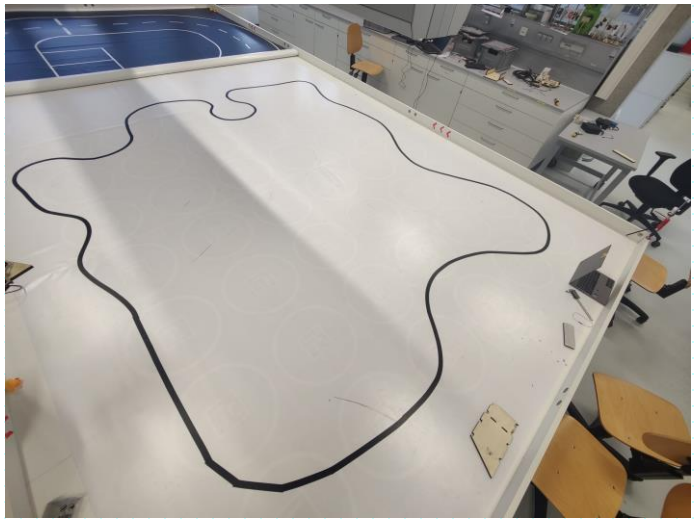
PROTOTYPING AND SYSTEMS ENGINEERING PRESENTATION

TEAM MEMBERS :

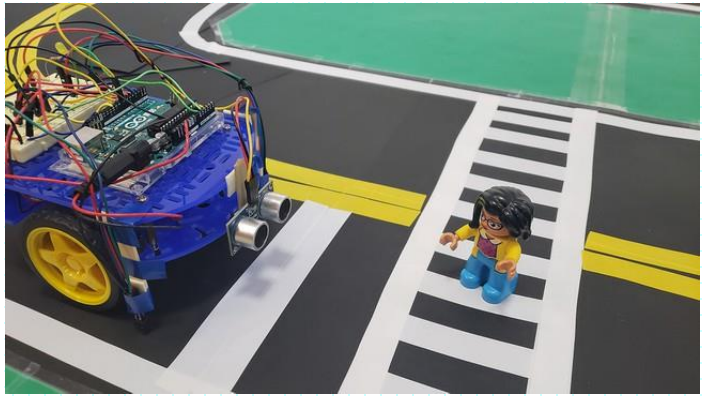
- PISULA GURUGE
- MEHEDI HASAN
- MASRUR JAMIL PROCHCHHOD
- JIBAN-UL AZAM CHOWDHURY SHAFIN

MOTIVATION



OVERVIEW

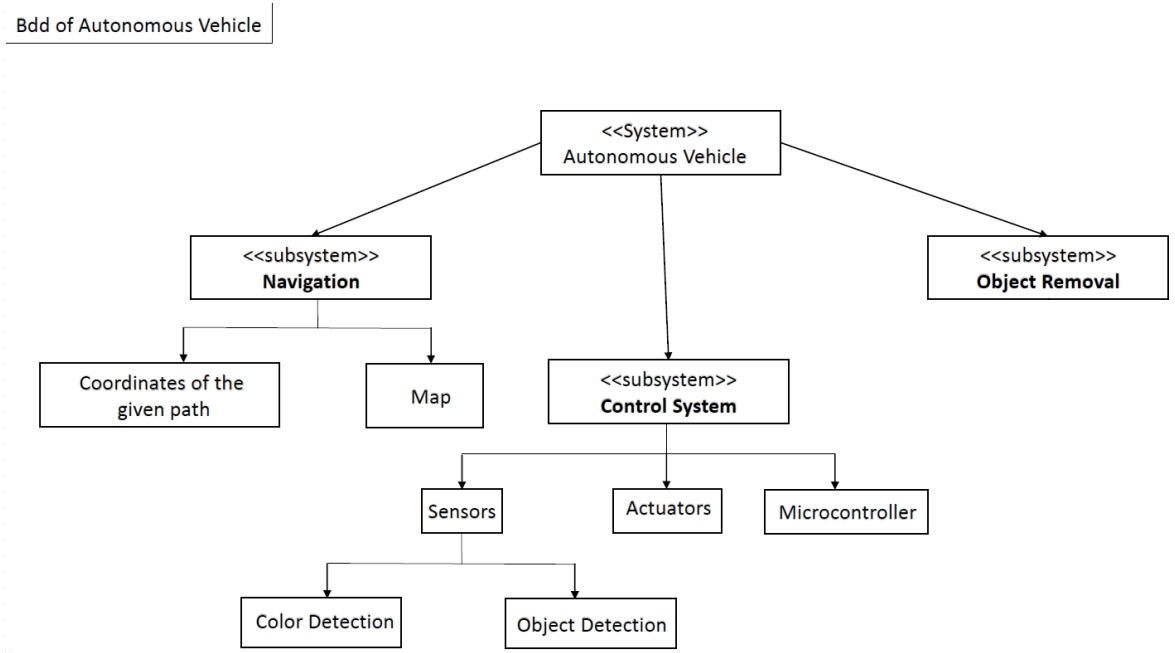
- Develop an autonomous vehicle that can drive autonomously on a given track.



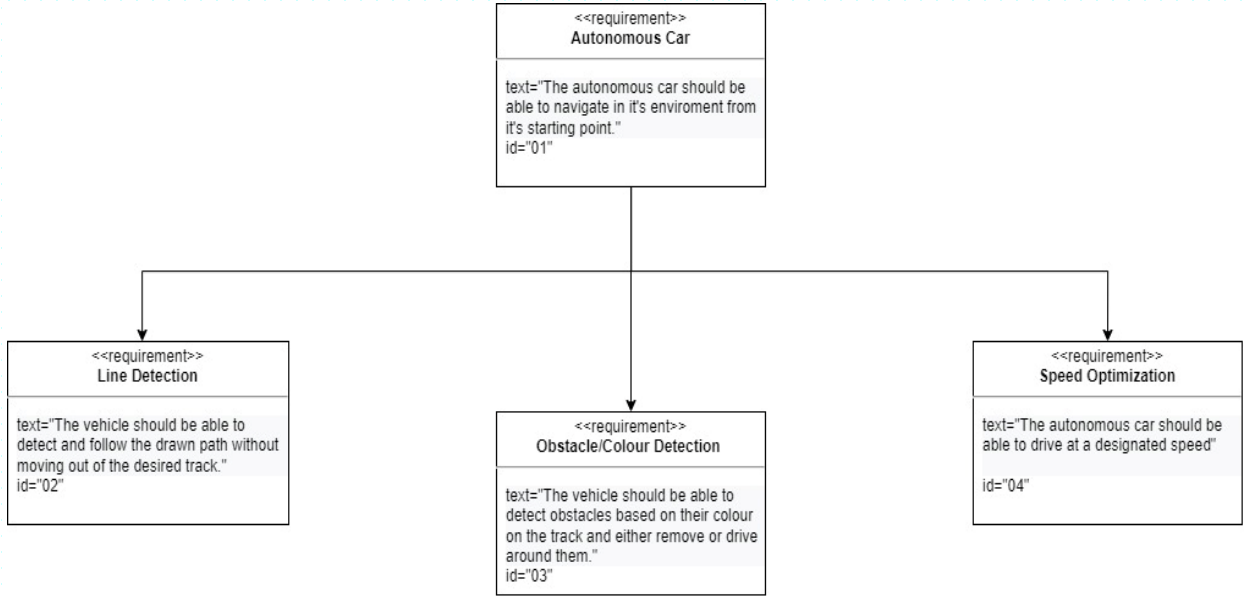
[1]

SYSML DIAGRAMS AND UPPAAL MODEL

- BLOCK DIAGRAM

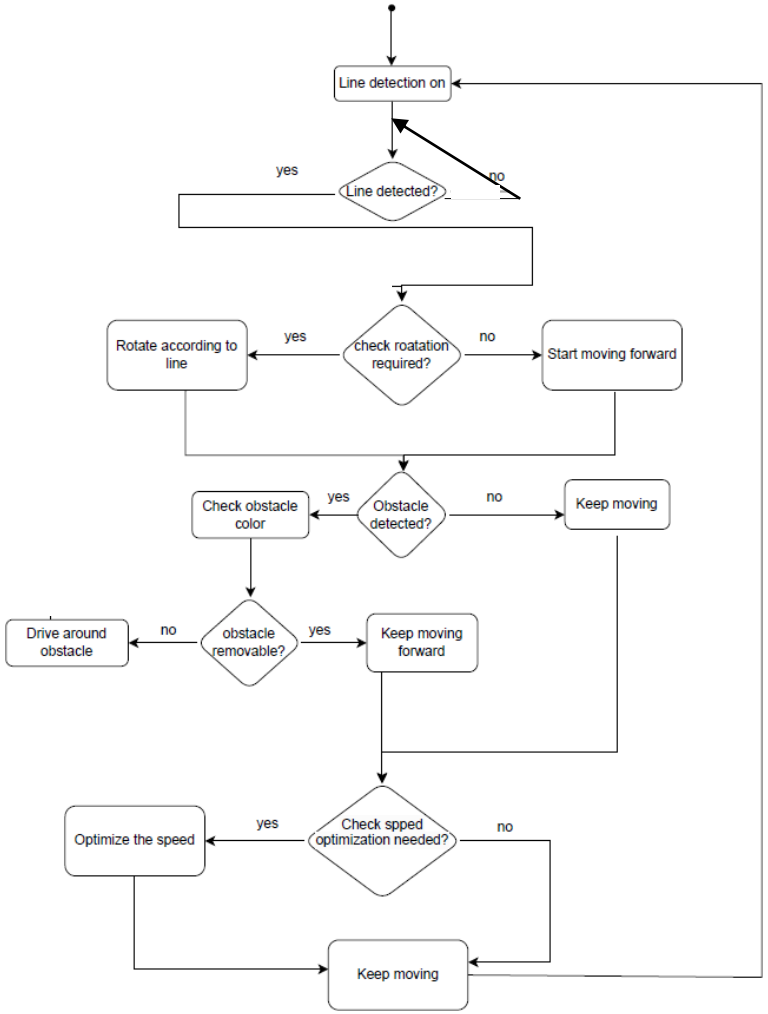


- REQUIRMENT DIAGRAM

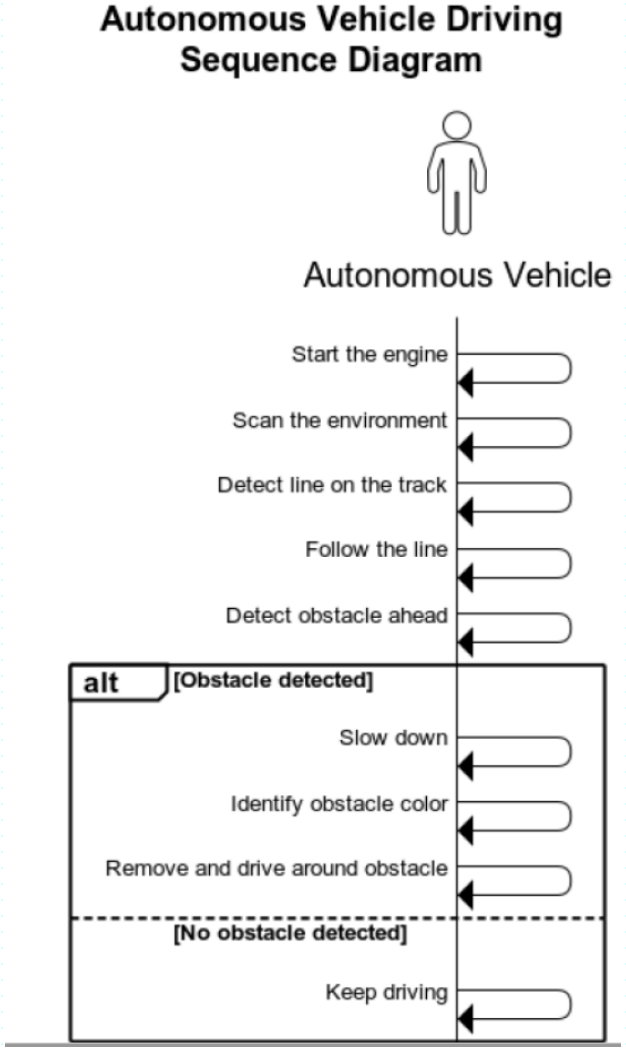


SYSML DIAGRAMS AND UPPAAL MODEL

- ACTIVITY DIAGRAM

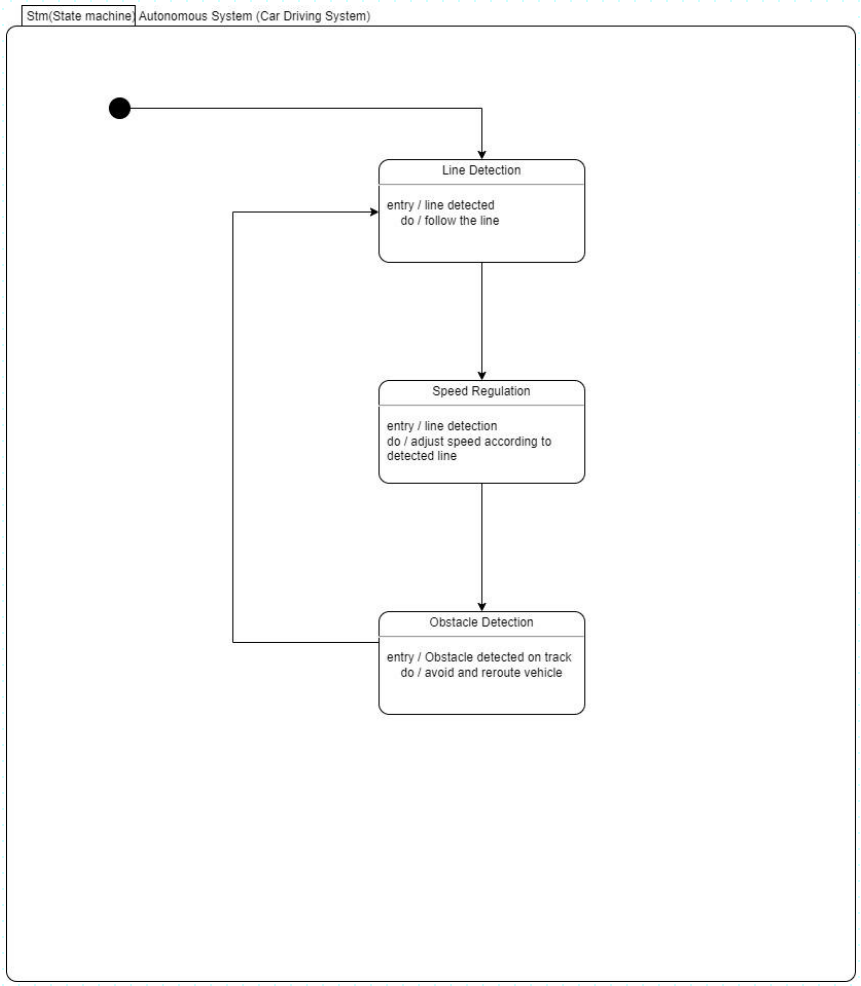


- SEQUENCE DIAGRAM

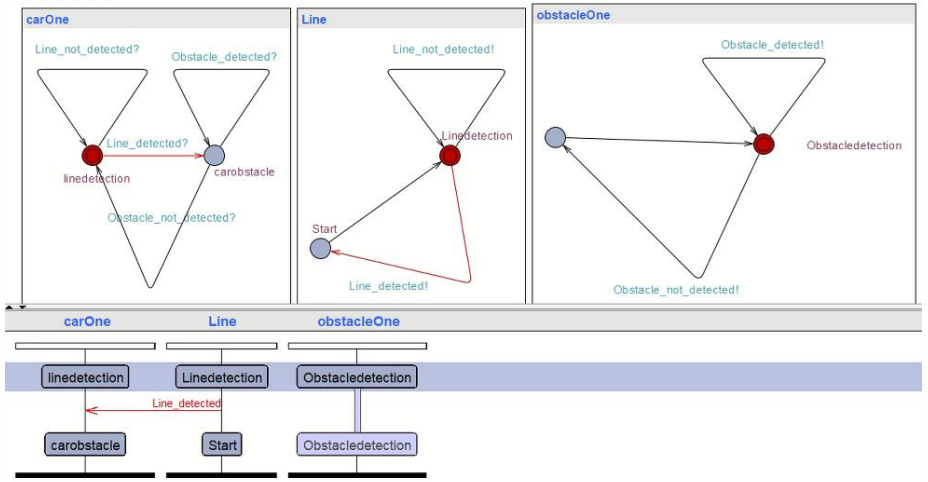


SYSML DIAGRAMS AND UPPAAL MODEL

- STATE MACHINE DIAGRAM



- UPPAAL MODEL



HARDWARE COMPONENTS

- Microcontroller - Arduino Uno

- Ultrasonic Sensor (HC-SR04)

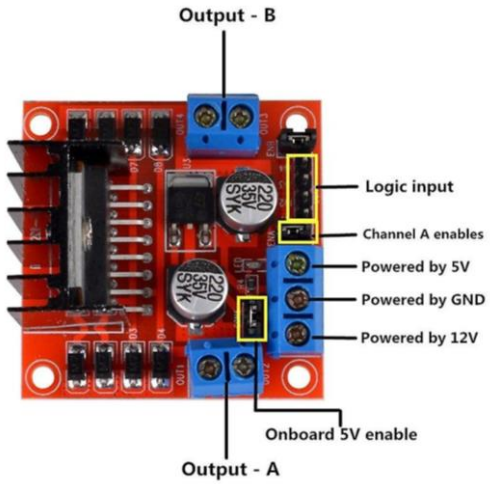
- Line sensor (IR Sensor,ST1140)

HARDWARE COMPONENETS

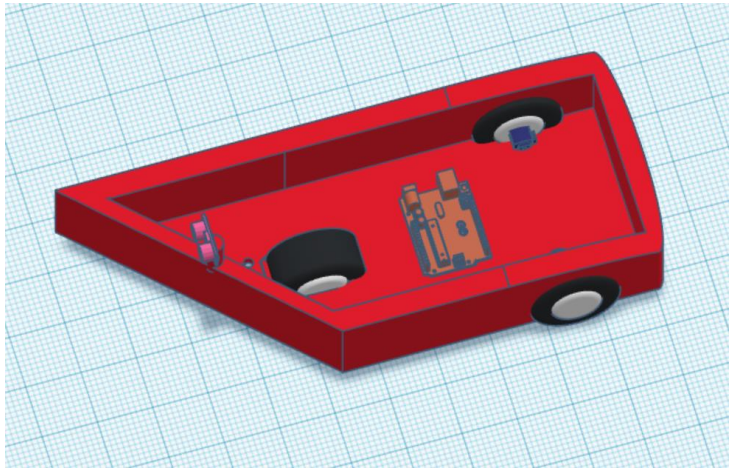
- Colour Sensor (TCS3200)

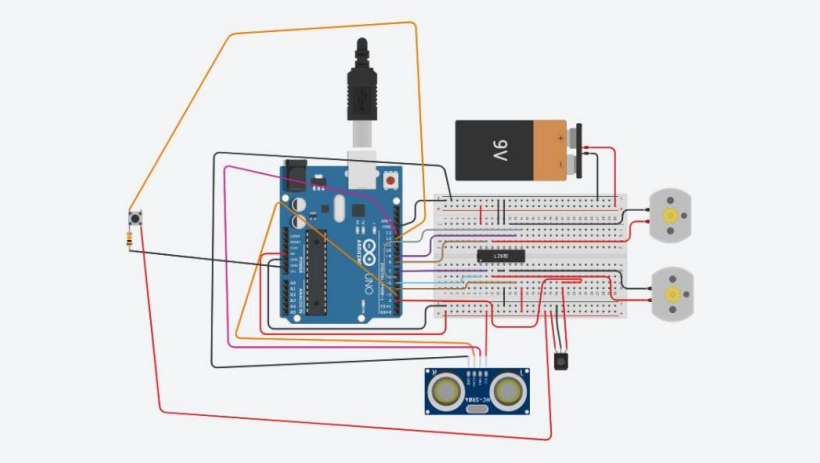
- 2 DC Motors

- Motor Driver



DESIGN & SCHEMATICS





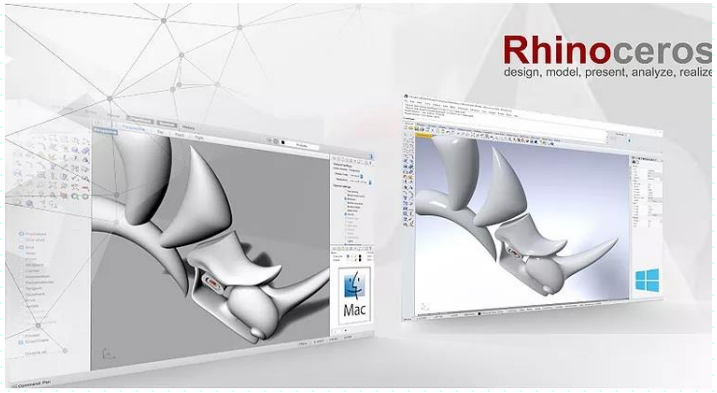
DESIGN & SCHEMATICS

TECHNOLOGIES USED

- TINKERCAD

AUTODESK® TINKERCAD® [2]

- Rhinoceros

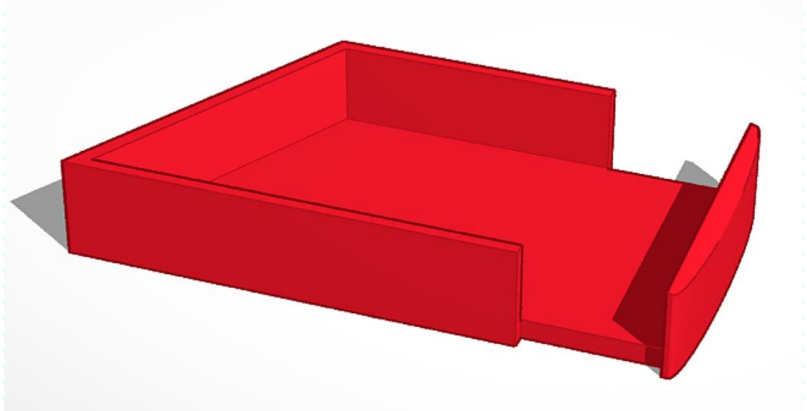


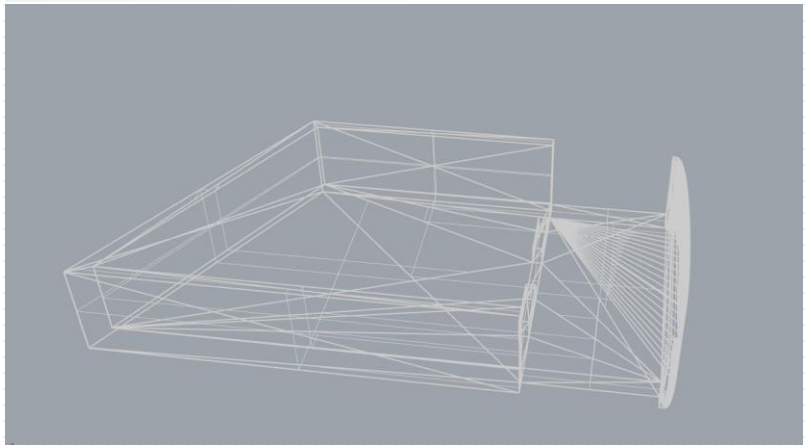
[3]

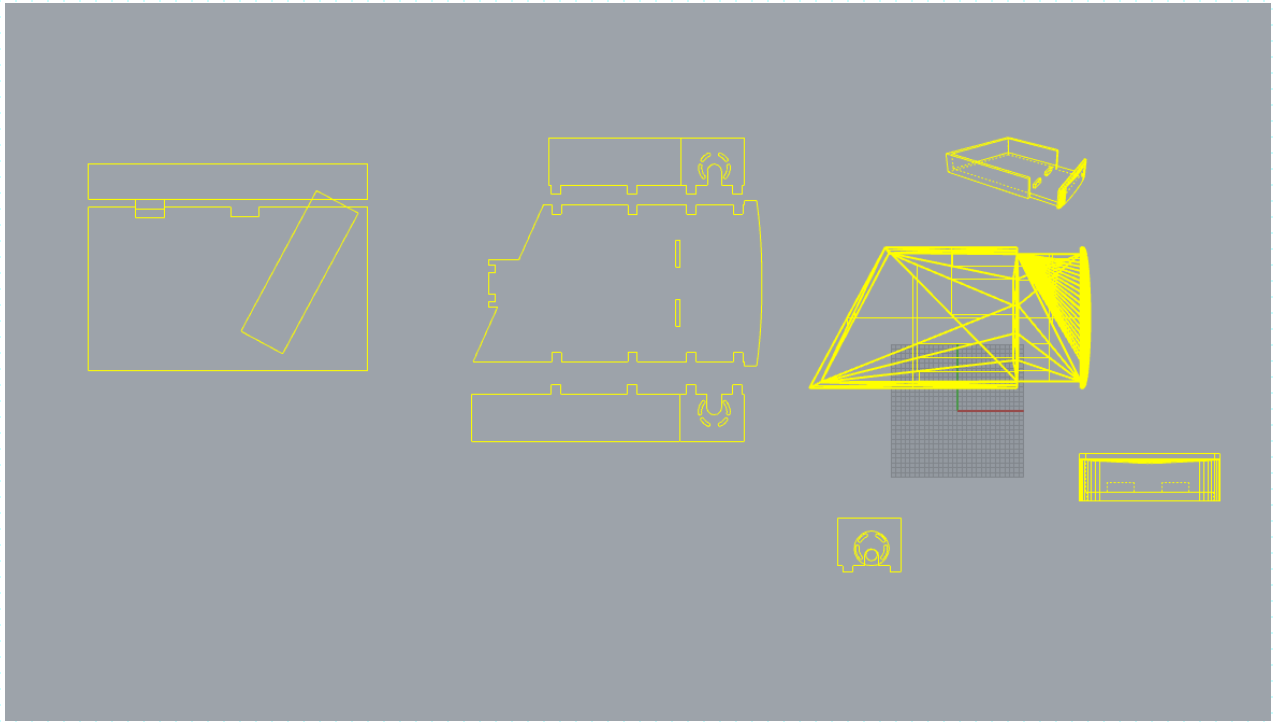
- Laser Cutting of Plywood

[4]

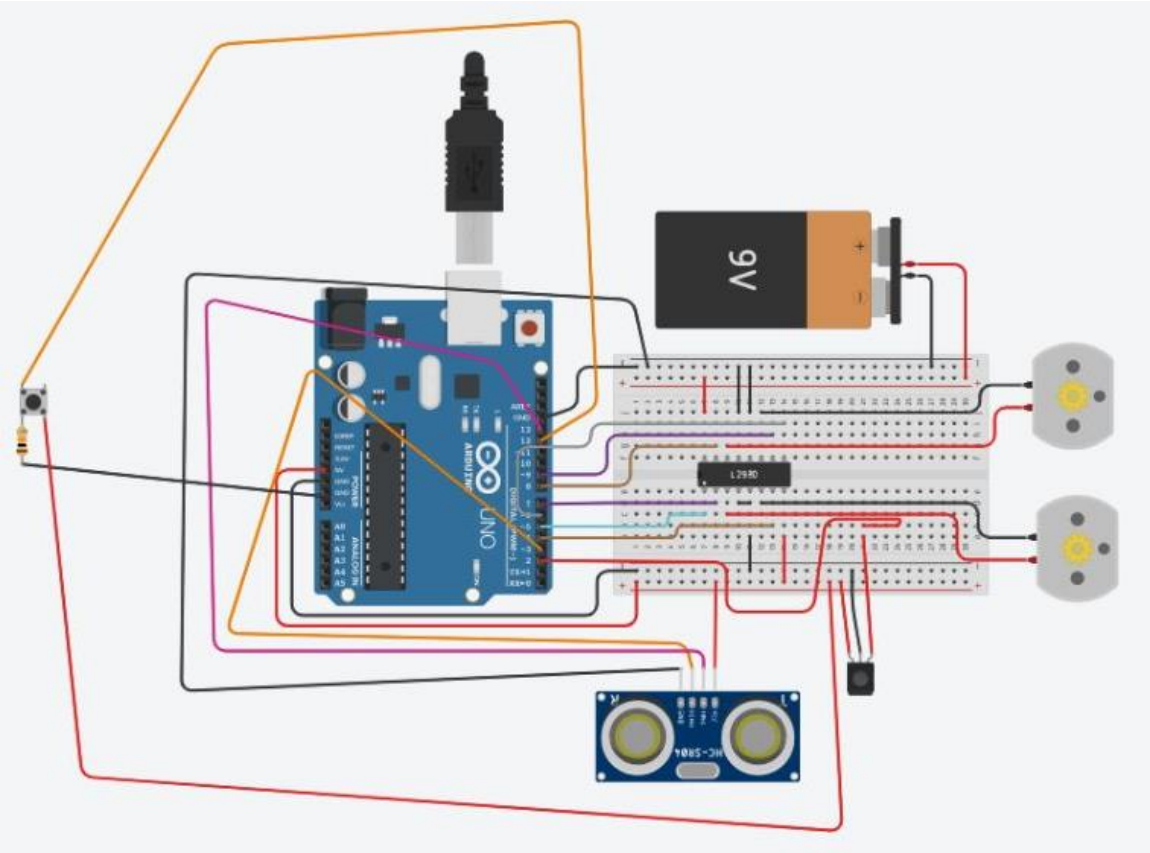
TINKERCAD & RHINOCEROS

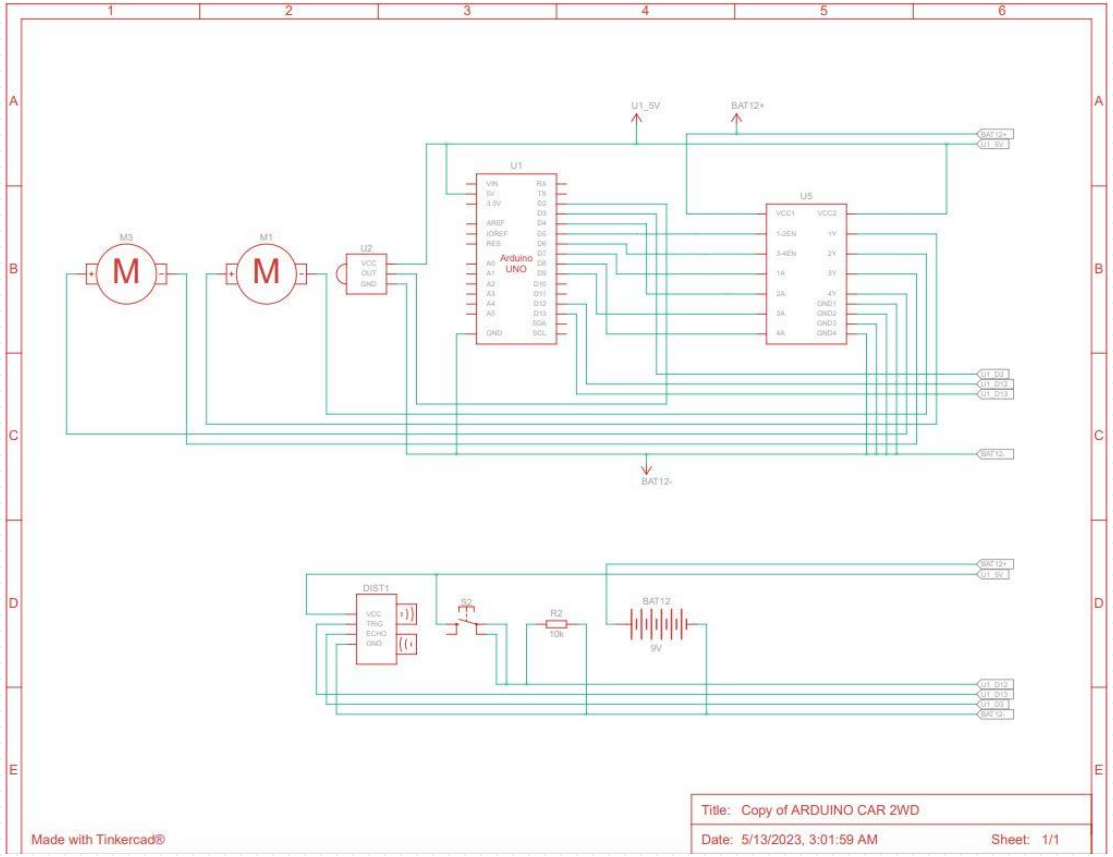


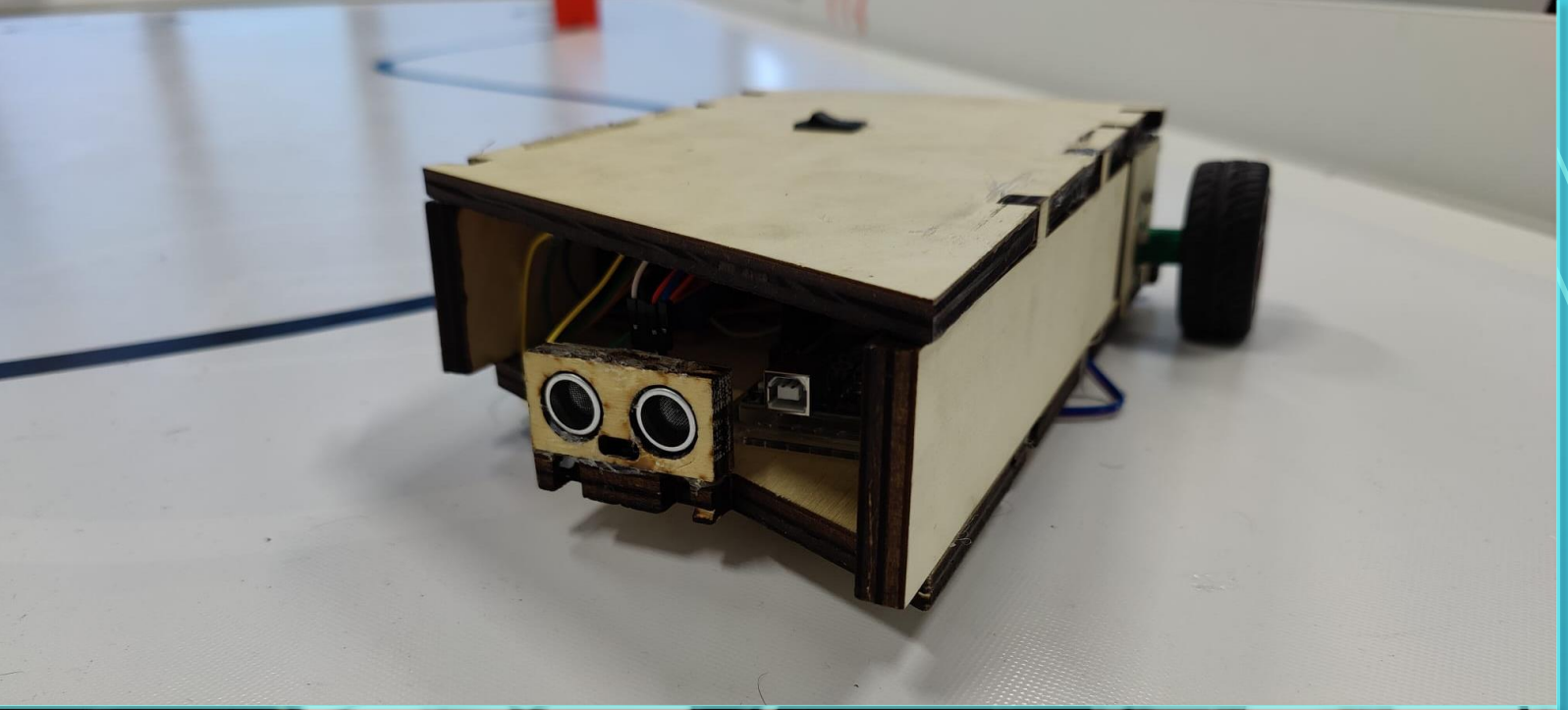


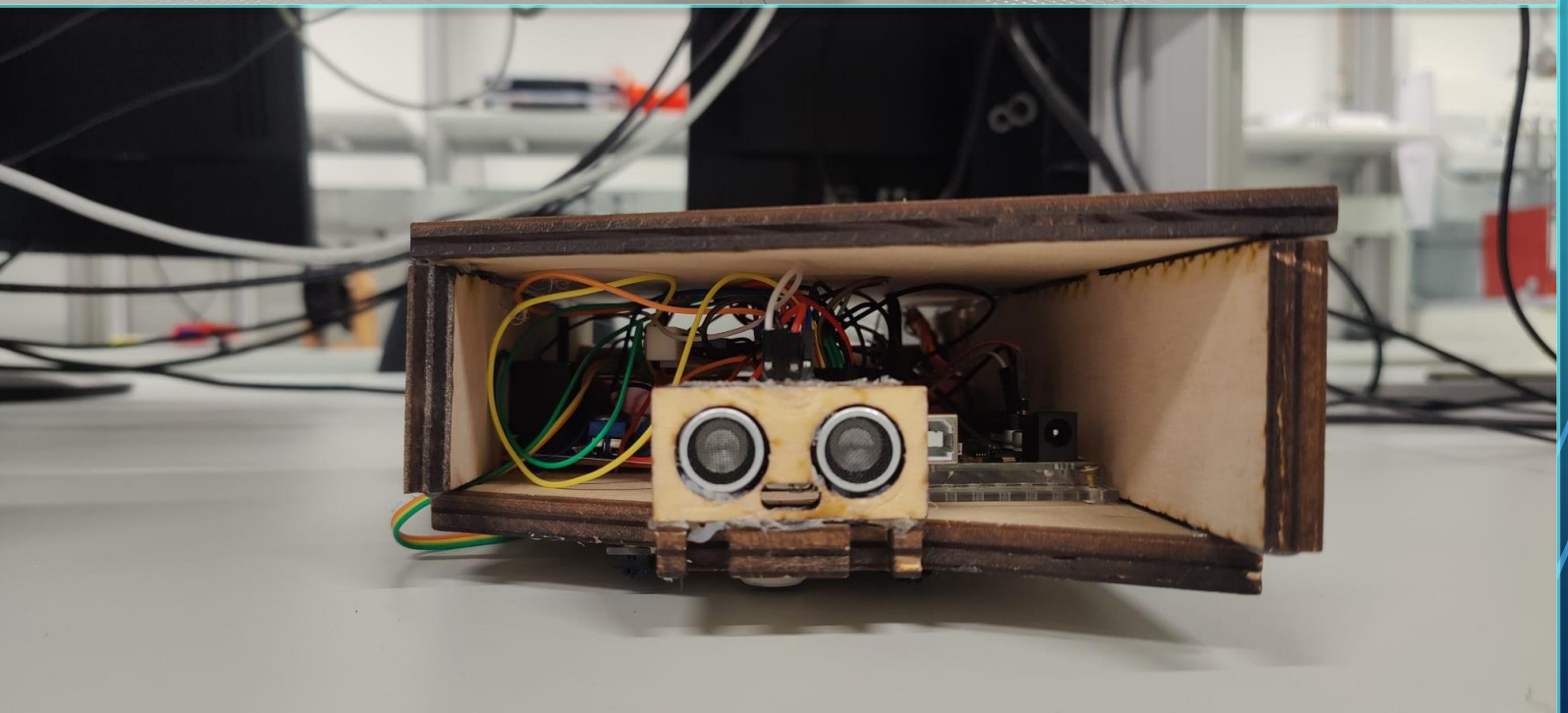


DESIGN & SCHEMATICS









FINAL PROTOTYPE

CODE

1.Initialisation

```
// Define pins for motor driver
const int in1Pin = 7;
const int in2Pin = 4;
const int in3Pin = 9;
const int in4Pin = 8;
const int enA = 5;
const int enB = 6;

// Define pins for ultrasonic sensor
const int trigPin = 13;
const int echoPin = 3;

// Define pins for IR sensor
const int irPin1 = 2;
const int irPin2 = 10;
```

CODE

1.Track Following

- 2 IR Sensor

- IrSensor1(left ir Sensor)
- IrSensor2(right ir Sensor)

Signal – HIGH When on White Path
– LOW When on Black Path

Vehicle Out of the track:- keeps moving forward using forward function until it finds the line again.

```
void forward() { // Moving Forward
  digitalWrite(in1Pin, LOW);
  digitalWrite(in2Pin, HIGH);
  digitalWrite(in3Pin, LOW);
  digitalWrite(in4Pin, HIGH);

void right() { // Moving right side of the track
  analogWrite(enA, 130);
  analogWrite(enB,160 );
  digitalWrite(in1Pin, LOW);
  digitalWrite(in2Pin, HIGH);
  digitalWrite(in3Pin, HIGH);
  digitalWrite(in4Pin, LOW);
}
}
  // Initialize IR sensor pin
  pinMode(irPin1, INPUT);
  pinMode(irPin2, INPUT);

void loop() {
  // Read IR sensor input
  int irSensorValue1 = digitalRead(irPin1);
  int irSensorValue2 = digitalRead(irPin2);
analogWrite(enA, 200);
  analogWrite(enB,200 );
  if (irSensorValue1 == 0 && irSensorValue2 == 0)
{
    forward();
  } else if (irSensorValue1 == 1 &&
irSensorValue2 == 0) {
    left();
  } else if (irSensorValue1 == 0 &&
irSensorValue2 == 1) {
    right();

  }
}
```

CODE

2. Obstacle detection

Ultrasonic sensor detects obstacles by sending sound waves.

- Trigger Pin – Sends high frequency signal
- Echo Pin - Receive the Signal

```
// Ultrasonic sensor code
digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(7);
digitalWrite(trigPin, LOW);
duration = pulseIn(echoPin, HIGH);
distance = duration/34.2;
 if(distance==0){
  distance=100;
}
```

2. Obstacle avoiding

movement sequence:

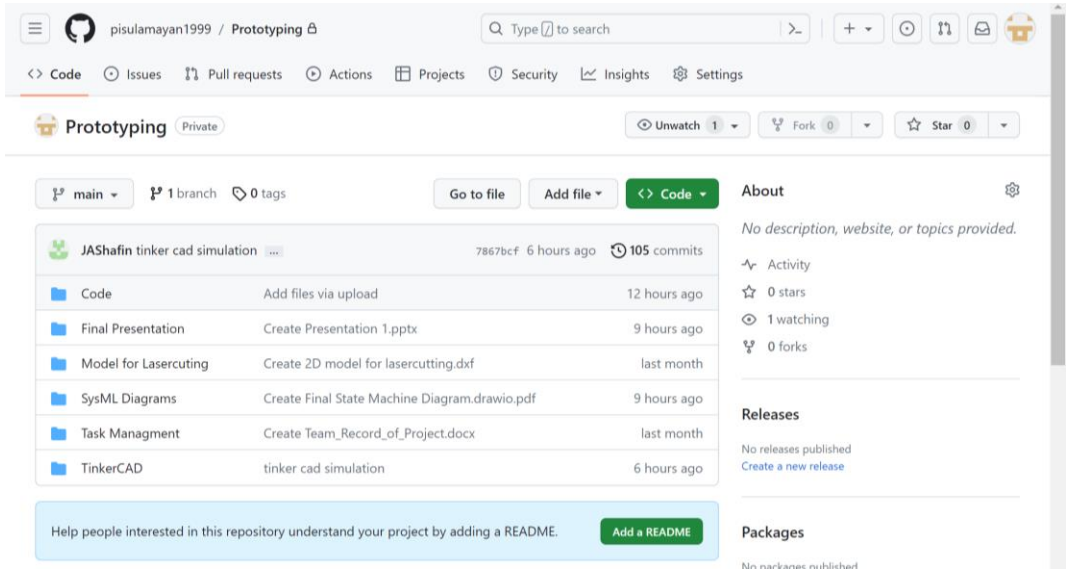
- left() - turning left to avoid the obstacle
- forward() - moving forward to pass the obstacle
- right() - turning right to align with the original track
- forwardU() - continuing forward after avoiding the obstacle

```
if(distance<10)
    {
     left();
      delay(1000);
      forward();
      delay(1700);
      right();
      delay(1400);
     forwardU();
  irSensorValue1 = digitalRead(irPin1);
  irSensorValue2 = digitalRead(irPin2);

while(irSensorValue1 == 0 && irSensorValue2 == 0 ){
   irSensorValue1 = digitalRead(irPin1);
irSensorValue2 = digitalRead(irPin2);
}

  stop();
  delay(2000);
  forwardU();
  delay(100);
   irSensorValue2 = digitalRead(irPin2);
  turn();
  while(irSensorValue2 == 0){
   irSensorValue2 = digitalRead(irPin2);
}
}

}
```



Team Record of Project: Autonomous line following object detectable vehicle

			Masrur		Shafin		Mehedi		Pisula	
#	Task	Short summary	(to doo incl. Deadline)	(Done incl. Finishing date)	(to do incl. Deadline)	(Done incl. Finishing date)	Mehedi(to do incl. Deadline)	Mehedi(Done incl. Finishing date)	Guruge(to do incl. Deadline)	Guruge(Dor incl. Finishing date)
1	Task 1	SysML	Sequence Diagram 19/04/23	17th of April	Modified Activity diagram, internal Block Diagram. 19th April	15th April	Block Diagram, User case diagram. 19th of April	16th of April	Requirement Diagram & State Machine Diagram	16th of Apr
2	Task 2	system engineering model Simulation and developing prototype	Finalizing design 26th of April	23rd of April	Done the coding for line following and successfully done simulation of line following done in TinkerCad+updated SysML 26th April	21th April	Done Coding and Simulation with Ultrasonic sensor, ir, sensor ,LCD, and Motor Driver. 26th of April	25th of April	Made the first prototype with TinkerCAD and updated my Sysml Diagrams	22nd of April
3	Task 2	Final Systems Engineering model	3D and 2D design preparing for laser cutting, compiling the prototype and preparing prototype for test drive. 17th of May	9th of May	First prototype of Dxf file designed for Laser cutting prototype, Sketching paper prototype, Participating in finalising design and assembling hardware for test drive, also done the code using switch case instead of switch case.10th May	17th May	3D design And 2D design Evaluation And Feedback. 10th of May. compiling the prototype and preparing prototype for test drive.	9th of May	Finalised and prepared the TinkerCad design of the whole car and the chasis. Assembled hardware with all team members.	9th of May

GITHUB AND TASK DISTRUBUTION

REFERENCES

- [1]https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.sciencebuddies.org%2Fscience-fair-projects%2Fproject-ideas%2FRobotics_p042%2Frobotics%2Farduino-self-driving-car&psig=AOvVaw12ht2KLSrzdl5yJLgyfdQz&ust=1687195535503000&source=images&cd=vfe&ved=0CBEQjRxqFwoTCLCs_6arzf8CFQAAAAAdAAAAABAR
- [2] https://upload.wikimedia.org/wikipedia/commons/thumb/4/4c/Logo-tinkercad-wordmark.svg/2560px-Logo-tinkercad-wordmark.svg.png
- [3] https://www.einscan.com/wp-content/uploads/2018/11/pressrel1.jpg
- [4] https://i.ytimg.com/vi/PrhFy8tD2t4/maxresdefault.jpg

RESULTS AND CONCLUSION

- Develop an autonomous vehicle that can drive autonomously on a given track.
- Being able to detect obstacles, avoid the obstacle and return back to the track.
- Optimize and maintain a constant speed.