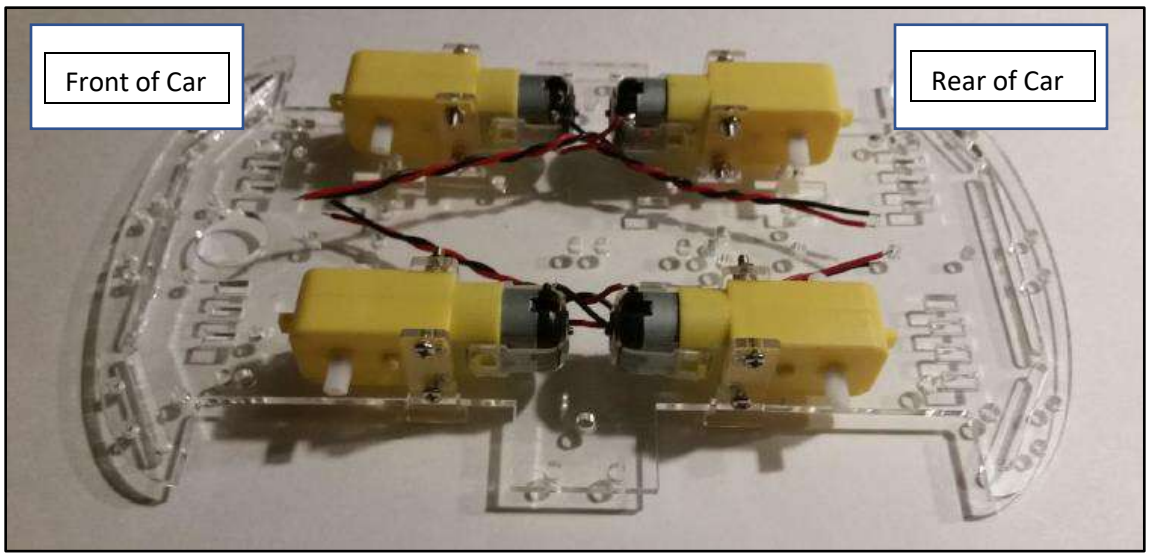

Figure 22: Chassis Base with All Four Motors Mounted

Use six [6] 3Mx8mm Phillips screws to attach the six [6] 3Mx40mm Hex Standoffs to the mounting holes.

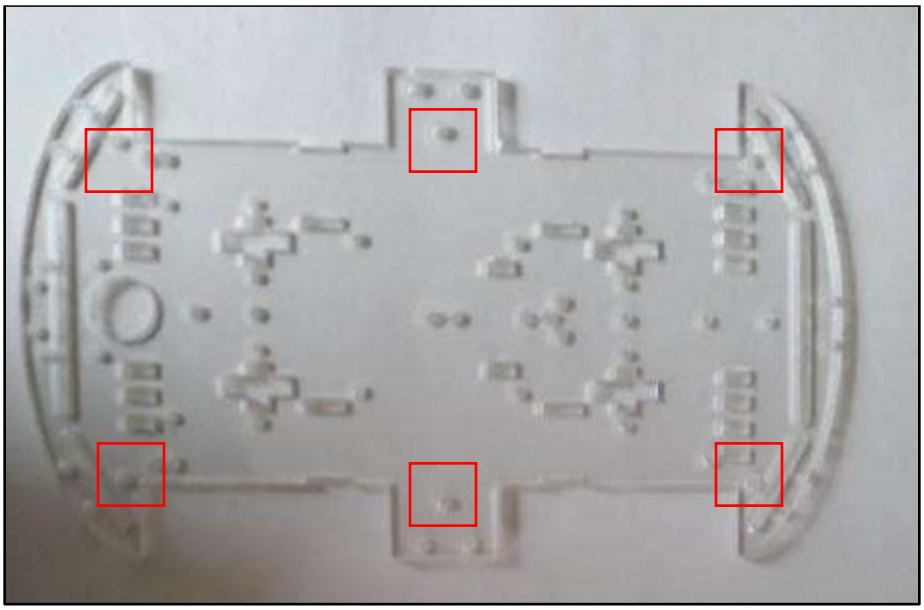

Figure 23: Location of 3Mx40 Hex Standoffs

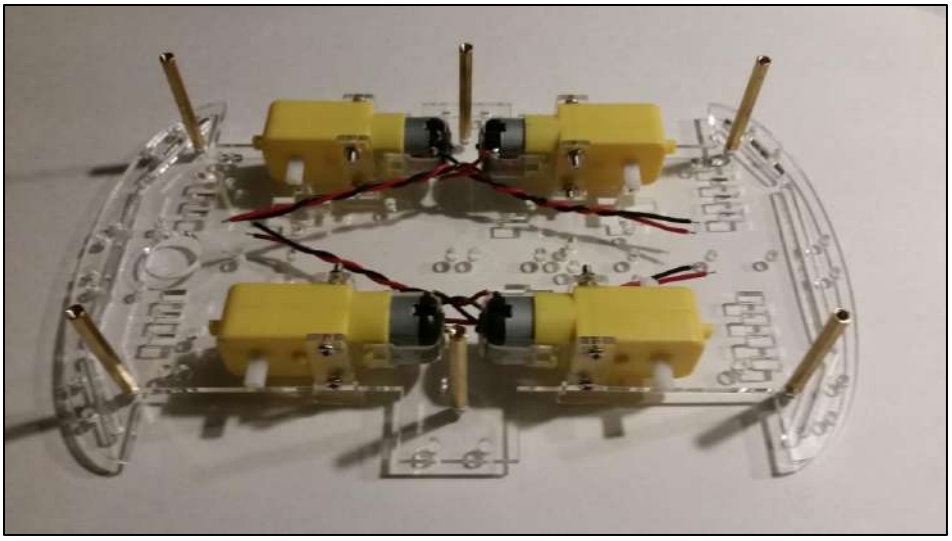

Figure 24: Chassis Base with Motors and Hex Standoffs Mounted

At this point you may attach the wheels to your chassis. Each wheel slots onto the white arm extending out of each motor.

Next we prepare to install the motor drive board. Insert four [4] 3Mx10 nylon screws up through the underside of the baseplate and secure them using four [4] 3M nylon nuts using a Phillips head screwdriver.

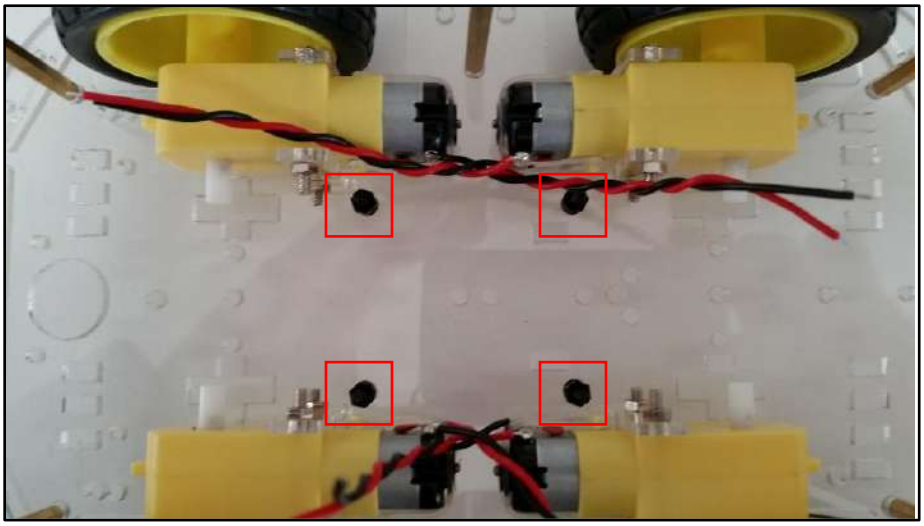

Figure 25: Chassis Base with Motor Drive Board Mounting Screws Installed

Take the Motor Drive Board and mount it on the four screws just installed. Orient the Motor Drive Board so that the screw terminals [the blue Lego-like blocks] face the front of the chassis. Remember, the front of the chassis is the end with the hole. Prior labeling of motors to help differentiate the front and back of the parts will make orientation easier.

Secure the Motor Drive Board to the chassis using four [4] nylon 3M nuts and a Phillips head screwdriver, as shown.

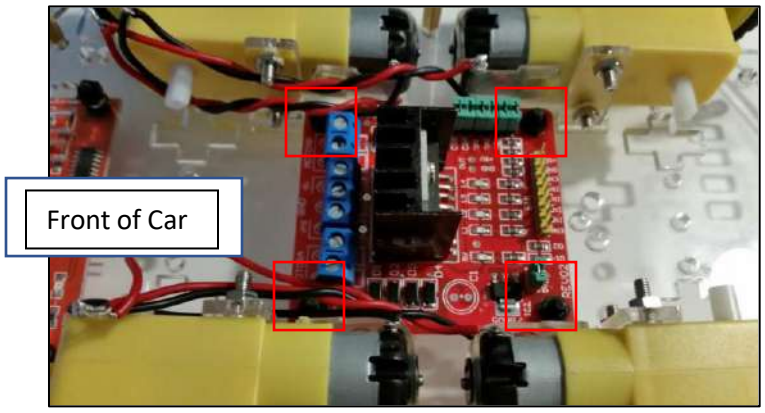

Figure 26: Motor Drive Board Mounted to Chassis Base

Now we prepare the motor wires for attachment to the Motor Drive Board. Use wire strippers to remove approximately 1 inch of insulation from each of the eight motor wires. Then twist the exposed wire together so that the top wire of the front left motor is twisted with the bottom wire of the back left motor, and vice versa. Repeat for the right side motors. Refer to figures below.

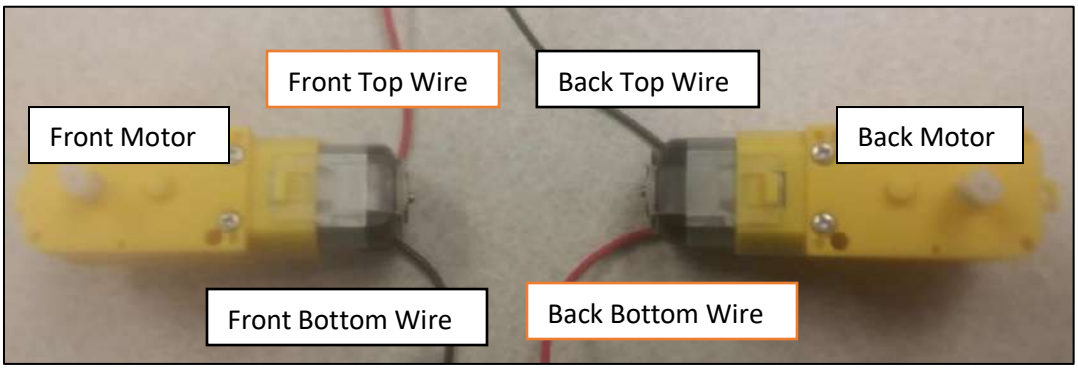

Figure 27: Motor Wiring Example Labeling

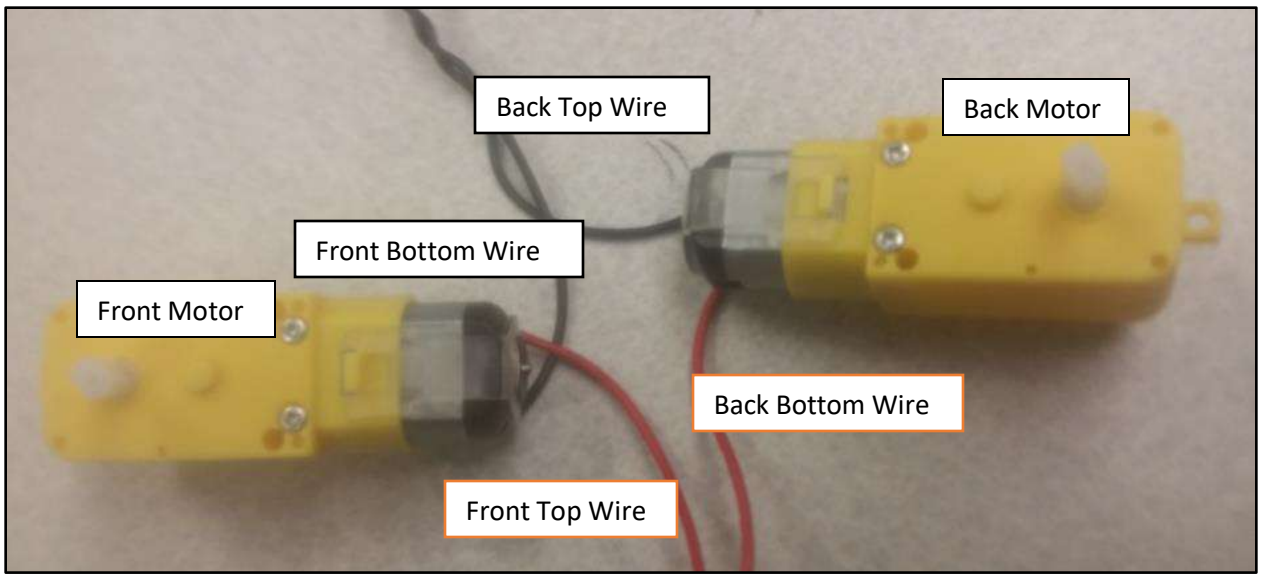

Figure 28: Motor Wiring Example Twisted

Once the four motors have their wires twisted together, they should look like figure below.

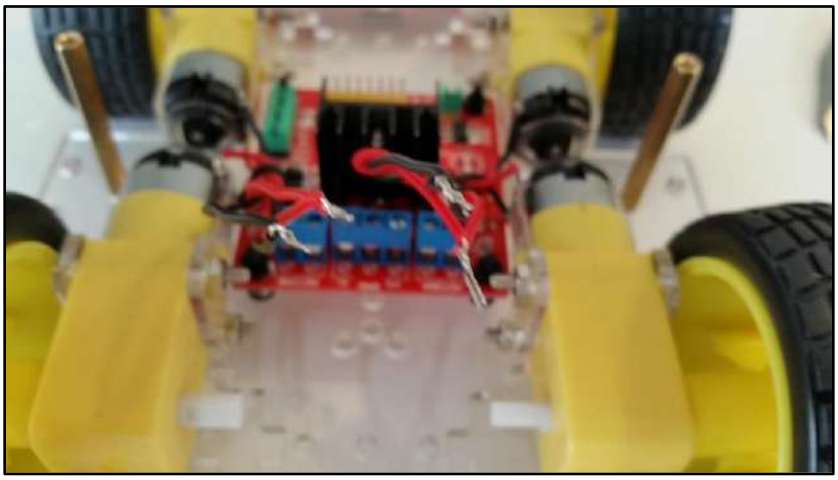

Figure 29: Motor Wires Twisted Together

It is time to connect the motor wires to the Motor Drive Board. Use a flathead screwdriver counterclockwise on the screw terminals [blue Lego-like components]. This opens the jaws of the screw terminal. Insert the corresponding wires to their screw terminal and use a flathead screwdriver clockwise to close the jaws of the screw terminal down onto the wires.

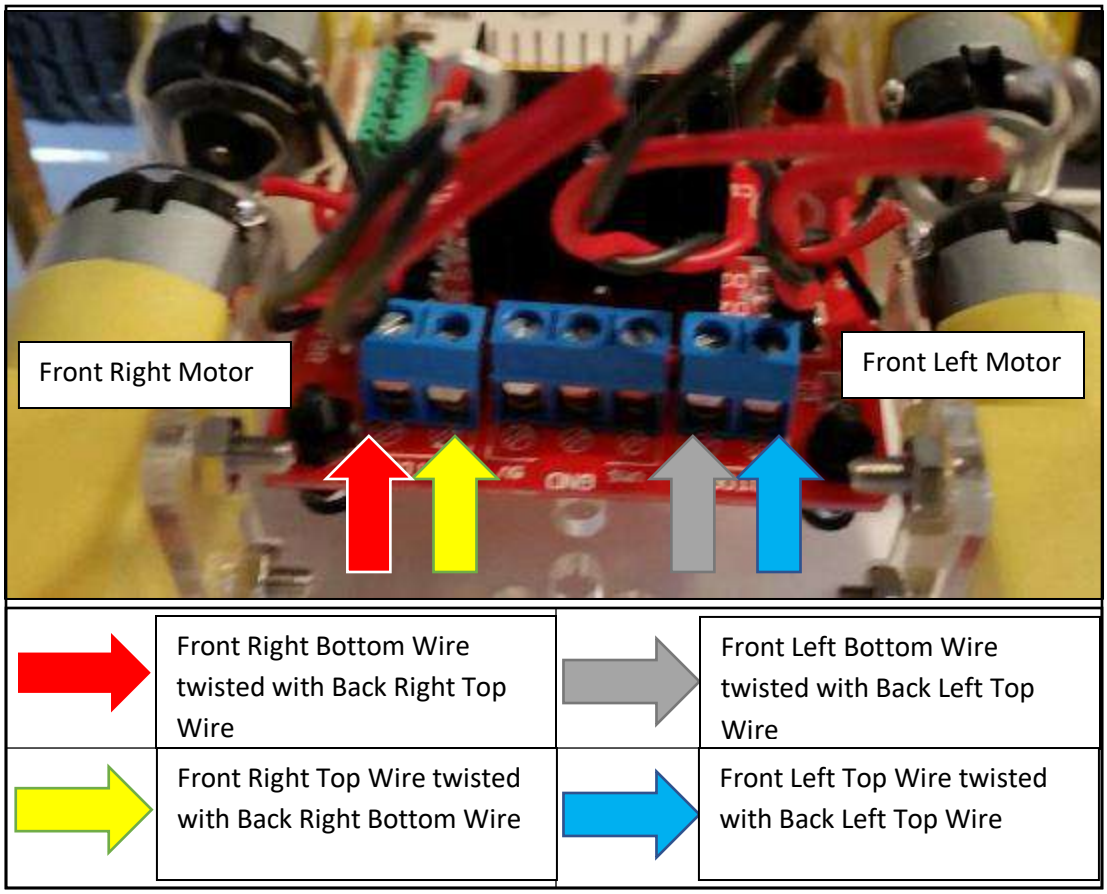

Figure 19: Motor Wire Screw Terminals Guide

Once all four sets of motor wires have been securely attached to the motor drive board's screw terminals your project should look like below.

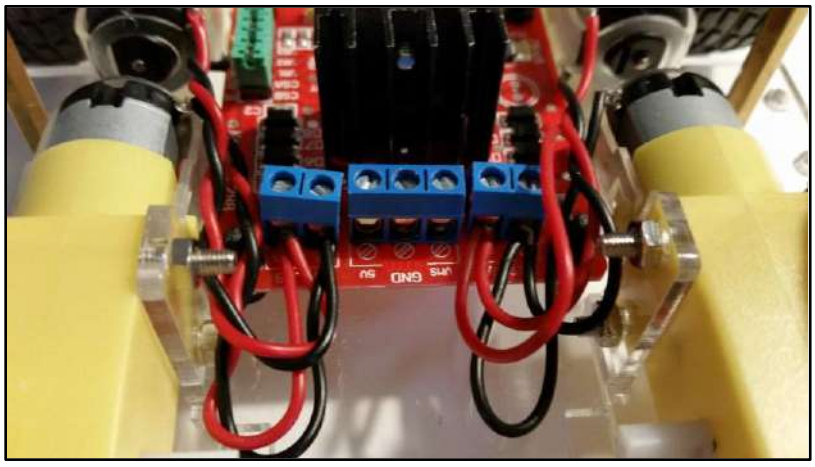

Figure 20: Motor Wires Secured to Motor Drive Board Screw Terminals

The last operation of this lesson is to attach the Line Tracking unit using remaining two [2] nylon 3Mx10 screws and four [4] nylon 3M hex nuts.

Insert the two [2] nylon 3Mx10 screws into the Line Tracking unit and secure them with two [2] nylon 3M hex nuts as shown below.

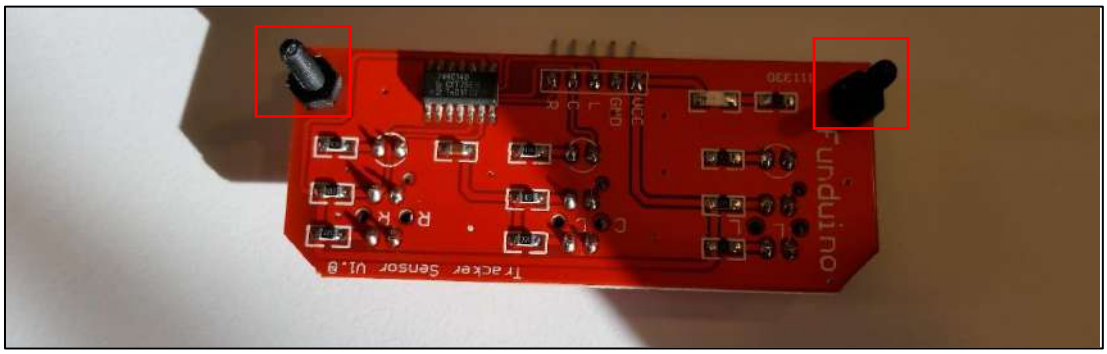

Figure 32: Line Tracking Module with Screws

Align the Line Tracking Module to the UNDERSIDE of the front of the smart car chassis base and affix it using two [2] nylon 3M hex nuts as shown below.

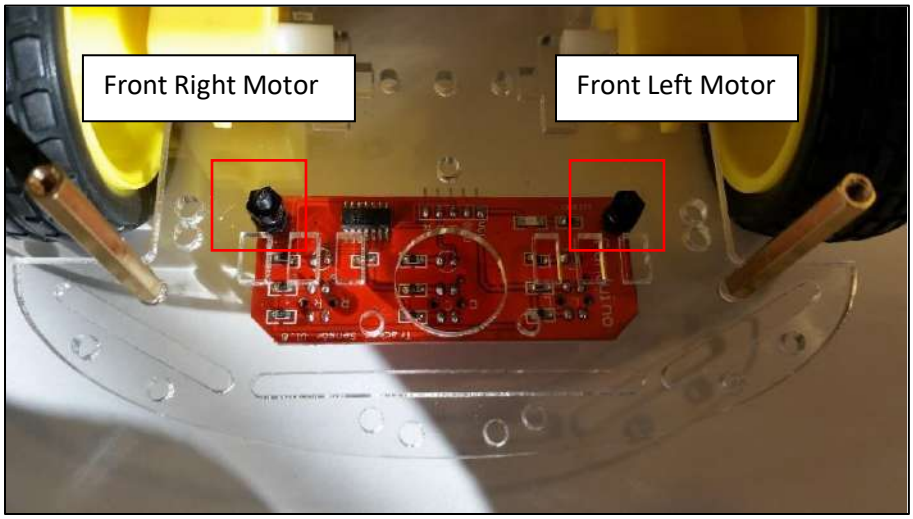

Figure 21: Line Tracking Module Attached to Smart Car Chassis Base

Identify the front end of the Chassis Top Plate by it being the side with four [4] rectangular cutouts instead of eight [8]. Notice the four [4] irregularly spaced holes in the center of the plate. The four [4] irregularly spaced holes in the center of the plate correspond to the irregularly arranged holes on the Arduino Uno as shown below.

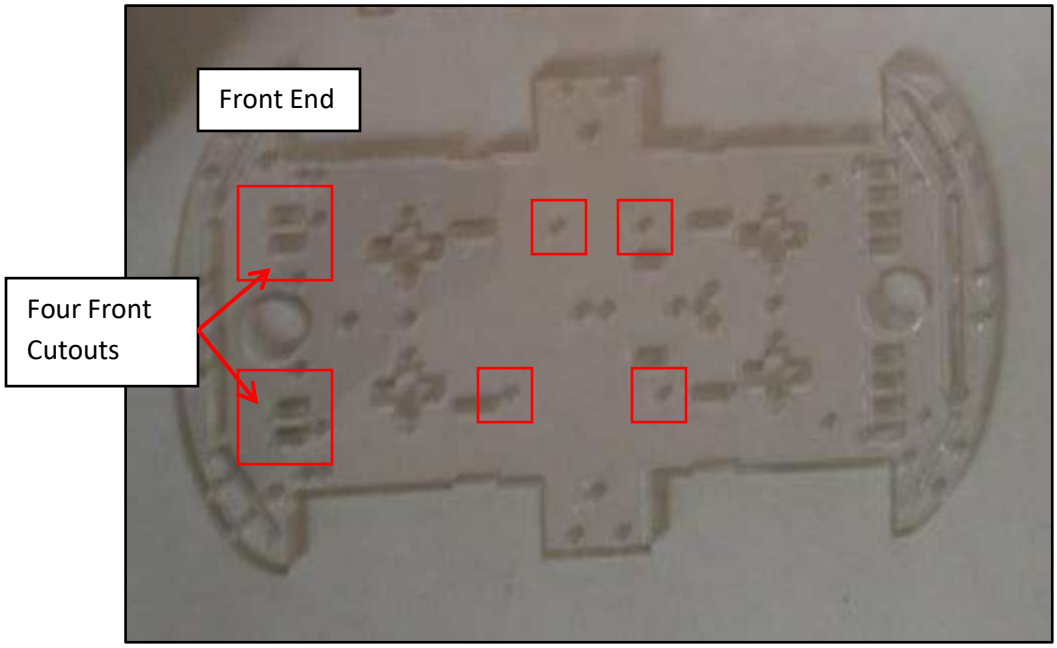

Figure 34: Chassis Top Plate with Arduino Mount Holes Marked

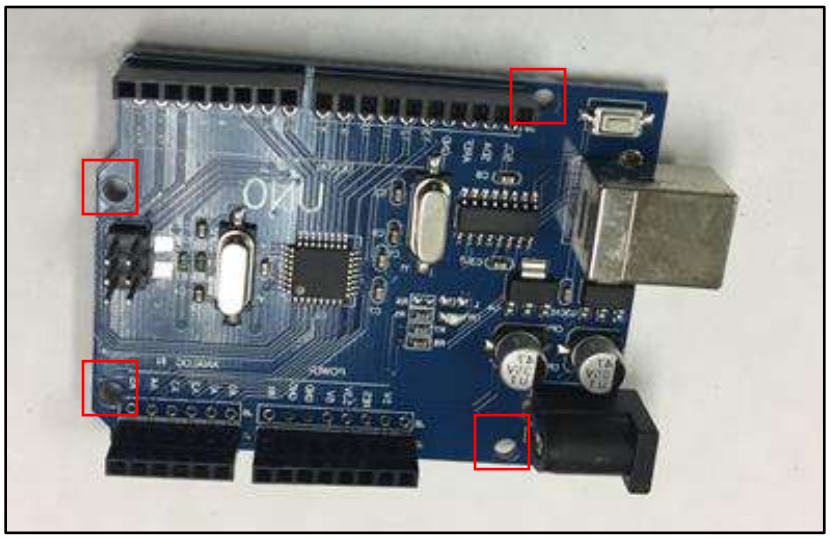

Figure 22: Arduino Uno with Mount Holes Marked

Align the Arduino Uno to the top of the Chassis Top Plate and attach it with four [4] nylon hex screws and nuts [the black plastic screws and nuts] as shown below. When attaching the Arduino Uno, it is easiest to insert the screws from underneath the Chassis Plate and up through the Arduino. Note that there is not enough room for the hex nuts to rotate on some of the attachment points. Hold the nut down on the Arduino before running the screw through the parts and use a screwdriver to twist the screw into the nut.

Figure 36: Arduino Uno Mounted to Chassis Top Plate

Once the Arduino Uno is attached to the Chassis Top, align pins coming out the bottom or the Sensor Shield with the receptors coming out the top of the Arduino Uno. Notice that both the Sensor Shield and the Arduino Uno have the same irregular silhouette, and that they should be aligned so that their silhouettes match. Once the pins have been aligned, evenly distribute pressure across the Sensor Shield so that the pins insert into the Arduino's receivers. Apply pressure until the Shield is completely seated into the Arduino, as shown below.

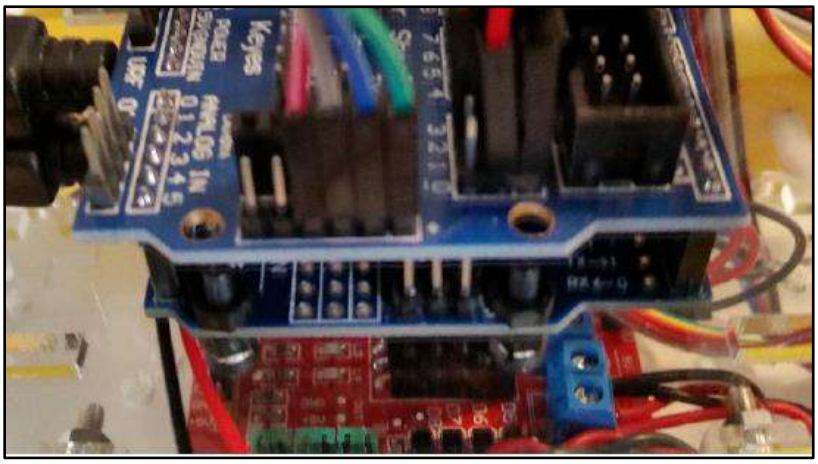

Figure 37: Arduino Sensor Shield Aligned and Mated to Arduino Uno

Take the Servo Motor and align it as shown below. Locate the two [2] small holes forward and behind the large hole in the front center of the Chassis Top Plate. Use two [2] 2Mx12 steel screws with two [2] 2Mx12 hex nuts through the small holes forward and behind the large hole in the front of the Chassis Top Plate to affix the Servo Motor.

Note the Servo Motor is mounted upside down so that the white output shaft if facing up in the direction of the Arduino Uno and Sensor Shield.

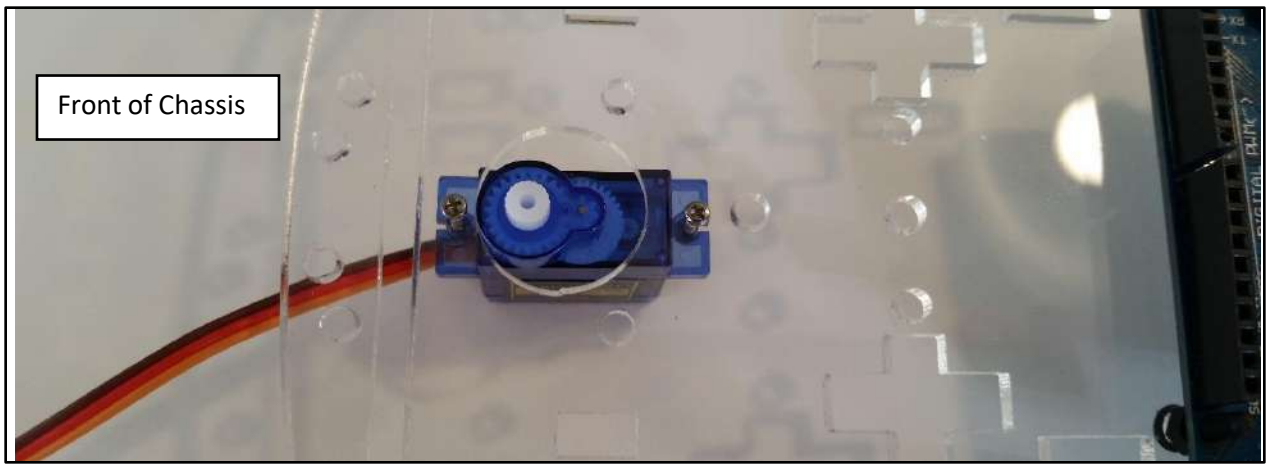

Figure 38: Servo Motor Attached to Chassis Top

Peel the protective brown paper off the Plexiglas Servo Motor Bracket. Align the white plastic Servo Horn so that the hole in the center of the servo horn lines up with the big hole in the center of the bracket. Make sure that the socket of the servo horn is flipped away from the bracket. Use the two [2] self-tapping mounting screws to affix the servo horn to the bracket as shown below. The self-tapping mounting screws should go through the fourth [4th] hole from the center on either side of the center of the servo horn. Use of a screwdriver is recommended.

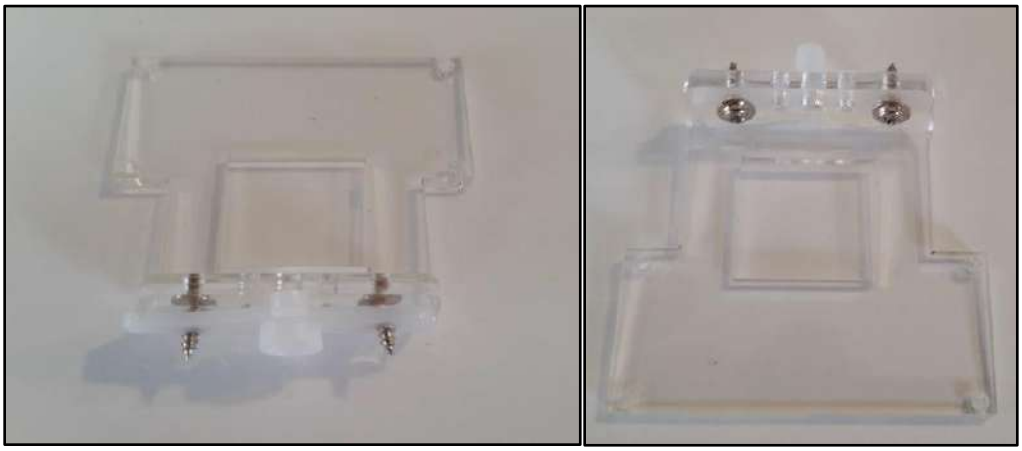

Figure 39: Servo Motor Bracket Affixed to Servo Horn

Use two [2] 2Mx12 screws and nuts to affix the Ultrasonic Sensor to the forward face of the Servo Motor Bracket as shown below. Put the screws in opposite corners for maximum stability. The Servo Horn Socket fits onto the white output shaft on the Servo Motor.

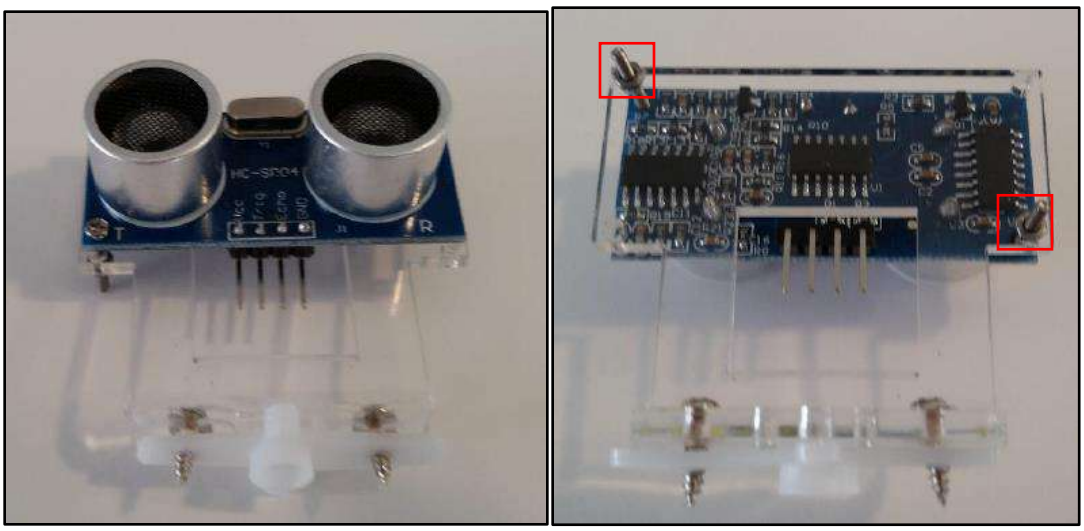

Figure 40: Ultrasonic Sensor Mounted to Servo Motor Bracket

Use one [1] black Nylon screw and two [2] nylon nuts to attack the Infrared Sensor to the front right of the Chassis Top Plate as shown below.

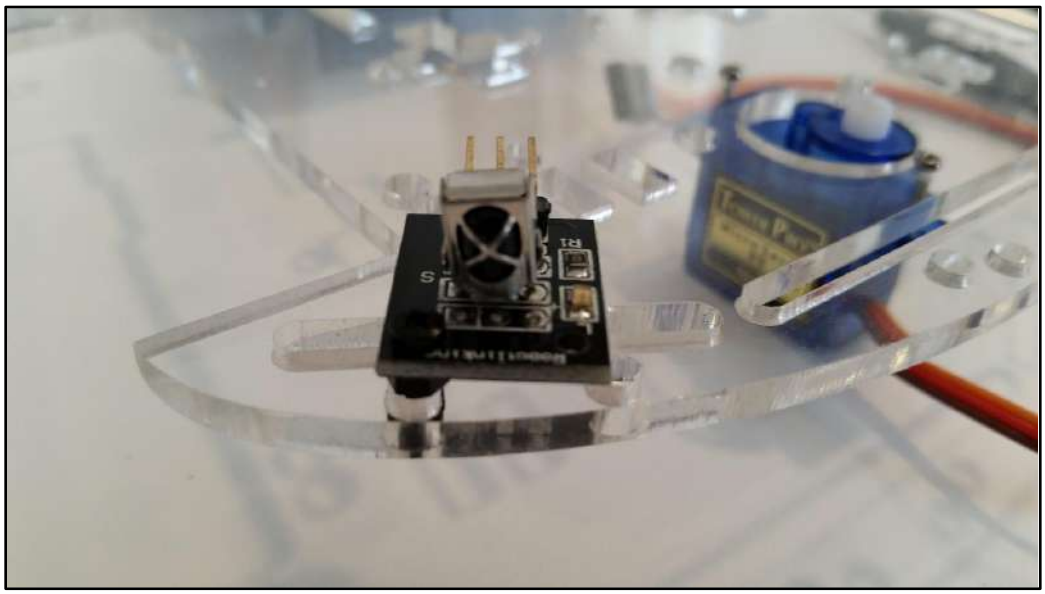

Figure 41: Infrared Sensor Mounted to Chassis Top Plate

Use the zip tie to affix the Bluetooth Module to the forward left of the Chassis Top Plate as shown in below.

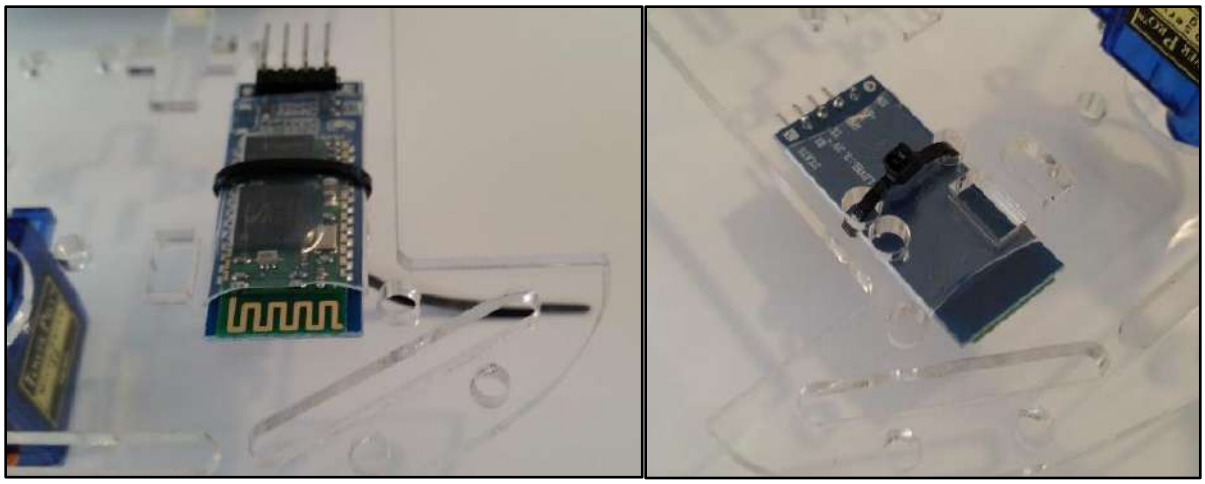

Figure 42: Bluetooth Module Zip-Tied to the Chassis Top Plate

Now it is time to assemble the two [2] USB plugs. Separate the components into two [2] piles, each containing: one [1] red male-to-female jumper wire, one [1] black male-to-female jumper wire, one [1] metal USB jack, both halves of the black insulation case. Each pile should contain the components shown below.

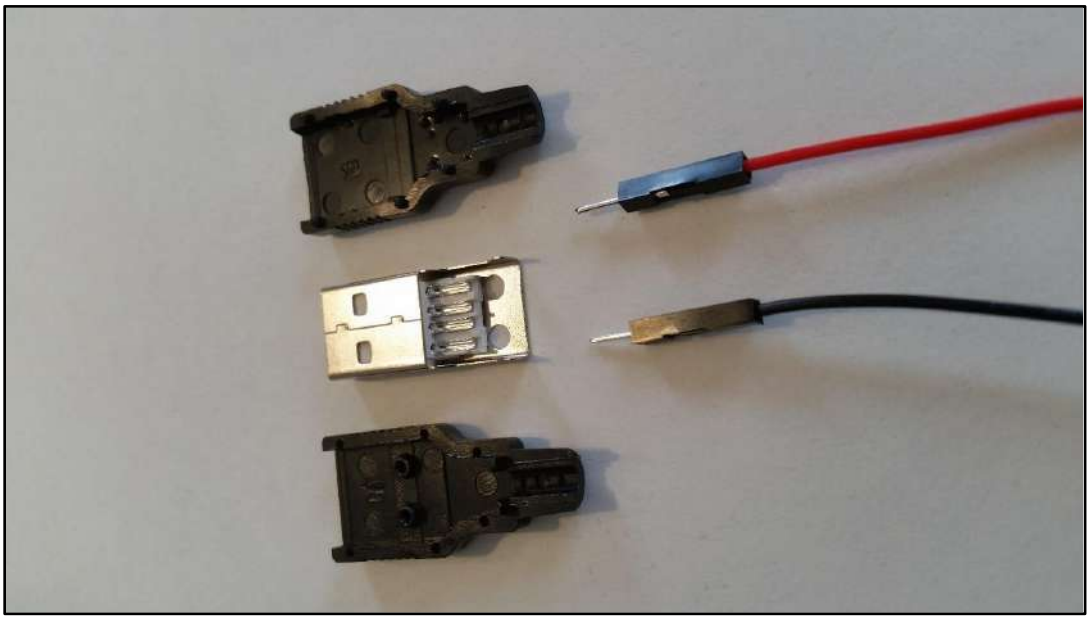

Figure 43: Components for a USB Jack

Soldier the male prong of the **red** jumper cable to the **top pin** of the USB jack. Soldier the male prong of the **black** jumper cable to the **bottom pin** of the USB jack. A completed soldering job will look like the example below. Ensure that soldier does not contact more than one [1] pin!!

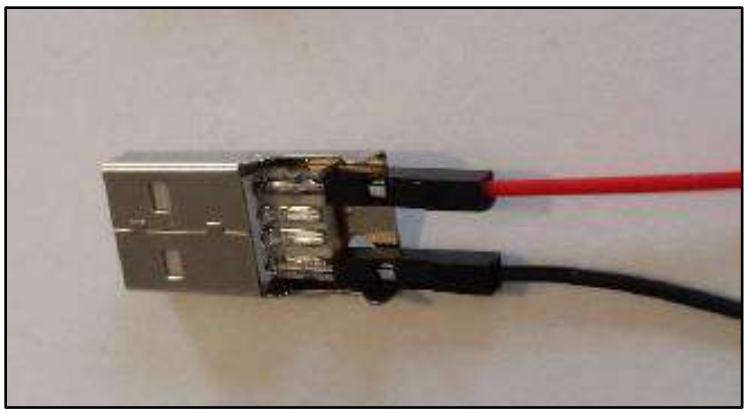

Figure 44: Soldiered USB Jack without Casing

Notice that one of the black plastic case halves has two circular pins coming out of its interior as shown in below. These pins slot into the holes in the metal USB Jack. Align the Soldiered USB Jack with this pinned case half and snap them together. You will have to flex the wires slightly to ensure that everything is fully seated.

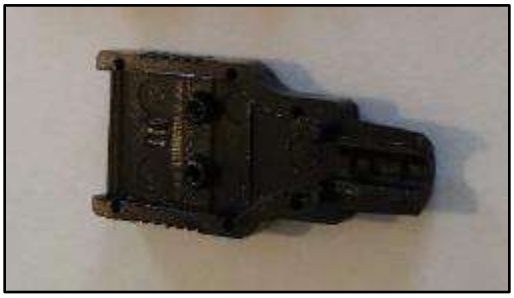

Figure 45: USB Case Half with Mounting Pins Marked

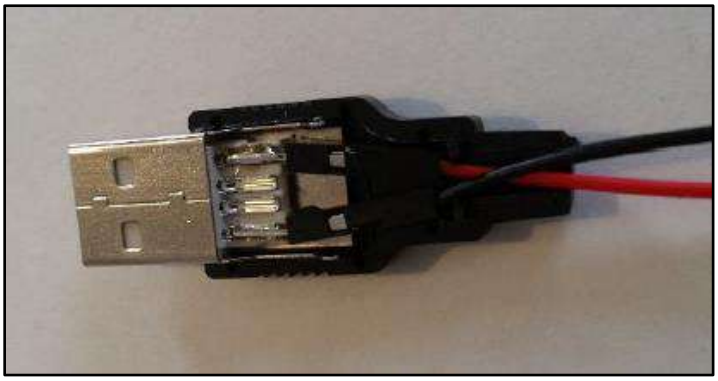

Figure 46: Soldiered USB Jack with Back Case Attached

Snap on the other half of the USB Jack case. You will hear a slight click when it is fully seated, and it should look like below. Once you have completed one [1] USB Jack, assemble the other in the exact same way.

Figure 47: Fully Assembled USB Jack

The first component to be wired is the Motor Drive Board. Take the strip of jumper cables and locate the side that sequences brown-red-orange-yellow-green. Keeping these five [5] wires attached to each other, peel them off the rest of the jumpers and slightly separate the female ends. Attach the female ends to the prongs on the Motor Drive Board as shown in Table 1.

Sub Assembly	***Pin***	***Color***
Motor Drive Board	IN1	Brown
	IN2	Red
	IN3	Orange
	IN4	Yellow
	GND	Green

Table 1: Motor Drive Board Pinout Key

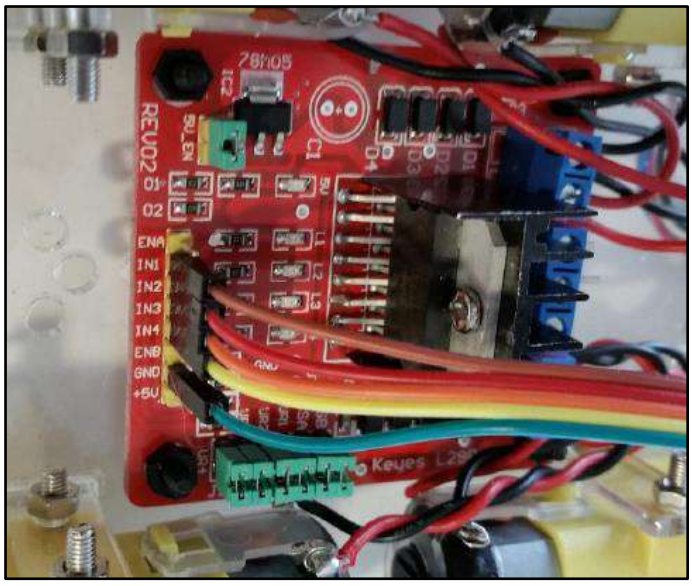

Figure 238: Motor Drive Board Pinout Picture

Going from the same side of the jumper wires, peel off the next five [5] wires [blue-purple-grey-white-black]. Locate the Line Tracker component and attach the female ends of the blue-black wires to the Line Tracker as shown in Table 2 and figure below. Note that the labels for the pins are on the side of the Line Tracker facing the Plexiglas Chassis Base.

Sub Assembly	*Pin*	*Color*
Line Tracker	VCC	Blue
	GND	Purple
	L	Grey
	C	White
	R	Black

Table 2: Line Tracker Module Pinout Key

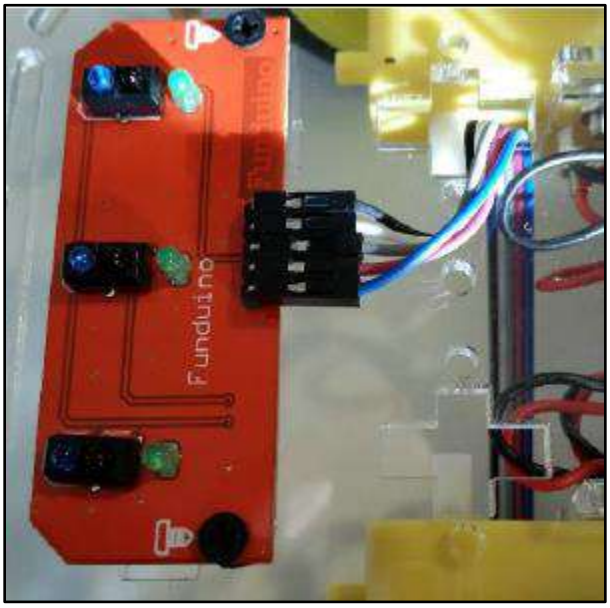

Figure 49: Line Tracker Module Pinout Picture

Route the wires of one of the USB assemblies through the top of Chassis Top. Pull the black plastic covering off the female end of the black and red leads. Using a Phillips head screwdriver, attach the USB wires to the Motor Drive Board screw terminals as shown in Table 3.

Sub Assembly	*Pin*	*Color*
Motor Drive Board Power	VMS	Red
	GND	Black

Table 3: Motor Drive Board Power Pinout Key

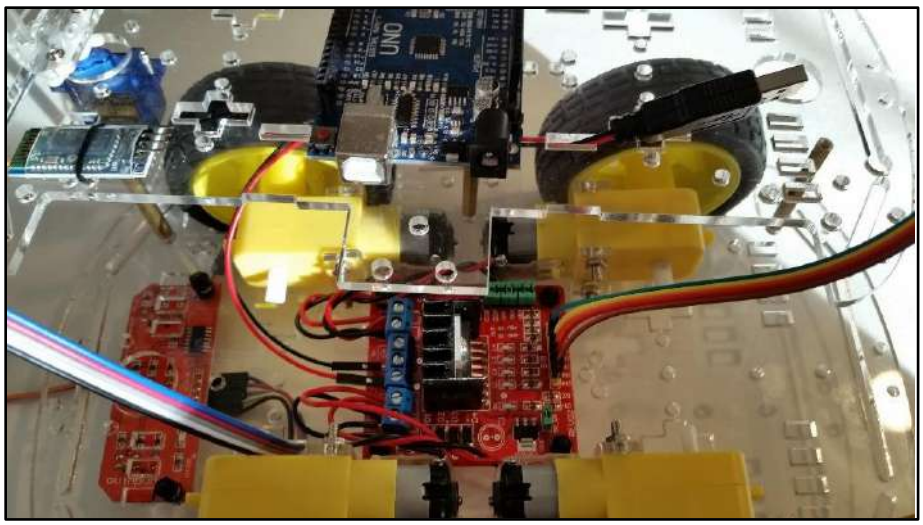

Figure 50: Motor Drive Board Power Picture

Route the Motor Drive Board wires, Line Tracker wires, and Servo wires through the plus shaped openings in the front of the Chassis Top Plate as shown below. Once all wires have been routed through, attach the top plate to the bottom with six [6] 3Mx8 screws.

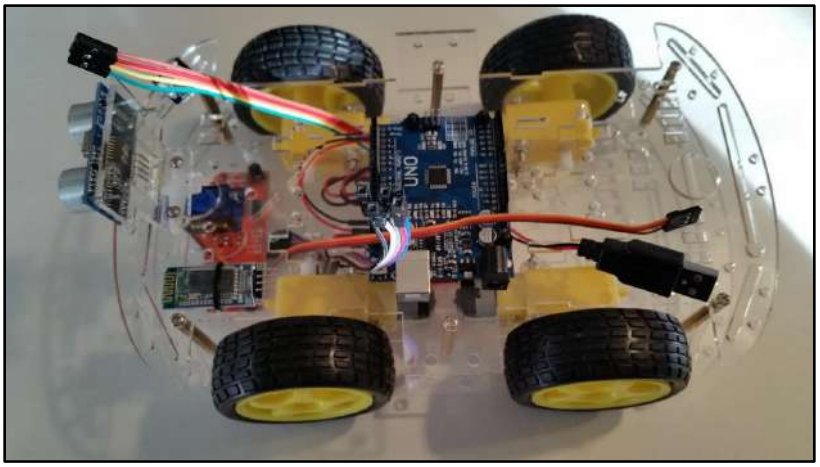

Figure 51: Top Chassis Plate Attached with Wires Routed Through

Remove the Ultrasonic Sensor from its mounting bracket. Set aside the screws and bracket for re-attachment. Separate the next four [4] wires from the jumper cables [brown-red-orange-yellow]. Attach the wires to the Ultrasonic Sensor as shown in

Sub Assembly	*Pin*	*Color*
Ultrasonic Sensor	VCC	Brown
	TRIG	Red
	ECHO	Orange
	GND	Yellow

Table 4. Once the wires are attached, route the other ends through the hole in the Ultrasonic Mounting Bracket and re-attach the Ultrasonic Sensor.

Table 4: Ultrasonic Sensor Pinout Key

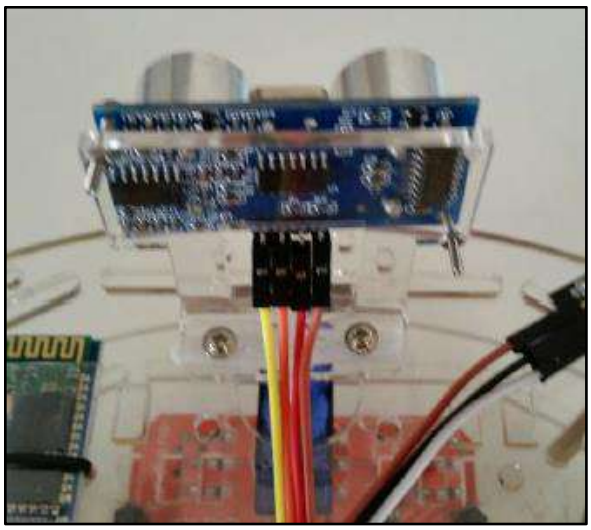

Figure 52: Ultrasonic Sensor Pinout Picture

Separate the next four [4] wires from the jumper cables [green-blue-purple-grey]. Locate the Bluetooth module on your smartcar and attach the wires as shown in Table 5 and figure below. Note that the labels for the pins are on the underside of the Bluetooth module.

Sub Assembly	***Pin***	***Color***
Bluetooth Module	+5V	Green
	GND	Blue
	Tx	Purple
	RX	Grey

Table 5: Bluetooth Module Pinout Key

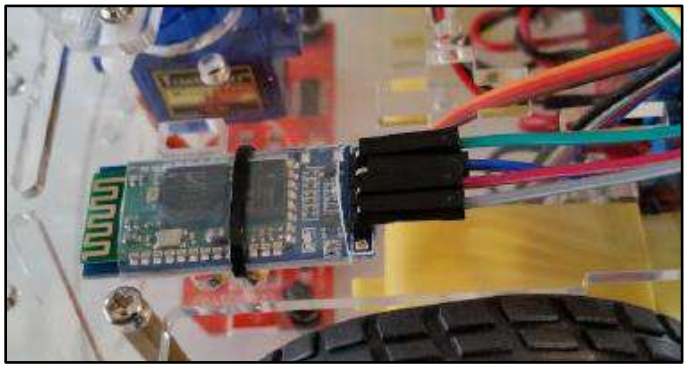

Figure 53: Bluetooth Module Pinout Picture

Separate the next three [3] wires from the jumper cables [white-black-brown]. Locate the IR Sensor and attach the three wires as shown in ASDF and ASDF below.

Sub Assembly	***Pin***	***Color***

IR Sensor	Y	White
	R	Black
	G	Brown

Table 6: IR Sensor Pinout Key

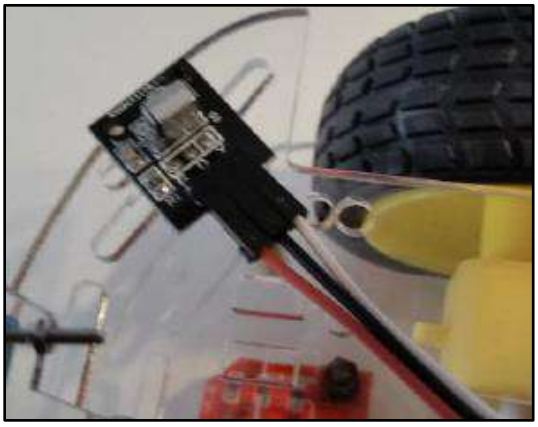

Figure 24: IR Sensor Pinout Picture

It is now time to connect the wires to the Sensor Shield Board. We will start with the Motor Drive Board. Locate the free ends of the Motor Drive Board wires and attach them to the Sensor Shield Board as shown in Table 7 and figure below. Note that the Digital Pins are arranged so that there are three [3] pins for every number: S, G, and V. It is imperative that each wire go to the correct pin.

Sub Assembly	***Pin***	***Color***	***Pin***	
Motor Drive Board	IN1	Brown	Digital 4 S	Sensor Shield
	IN2	Red	Digital 5 S	
	IN3	Orange	Digital 6 S	
	IN4	Yellow	Digital 7 S	
	GND	Green	Digital 7 G	

Table 7: Motor Drive Board to Sensor Shield Key

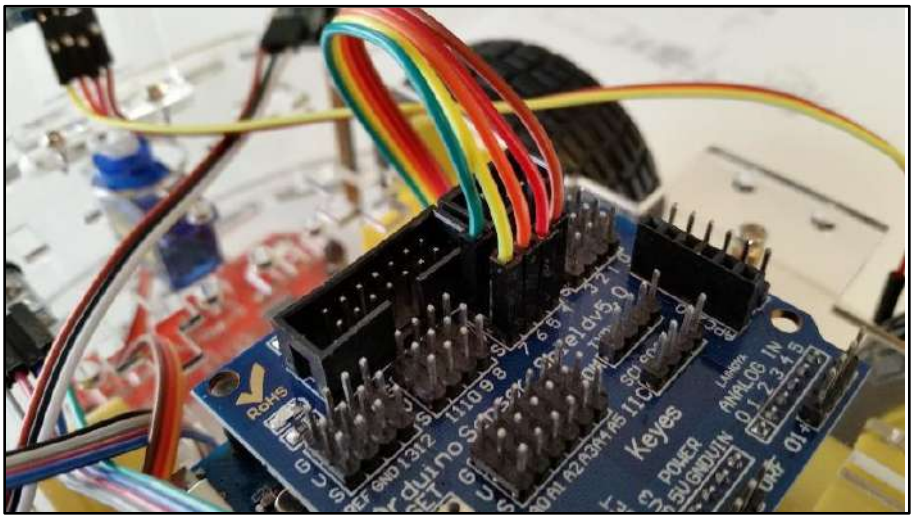

Figure 54: Motor Drive Board Wired to Sensor Shield

Locate the wires from the Line Tracker Module. Attach them to the Sensor Shield Board according to Table 8 and figure below.

Sub Assembly	*Pin*	*Color*	*Pin*	
Line Tracker	VCC	Blue	Digital 8 V	Sensor Shield
	GND	Purple	Digital 8 G	
	L	Grey	Digital 8 S	
	C	White	Digital 9 S	
	R	Black	Digital 10 S	

Table 8: Line Tracker Module to Sensor Shield Key

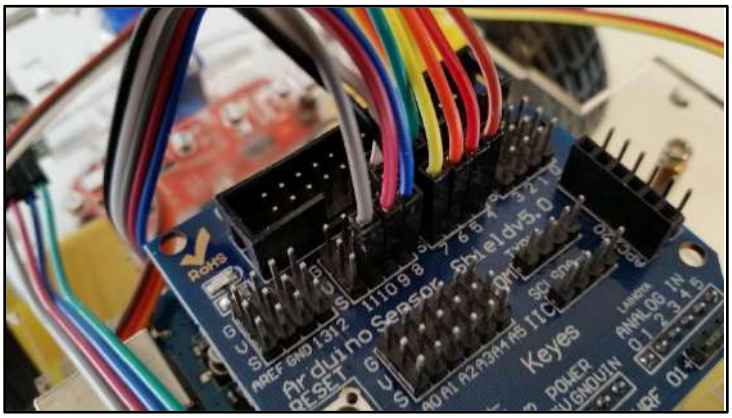

Figure 55: Line Tracker Module Wired to Sensor Shield

Locate the wires coming out of the Servo Motor. Align them and attach them to the Senor Shield as shown in Table 9 and figure below.

Sub Assembly	*Pin*	*Color*	*Pin*	
Servo Motor	GND	Brown	Digital 2 G	Sensor Shield
	VCC	Red	Digital 2 V	
	SIGNAL	Orange	Digital 2 S	

Table 9: Servo Motor to Sensor Shield Key

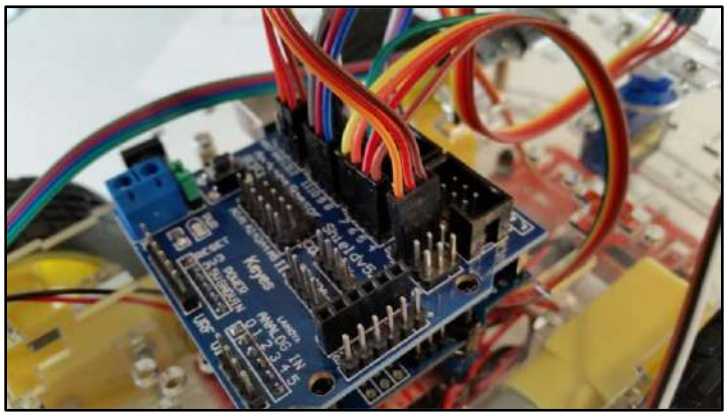

Figure 56: Servo Motor Wired to Sensor Shield

Locate the wires for the Ultrasonic Sensor and attach them to the Sensor Shield according to Table 10 and figure below.

Sub Assembly	*Pin*	*Color*	*Pin*	
Ultrasonic Sensor	VCC	Brown	Digital 12 V	Sensor Shield
	TRIG	Red	Digital 12 S	
	ECHO	Orange	Digital 13 S	
	GND	Yellow	Digital 12 G	

Table 10: Ultrasonic Sensor to Sensor Shield Key

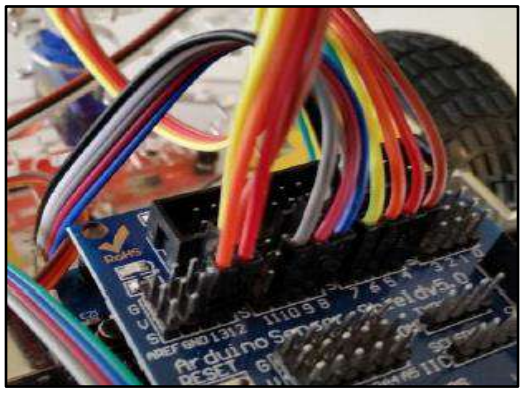

Figure 57: Ultrasonic Sensor Wired to Sensor Shield

Locate the wires for the Bluetooth module and attach them to the Sensor Shield.

Sub Assembly	*Pin*	*Color*	*Pin*	
Bluetooth Module	+5V	Green	Bluetooth VCC	Sensor Shield
	GND	Blue	Bluetooth GND	
	Tx	Purple	Bluetooth D1	
	RX	Grey	Bluetooth D0	

Table 11: Bluetooth Module to Sensor Shield Key

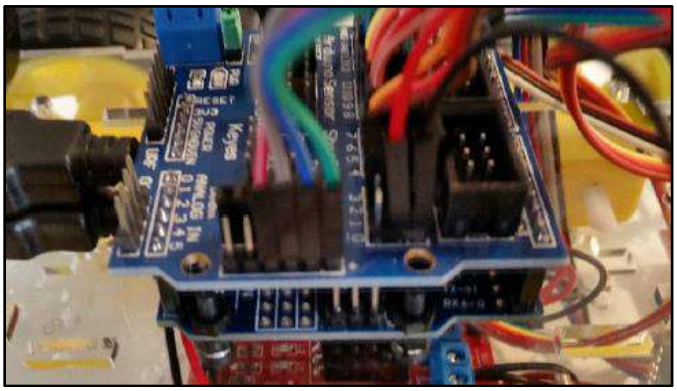

Figure 58: Bluetooth Module Wired to Sensor Shield

Locate the IR Sensor wires and attach them to the Sensor Shield as shown in Table 12.

Sub Assembly	*Pin*	*Color*	*Pin*	
IR Sensor	Y	White	A0 S	Sensor Shield
	R	Black	A0 V	
	G	Brown	A0 G	

Table 12: IR Sensor to Sensor Shield Key

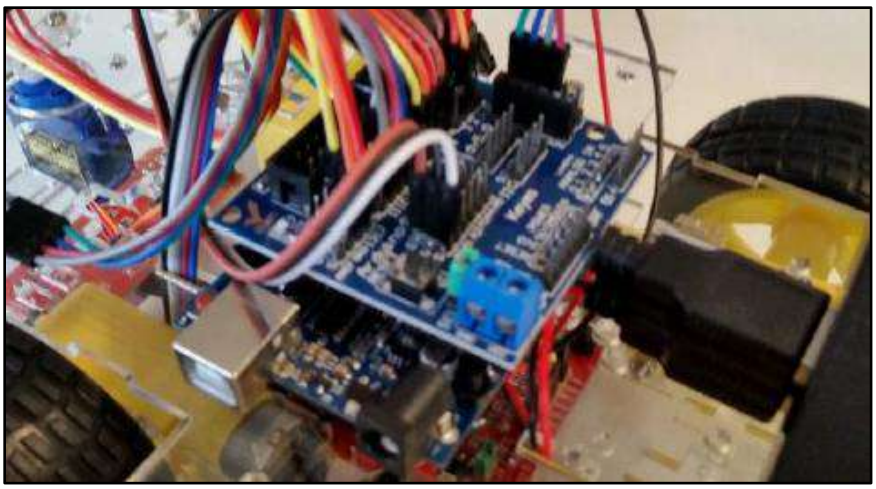

Figure 59: IR Sensor Wired to Sensor Shield

It is time to attach the battery pack. Remove the protective paper backing from the loop [soft side] of the Velcro dots. Stick them to the middle of the underside of the Battery Pack as shown below.

Figure 25: Velcro Dots Stuck to Bottom of Battery Pack

Remove the protective paper backing from the hook [hard side] of the Velcro dots and affix them to the rear of the Chassis Top Plate. Make sure that approximately half of the battery pack is sticking out into empty space behind the vehicle so as to leave enough room for both of your USB assemblies to comfortably slot into the battery, as shown below.

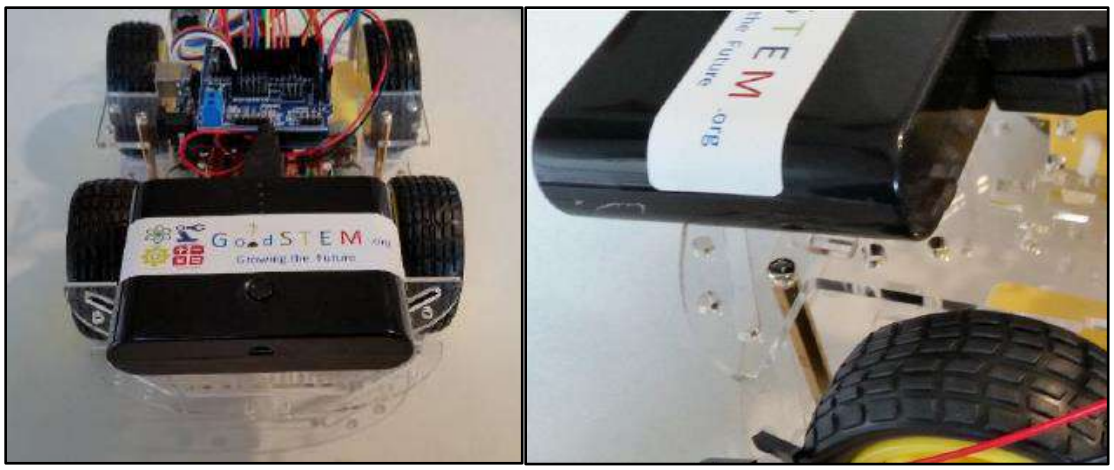

Figure 60: Battery Affixed to Back of Smartcar

Now it is time to attach both USB assemblies. Insert the USB connected to the Motor Drive Board to the upper battery port. Insert the other USB assembly into the bottom battery port.

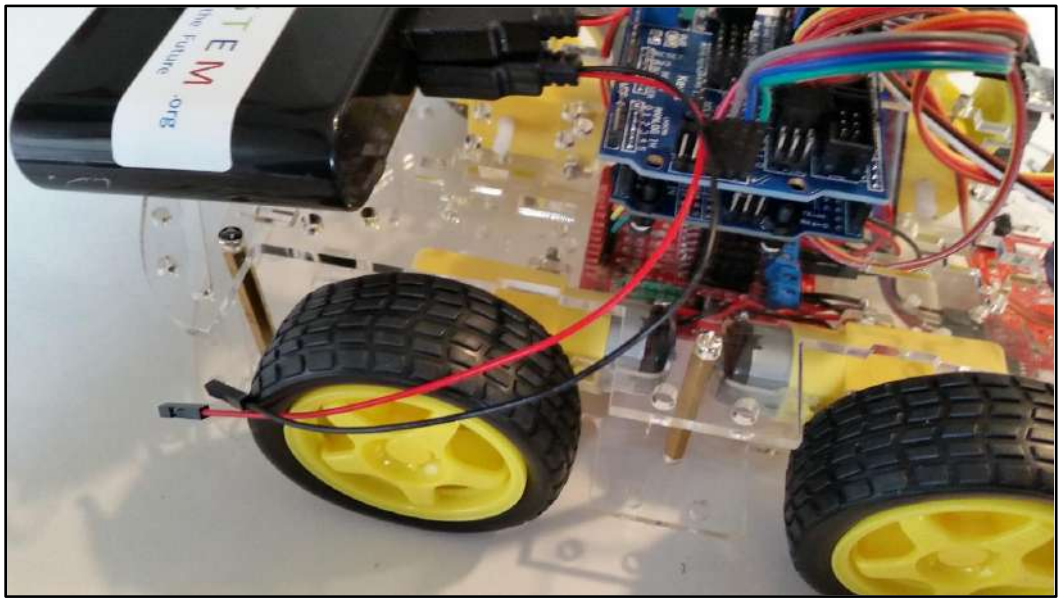

Figure 61: USB Assemblies Plugged into Battery

The last step is to connect the wires from the bottom USB assembly to the Sensor Shield. Connect the wires according to Table 13 and figure below.

Sub Assembly	***Pin***	***Color***	***Pin***	
Battery Power	USB	Red	Digital 0 V	Sensor Shield
	USB	Black	Digital 0 G	

Table 13: Battery Power to Sensor Shield Key

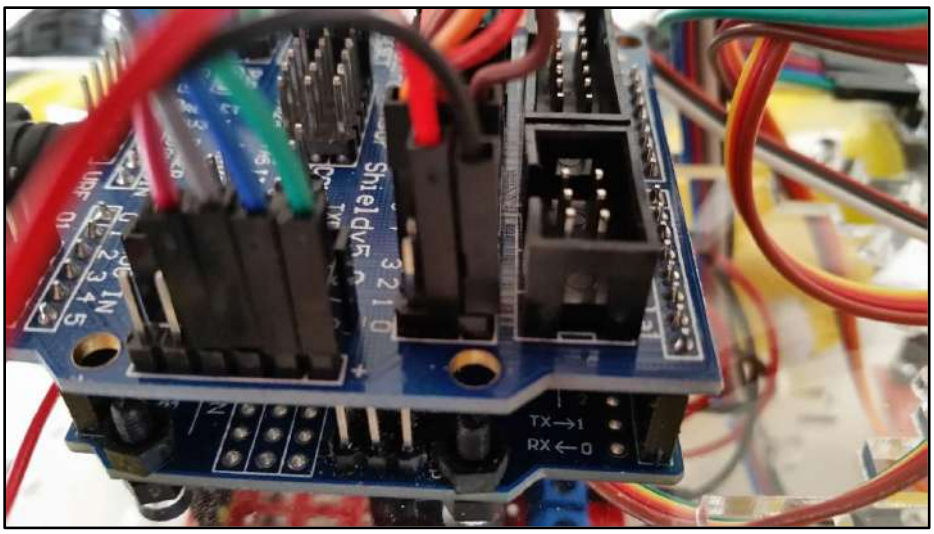

Figure 62: Battery Power Wired to Sensor Shield

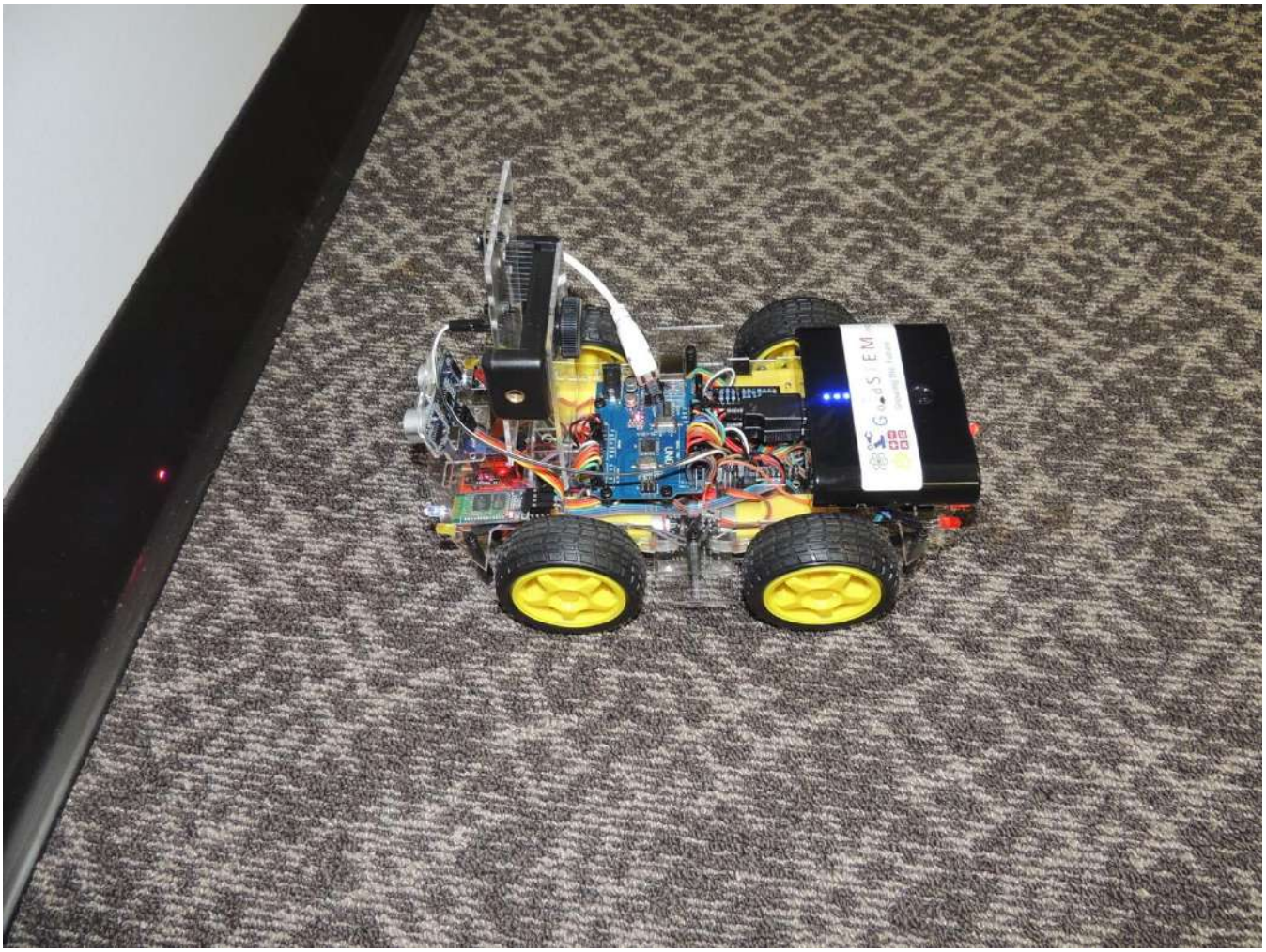

Figure 63: Final Car

Arduino Code:

```
//********Include libraries**********************************************
#include <IRremote.h>
#include <Servo.h>

//Pin assignments and global variables per function. Customize if needed
//*******Pin assignments Motor board and IR receiver******************
const int MotorRight1 = 4;
const int MotorRight2 = 5;
const int MotorLeft1 = 6;
const int MotorLeft2 = 7;
int MotorRightPWM = 0;
int MotorLeftPWM = 0;

//const int MotorLeft1    = 7;
//const int MotorLeft2    = 8;
//const int MotorRight1   = 9;
//const int MotorRight2   = 10;
//const int MotorRightPWM = 6;
//const int MotorLeftPWM  = 11;

// Memory fore line tracking
int mRight=0;//moved right upcounts each time you move right
int mLeft=0;
int mStraight=0;

int sRight=0;//Status right
int sLeft=0;
int sStraight=0;
int lostline=0;

const int irReceiverPin = A0;
const int servoPin = 2; //orange wire

int iSpeed = 255; //speed, range 0 to 255
int rwSpeed = 255; //speed, range 200 to 255
int lwSpeed = 255; //speed, range 200 to 255
const int LedPin=13;

//******Infrared key bindings*************************************
const long IRspeedup = 0x00FFA857;// Speed up+
const long IRspeeddown = 0x00FFE01F;//Speed down-
const long IRright = 0x00FF30CF;      //go straight: button 1 turn right one wheel
const long IRfront = 0x00FF18E7;      //go straight: button 2
const long IRleft = 0x00FF7A85;      //go straight: button 3 turn left one wheel
const long IRback = 0x00FF4AB5;       //go back    : button 8
const long IRturnright = 0x00FF10EF;  //turn right : button 6****This is button4
const long IRturnleft = 0x00FF5AA5;   //turn left  : button 4*****This is button 6
const long IRstop = 0x00FF38C7;       //stop       : button 5
const long IRcny70 = 0x00FF906F;      //CNY70 automatic mode: button EQ *****this is not EQ
0x00FFE01F EQ = FF906F ++Fixed
const long IRAutorun = 0x00FFC23D;    //Ultrasonic mode : button play/pause *****this is not
play/pause 0x00FF22DD should be FFC23D ++Fixed
```

```
//******Track following pin assignments and signals*********************
const int SensorLeft = 8;      //
const int SensorMiddle = 9 ;   //
const int SensorRight = 10;     //
IRrecv irrecv(irReceiverPin);  // IRrecv signal
decode_results infrared;       // decode result
//*******Ultrasonic pin assignments and signals*************************
const int echoPin = 12; // ultrasonic receive=echo pin
const int triggerPin = 13; // ultrasonic send=trigger pin
Servo myservo; // define myservo
const int degreesForward = 90; //nr degrees to look forward ***** should be 90 not 130
const int degreesLeft = 30; //nr degrees to look left ***** should be 30 not 60
const int degreesRight = 150; //nr degrees to look right ***** should be 150 not 180
const int delay_time = 250; // servo motor delay
const int Fgo = 8; // go straight
const int Rgo = 6; // turn right
const int Lgo = 4; // turn left
const int Bgo = 2; // go back
//*****Bluetooth signals************************************************
char val; //stores received character. Needs to be global to perform continuous movement

//*********General SETUP: activate pins**********************************
void setup() {
  //start receiving serial infor
  Serial.begin(9600);
  //motor connections
  pinMode(MotorRight1, OUTPUT);  //
  pinMode(MotorRight2, OUTPUT);  //
  pinMode(MotorLeft1,  OUTPUT);  //
  pinMode(MotorLeft2,  OUTPUT);  //
  pinMode(MotorRightPWM, OUTPUT); //enable for right side motor
  pinMode(MotorLeftPWM, OUTPUT); //enable for right side motor
  irrecv.enableIRIn();      // start infrared decode
  myservo.write(degreesForward);       // will make head look in front

  //black track following
  pinMode(SensorLeft, INPUT);
  pinMode(SensorMiddle, INPUT);
  pinMode(SensorRight, INPUT);

  //Ultra sonic
  //digitalWrite(2,HIGH); //what is this pin for?
  pinMode(echoPin, INPUT);
  pinMode(triggerPin, OUTPUT);
  myservo.attach(servoPin);
}

//**************Movement functions*******************************
//**ADVANCE*****Movement functions*******************************
void advance(int d, int b){//go straight
/*Serial.println ("Move Function straight ");// debug
Serial.println ("rwSpeed lwSpeed");// debug
Serial.print (rwSpeed);// debug
Serial.println (lwSpeed);// debug
Serial.print ("d= ");// debug
Serial.println(d);// debug
Serial.print ("b= ");// debug
Serial.println(b);// debug
*/
  digitalWrite(MotorRight1, HIGH);//Motor left forward
  digitalWrite(MotorRight2, LOW);
  digitalWrite(MotorLeft1, HIGH);
  digitalWrite(MotorLeft2, LOW);
  analogWrite(MotorRightPWM, 255);
  analogWrite(MotorLeftPWM, 255);
```

```
  delay(10);
  analogWrite(MotorRightPWM, rwSpeed);
  analogWrite(MotorLeftPWM, lwSpeed);

  delay(d);// think there is a bug in ARDUINO delay =0

  if (b == 1) { //break
  analogWrite(MotorRightPWM, 0);
  analogWrite(MotorLeftPWM, 0);
Serial.println ("break = 1");
  }
Serial.println ("break = 0");

  } //return

//**RIGHT*****Movement functions*****************************
void right(int d, int b) { //turn right (single wheel)
/*Serial.print ("Move Function right one wheel ");// debug
Serial.println ("rwSpeed lwSpeed");// debug
Serial.print (rwSpeed);// debug
Serial.println (lwSpeed);// debug
Serial.print ("d= ");// debug
Serial.println(d);// debug
Serial.print ("b= ");// debug
Serial.println(b);// debug
*/
  digitalWrite(MotorRight1, HIGH);
  digitalWrite(MotorRight2, LOW);
  digitalWrite(MotorLeft1, LOW);
   digitalWrite(MotorLeft2, LOW);
   analogWrite(MotorRightPWM, 255);
  analogWrite(MotorLeftPWM, 255);
  delay(10);
  analogWrite(MotorRightPWM, rwSpeed);
  analogWrite(MotorLeftPWM, lwSpeed);

  delay(d);

  if (b == 1) { //break
  analogWrite(MotorRightPWM, 0);
  analogWrite(MotorLeftPWM, 0);
//Serial.println ("break = 1");
  }
//Serial.println ("break = 0");
  } //return
//**LEFT*****Movement functions*****************************
void left(int d, int b) {//turn left(single wheel)
/*Serial.print ("Move Function left one wheel ");// debug
Serial.println ("rwSpeed lwSpeed");// debug
Serial.print (rwSpeed);// debug
Serial.println (lwSpeed);// debug
Serial.print ("d= ");// debug
Serial.println(d);// debug
Serial.print ("b= ");// debug
Serial.println(b);// debug
*/
  digitalWrite(MotorRight1, LOW);
  digitalWrite(MotorRight2, LOW);
  digitalWrite(MotorLeft1, HIGH);
  digitalWrite(MotorLeft2, LOW);
  analogWrite(MotorRightPWM, 255);
  analogWrite(MotorLeftPWM, 255);
  delay(10);
  analogWrite(MotorRightPWM, rwSpeed);
  analogWrite(MotorLeftPWM, lwSpeed);

 delay(d);
```

```
if (b==1) { //break
  analogWrite(MotorRightPWM, 0);
  analogWrite(MotorLeftPWM, 0);
//Serial.println ("break = 1");
  }
//Serial.println ("break = 0");
  } //return

void turnR(int d, int b) {//turn right (two wheels)
  Serial.print ("Move Function right two wheel ");// debug
  Serial.println(d);// debug
  digitalWrite(MotorRight1, HIGH);
  digitalWrite(MotorRight2, LOW);
  digitalWrite(MotorLeft1, LOW);
  digitalWrite(MotorLeft2, HIGH);
  analogWrite(MotorRightPWM, 255);
  analogWrite(MotorLeftPWM, 255);
  delay(10);
  analogWrite(MotorRightPWM, rwSpeed);
  analogWrite(MotorLeftPWM, lwSpeed);
 delay(d);
}
void turnL(int d, int b) {//turn left (two wheels)
   Serial.print ("Move Function left two wheel ");// debug
  Serial.println(d);// debug
  digitalWrite(MotorRight1, LOW);
  digitalWrite(MotorRight2, HIGH);
  digitalWrite(MotorLeft1, HIGH);
  digitalWrite(MotorLeft2, LOW);
  analogWrite(MotorRightPWM, 255);
  analogWrite(MotorLeftPWM, 255);
  delay(10);
  analogWrite(MotorRightPWM, rwSpeed);
  analogWrite(MotorLeftPWM, lwSpeed);
  delay(d);
}
void stopp(int d, int b) { //stop
  //Serial.print ("Move Function stop ");// debug
  //Serial.println(d);// debug
  digitalWrite(MotorRight1, LOW);
  digitalWrite(MotorRight2, LOW);
  digitalWrite(MotorLeft1, LOW);
  digitalWrite(MotorLeft2, LOW);
  analogWrite(MotorRightPWM, 255);
  analogWrite(MotorLeftPWM, 255);
  delay(10);
  analogWrite(MotorRightPWM, rwSpeed);
  analogWrite(MotorLeftPWM, lwSpeed);
 delay(d);
}
void back(int d, int b) { //go back
  Serial.print ("Move Function back ");// debug
  Serial.println(d);// debug
  digitalWrite(MotorRight1, LOW);
  digitalWrite(MotorRight2, HIGH);
  digitalWrite(MotorLeft1, LOW);
  digitalWrite(MotorLeft2, HIGH);
  analogWrite(MotorRightPWM, 255);
  analogWrite(MotorLeftPWM, 255);
  delay(10);
  analogWrite(MotorRightPWM, rwSpeed);
  analogWrite(MotorLeftPWM, lwSpeed);
 delay(d);
}
```