NED UNIVERISTY

OF ENGINEERING & TECHNOLOGY

Internship Report

PLACE:	NCAI Smart City Lab, NED
INSTRUCTOR:	Ms. Shumaila Ahmed

GROUP MEMBERS		
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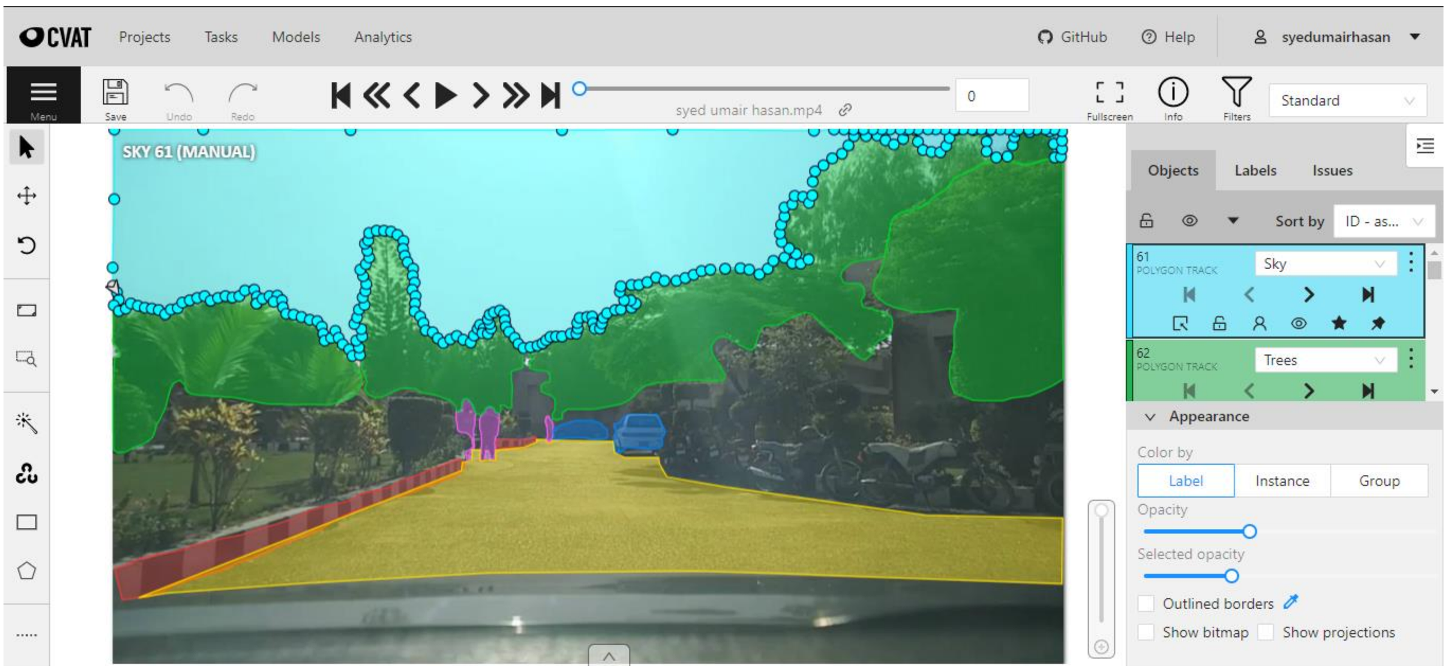
REPORT

NOVEMBER 2020 – MARCH 2021

DUTIES AND RESPONSIBILITIES PERFORMED

Annotation using CVAT tool

Computer Vision Annotation Tool (CVAT) is a free, open source, web-based image and video annotation tool which is used for labeling data for computer vision algorithms. Each of us were assigned a short video clip, which we had to annotate using CVAT tool.



After accomplishing this task, we can now annotate any picture or video using CVAT Tool.

Link to Annotated Files:

https://drive.google.com/file/d/1vjvrXvLwLM9N2cJRTyESEUpnOacnZL9d/view?usp=sharing

https://drive.google.com/file/d/13VbmWaxRRkRW97iXYSpd5BJjr_6MQwRs/view?usp=sharing

https://drive.google.com/file/d/1BDrcpVRmXH8jO9VneYoxGiNQ-8eGIZLx/view?usp=sharing

2D map - Occupancy Grid Research Task

In this task we had to establish an understanding of the Occupancy Grids used in Autonomous Vehicles. We addressed the following concepts:

1. What is an occupancy grid?
2. Why do AVs need occupancy grid?

3. What information does it represent?
4. What are the Data requirements of the occupancy grid?
5. What are the key challenges?
6. How is it different from HD maps (3d maps)?

Due to this task, we got the conceptual understanding of Occupancy Grid

Link to Report: https://drive.google.com/file/d/17Y4QexQ6oJ0o2DqN2LnnwnB0YYcN8xRz/view?usp=sharing

Comparison and analysis of GPS outlier's accuracy using different algos and hardware

We were assigned a task in which we had to prepare report on different algorithms and hardware modules which would enhance the accuracy of the GPS system. This task was to be done on individual basis. The following concepts were covered in the report:

1. How do GPS and GNSS work?
2. Difference between mobile GPS and GPS receiver
3. What is the NMEA sentence what information each holds
4. List some GPS Sensors and modules, go through their datasheet and find accuracy, range, channels, no of the satellite, frequency, and price if available.
5. Define the accuracy, range, channels, no of the satellites, the frequency for a GPS sensor, and establish through understanding.
6. How to increase the efficiency of low-cost GPS, what sensors, and what algorithms can be used to improve accuracy.
7. Study the sensor fusion of accelerometer, magnetometer, a gyroscope for increasing GPS accuracy. In general, usage of IMU for improving GPS accuracy.
8. Explain the individual and collective effect of each sensor.
9. Study the effect of Kalman filtering, Extended Kalman filtering, unscented Kalman filtering, Monte Carlo localization, Markov localization, and basic moving average on GPS sensor data, and sensor fusion data, while listing other algorithms commonly used for improving GPS accuracy.
10. Lastly the importance and usage of GPS in the application of Self-driving vehicles.

Link to our Reports:

https://drive.google.com/file/d/1xOB5ds-9-GQiVix7gEsNgpyup1zEKD_U/view?usp=sharing

3D Distance Calculation Research Paper

This was a physical activity and we had to calculate the 3D distance for a research paper. We had to accomplish the following tasks:

1. Images of vehicles
2. Actual distance of vehicle
3. Take images at 5ft 10ft 15ft 20ft 25ft and 30ft
4. Bring measurement tape
5. Camera

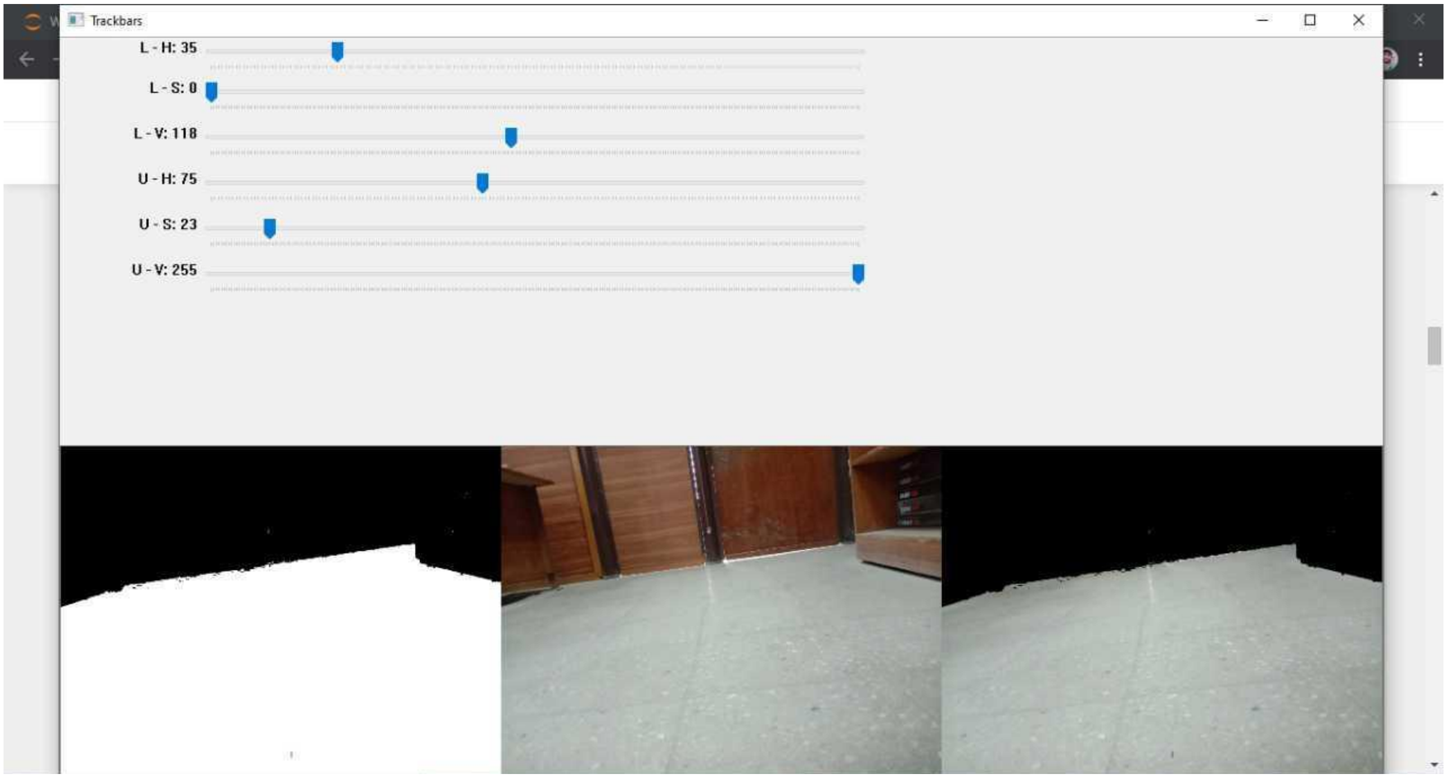
Finding Floor & Non-Floor Regions using Contour Detection

In this task we had to detect the floor and non-floor regions using OpenCV Library. We compared the following 3 approaches to detect the floor and non-floor regions:

1. Implementation by using Color Detection
2. Implementation by using Watershed Algorithm
3. Implementation by using Contour Detection

Color Detection

This approach used HSV color values to detect the floor.

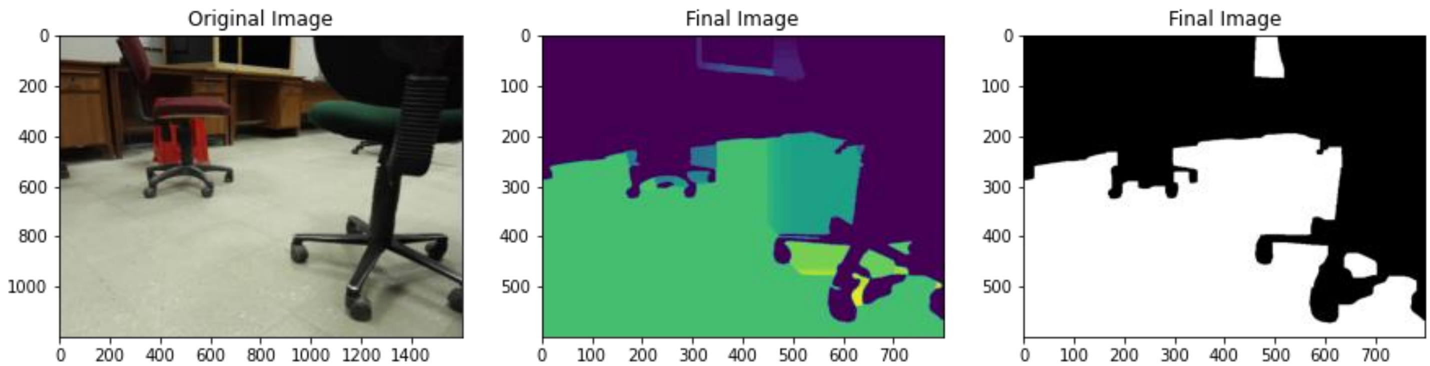


Drawbacks of Color Detection

1. It cannot be generalized as it uses HSV color values so it will work only on specific floor
2. Will not function properly if color of non-floor matches with floor
3. If picture of specific floor is taken from different cameras, then it will not function well as color of picture can vary from in different cameras.

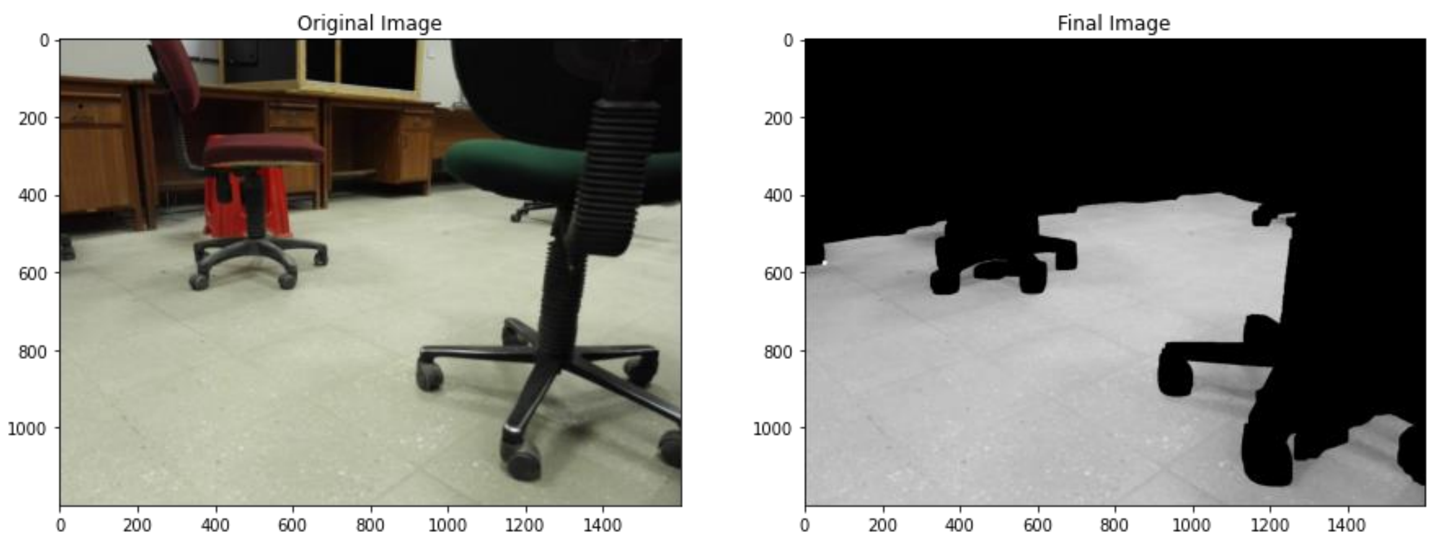
Watershed Algorithm

The watershed is a classical algorithm used for segmentation, that is, for separating different objects in an image. Starting from user-defined markers, the watershed algorithm treats pixels values as a local topography (elevation). The algorithm floods basins from the markers until basins attributed to different markers meet on watershed lines. In many cases, markers are chosen as local minima of the image, from which basins are flooded.



Contour Detection

Using contour detection, we can detect the borders of objects, and localize them easily in an image. It is often the first step for many interesting applications, such as image-foreground extraction, simple-image segmentation, detection and recognition.

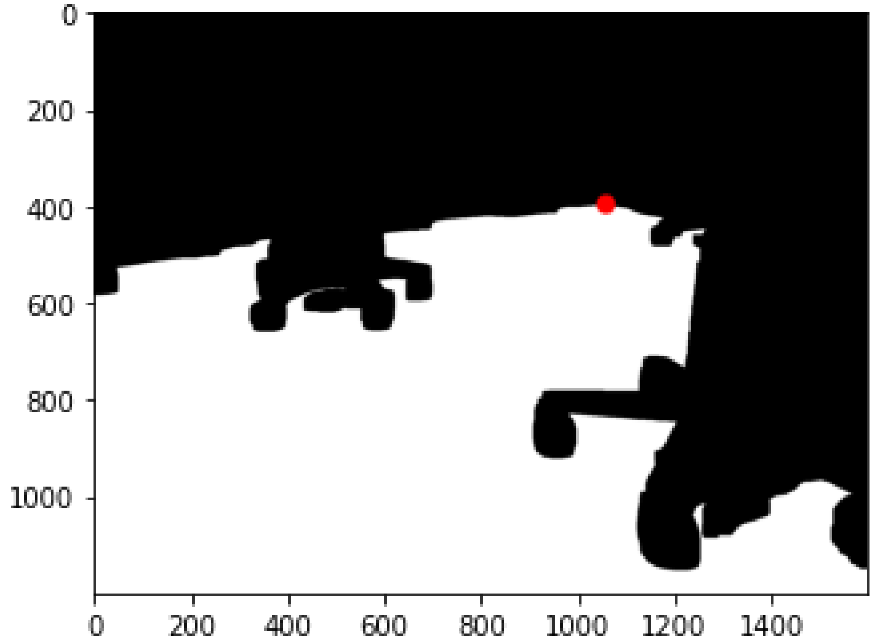


Conclusion

Out of all three approaches we found that Simple Contour Detection with Morphological Operations worked best for us as the results are shown for most of the images. While Marker Based Watershed showed moderate results however in some images Marker Based Watershed worked poorly as it didn't find any Unique Segments. If we manually provide markers to watershed algorithm, then it will give good results, however, in the approach we used, markers were detected automatically.

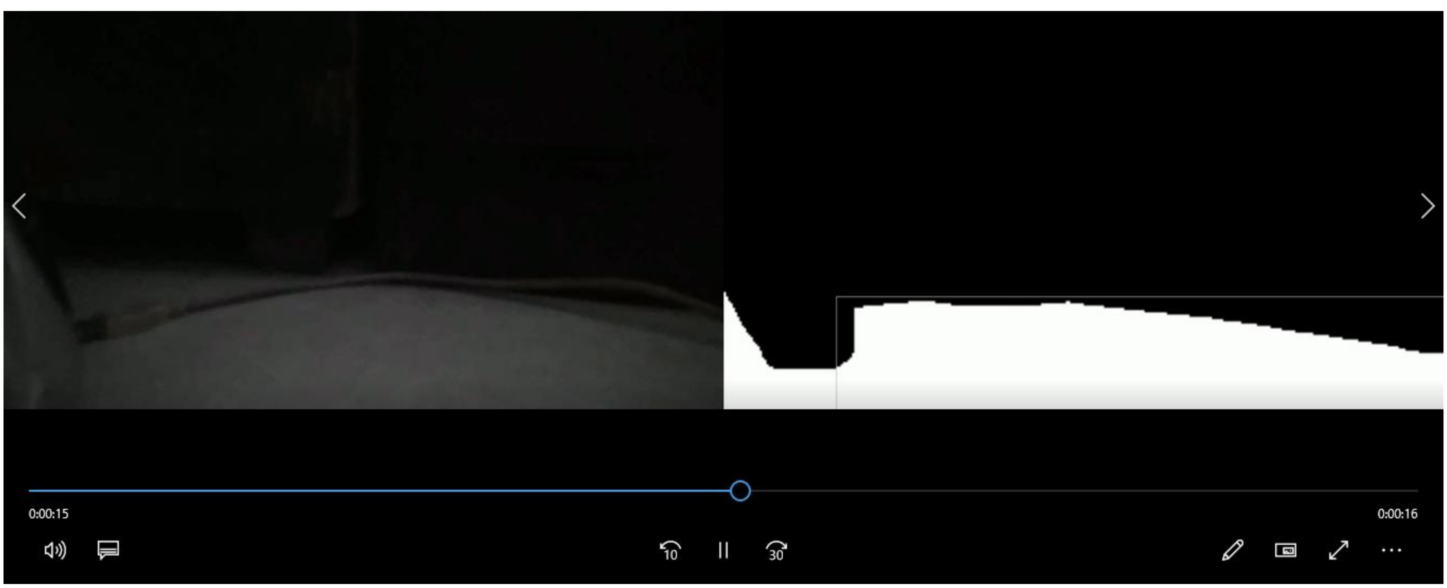
Finding the furthest point of Floor Contour

After detecting the contour of floor, we had to find the furthest coordinate on floor which we accomplished using image processing functions. The red dot shows the furthest point in the following figure:



Contour Detection on Video Stream

Now we had to apply the Contour Detection Function on a video feed. Therefore, we had to do some little modifications to our code.

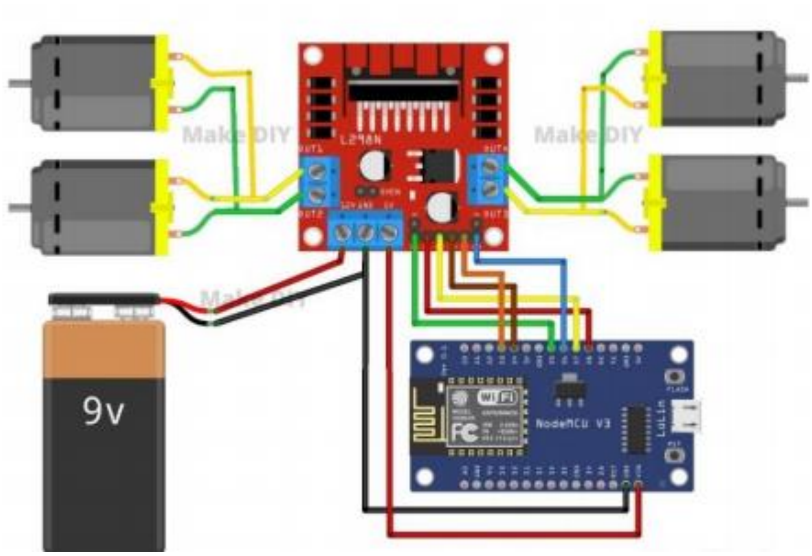


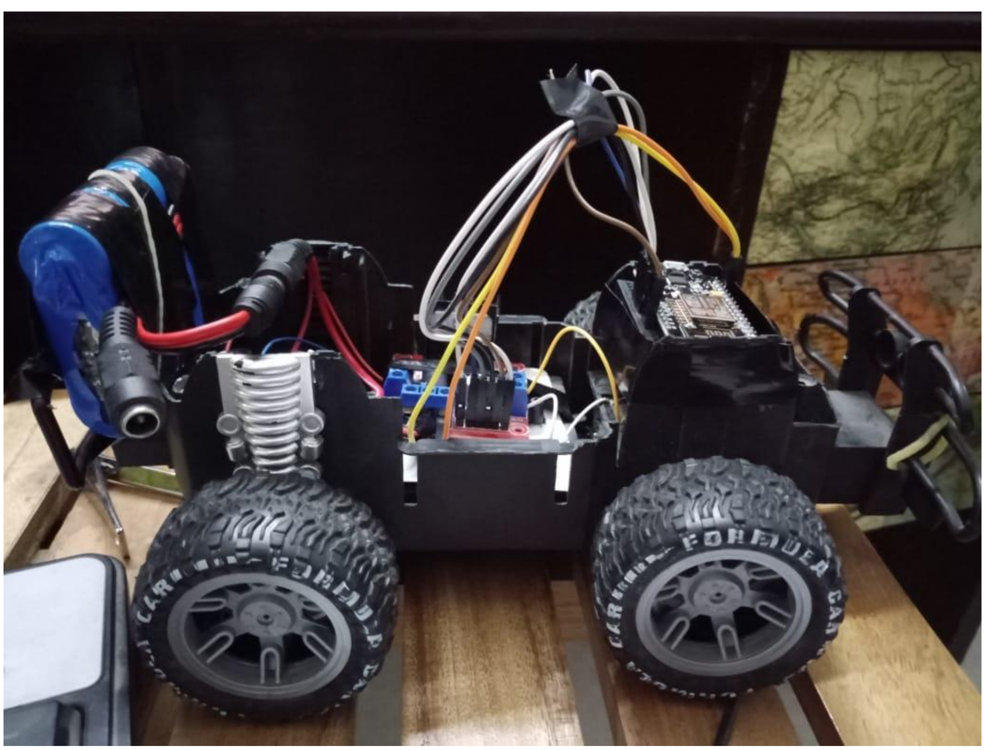
Implementing everything learned on RC Toy Car

Now our final task was to implement our Floor and Non-Floor Algorithms practically on RC Toy Car. We used the following components in order to make our toy car functional:

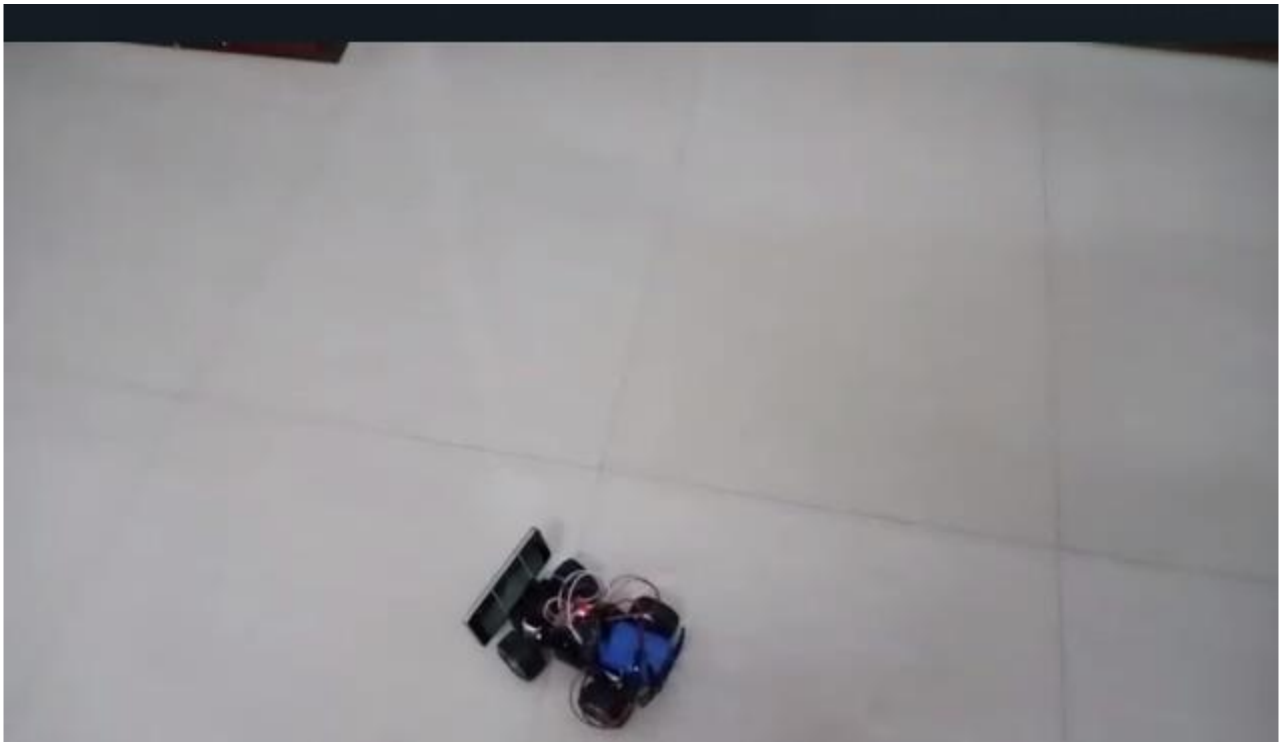
1. L298N Motor Driver
2. NODEMCU ESP8266
3. BATTERY
4. MOBILE CAMERA

We created the connections by following the diagram below:





We then installed IP Web Cam application on mobile and placed the mobile Infront of the car. Both the Mobile and the Laptop were connected with the Wifi of NodeMCU module. The Ip camera sends feed at a particular Ip address and the algorithm in our laptop processes the feed and sends output to the car, whether it should move left, right or forward.



Link to Complete Material:

https://drive.google.com/drive/folders/1clmncWGGbVngWOYy6QVSFnQUrc7kR50J?usp=sharing

CONCLUSION AND LEARNING EXPERIENCE

This Internship was full of learning and the tasks at first seemed very difficult, but we are now proud that due to this internship we were able to develop a prototype of a self-driving car with a smaller number of resources. Along with that we also got the taste of hardware and Internet of Things.