Autonomous Taxi

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PCPG No. 148

Under the Mentorship of
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Problem Definition

- Not only is the increase in the number of accidents due to human negligence a major problem, but the number of premature deaths due to poor air quality continues to rise.
- It is expected that autonomous vehicles will help ease congestion and the improved traffic flow will not only save the fuel bills but also help in improving the air quality. The death rate due to road accidents will also reduce significantly.
- In this project we are trying to take autonomous cars one step ahead by implementing an autonomous taxi. This taxi would eliminate the need for human drivers ,which represents a significant part of the operating costs of such services and would make it affordable for customers.
- A user interface would be provided using which users can book the cab as per their requirements.

Project Scope

- This model is limited to train the model of taxi which will be capable of staying in the lane, avoid collisions with other vehicles in immediate vicinity, keep a track of other vehicles and stop at predefined destinations.
- A website is employed for connecting the customers with our organisation for booking the taxi as and when required. Apart from this, it also has multifarious purposes such as by connecting with large databases, it helps to track the number of users visiting our website.
- The project can be implemented on a larger scale with practical cars.

Project Objectives

- Smoothly move on trajectory.
- Stay in lane.
- Avoid collisions with other vehicles
- Switch lanes when necessary
- Stop at predefined destination.

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- Registration / Login
- Online booking
- Checking availability
- Calculating Fare

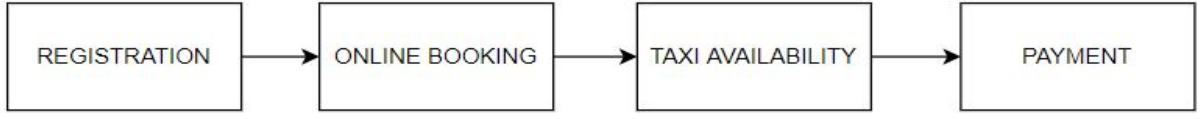
Literature Survey

- A research with the title “Autonomous Vehicles” was done. The strength of this research is that it reduces human error while driving and results in a decreasing possibility of accidents occurring. Better fuel efficiency is also achieved when more and more autonomous vehicles are promoted which will lead to changes in driving habits of the masses. Destination can be achieved in a short duration of time and moreover the safety algorithms applied make these vehicles more secure.
- "Autonomous Taxi Service Design and User Experience" by Sangwon Kim et al, is concerned with the problem of how an autonomous taxi service be designed and field-tested if the self-driving technology is imperfect. This study conducted field tests with scenarios involving an actual taxi, and examined customer pain points. It provides user-experience-based design solutions for resolving them.

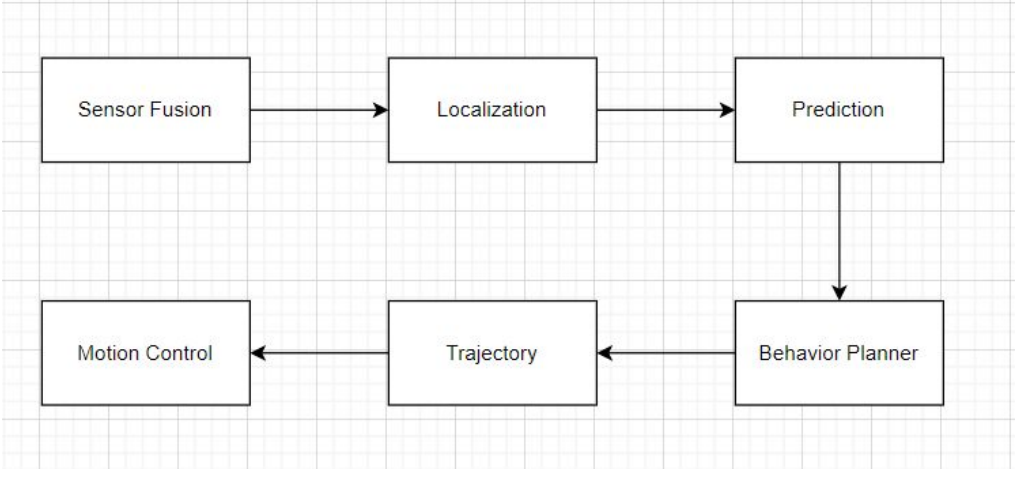
- "Impacts of Shared Autonomous Taxis in a Metropolitan Area" by Wilco Burghout, Pierre-Jean Joseph Rigole and Ingmar Andreasson provided an analysis of potential benefits of a fleet of shared autonomous taxis "aTaxis" when replacing private car commuter trips in a metropolitan city.
- "Routing an Autonomous Taxi with Reinforcement Learning" by Miyoung Han, Pierre Senellart, Stéphane Bressan and Huayu Wu proposed that the design and implementation of intelligent routing algorithms in deployment of autonomous taxis. They demonstrate that a reinforcement learning algorithm of the Q-learning family, based on a customized exploration and exploitation strategy, is able to learn optimal actions for routing autonomous taxis in a real scenario at the scale of the city of Singapore with pick-up and drop-off events for a fleet of one thousand taxis.

Architecture of the Project

Block Diagram of Taxi Booking system:

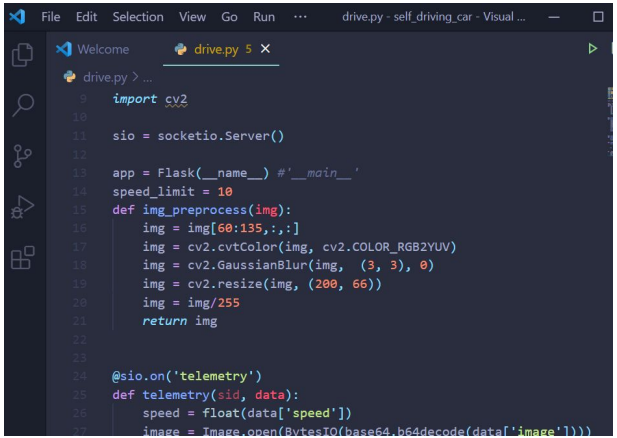


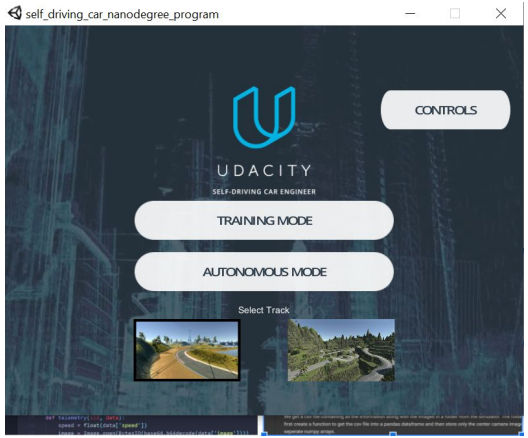
Block Diagram of Autonomous Taxi:



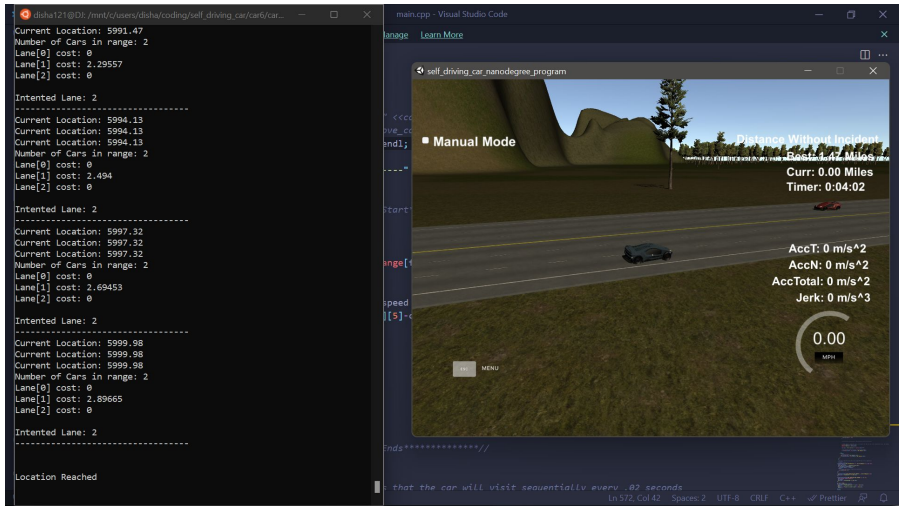
Tools used

- Visual Studio Code for WebDev and model testing.
- Visual Studio Code, Udacity Self driving simulator for car model.



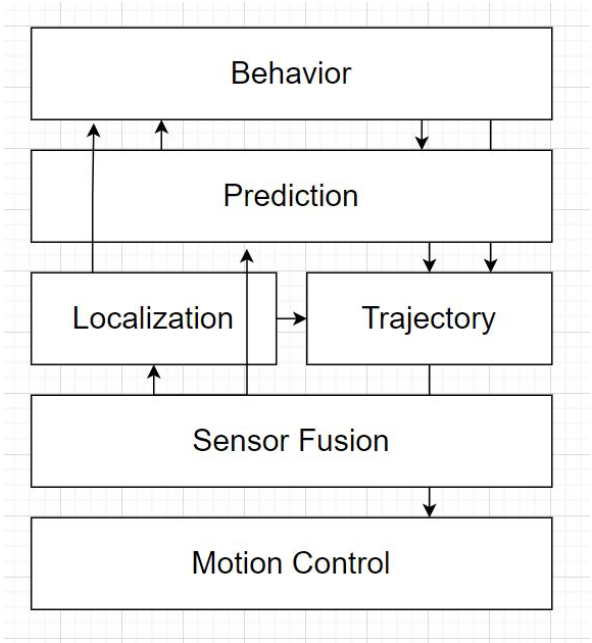


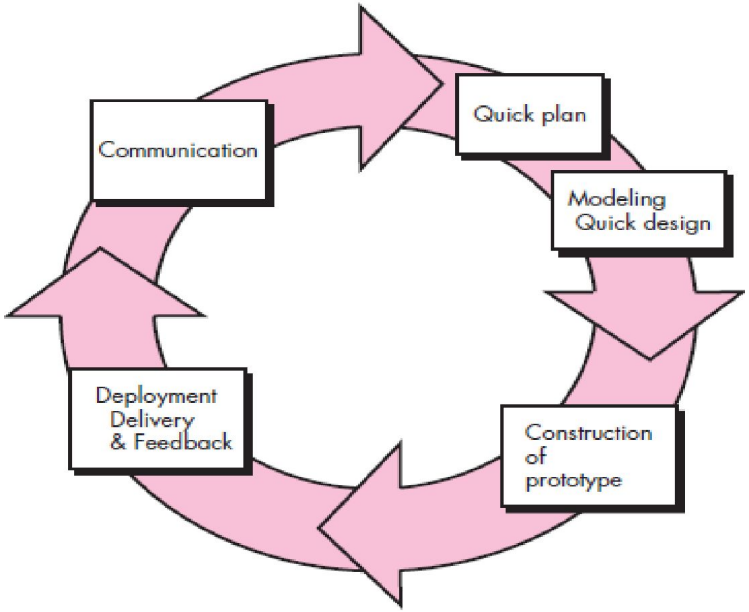
Snapshots


Current Location: 5991.47
Number of Cars in range: 2
Lane[0] cost: 0
Lane[1] cost: 2.29557
Lane[2] cost: 0
Intented Lane: 2
Current Location: 5994.13
Current Location: 5994.13
Current Location: 5994.13
Number of Cars in range: 2
Lane[0] cost: 0
Lane[1] cost: 2.494
Lane[2] cost: 0
Intented Lane: 2
Current Location: 5997.32
Current Location: 5997.32
Current Location: 5997.32
Number of Cars in range: 2
Lane[0] cost: 0
Lane[1] cost: 2.69453
Lane[2] cost: 0
Intented Lane: 2
Current Location: 5999.98
Current Location: 5999.98
Current Location: 5999.98
Number of Cars in range: 2
Lane[0] cost: 0
Lane[1] cost: 2.89665
Lane[2] cost: 0
Intented Lane: 2
Location Reached
self_driving_car_nanodegree_program
Manual Mode
Distance Without Incident
Curr: 0.00 Miles
Timer: 0:04:02
AccT: 0 m/s^2
AccN: 0 m/s^2
AccTotal: 0 m/s^2
Jerk: 0 m/s^3
0.00
MPH
MENU


Dashboard
Rides
Profile
All Rides
22
Go To
Pending Rides
18
Go To
Completed Rides
2
Go To
Cancelled Rides
2
Go To
Total Spendings
₹4296
on Completed Rides
Edit
Profile
Go To

Methodology





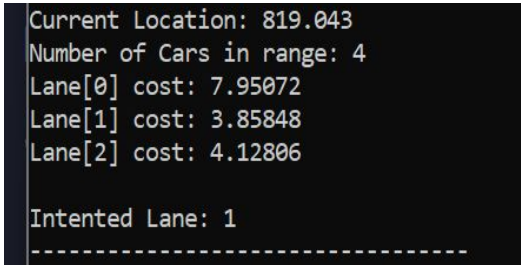
Algorithms Used in Taxi Model

Lane Cost: The system is developed on lane cost. There are 3 lanes on one side of our highway and if. The cost of each lane depends on two factors:

- Distance between the taxi and other vehicles.
- Speed of the other vehicle

Total cost of a vehicle = distance / speed.

Vehicle Count: For our project we kept a track of vehicles 100m ahead of us and 10m behind us.



Algorithms Used in Taxi Model

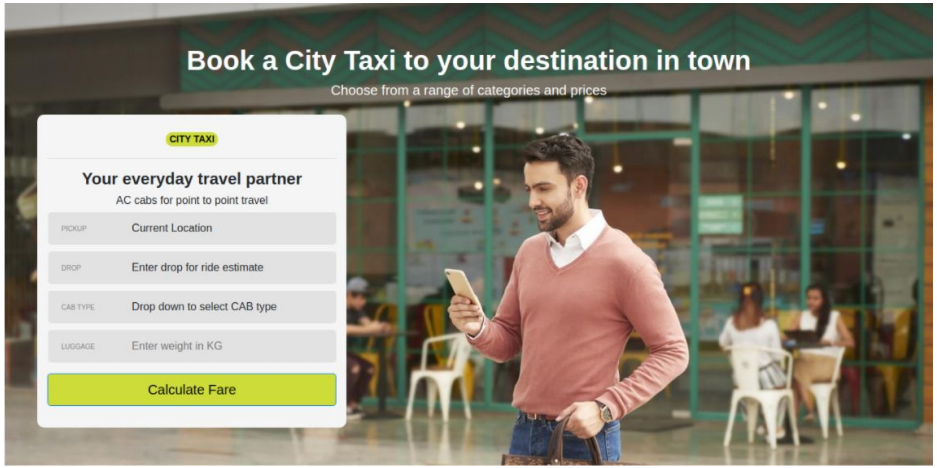
Stopping at the destination:

- The stopping and starting point for our taxi are predefined.
- When the destination point is reached the vehicle starts to slow down and then stops completely and waits there for a predefined period of time.
- After that the vehicle starts to slowly increase its speed until it is moving smoothly on the road.
- When it reaches the starting point again, the car stops moving and our task is finished.

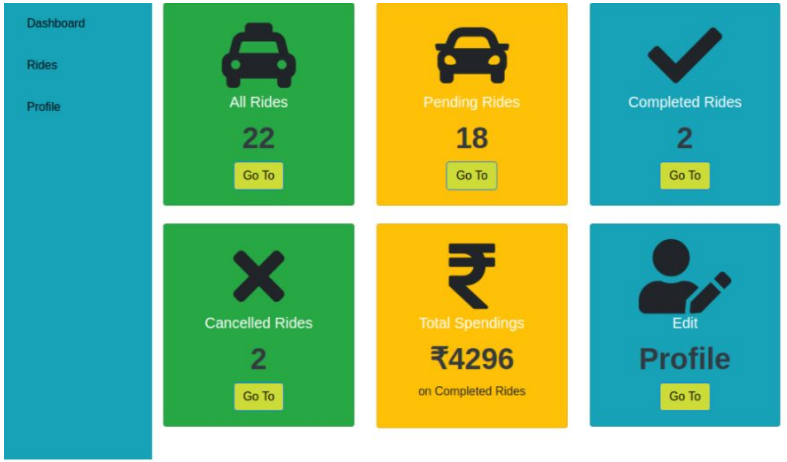
```
if(car_s >= 1000 && !stopped_once){
  stopped_once = true;
  double prev_speed = car_speed;
  while(car_speed> 0){
    car_speed--;
    sleep(0.5);
  }
  cout<<"\n\nLocation Reached\n\n<<endl";
  sleep(10);
  while(car_speed < prev_speed){
    car_speed++;
    sleep(0.2);
  }
}
```

Website

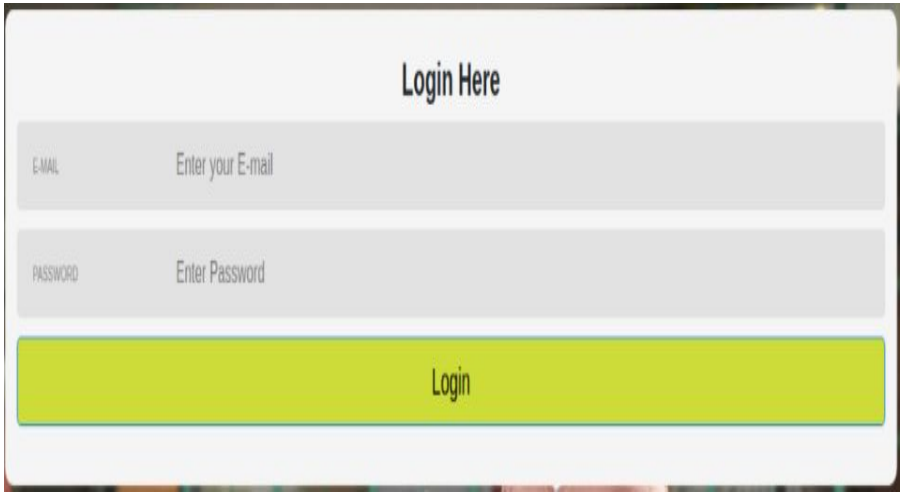
Landing Page:



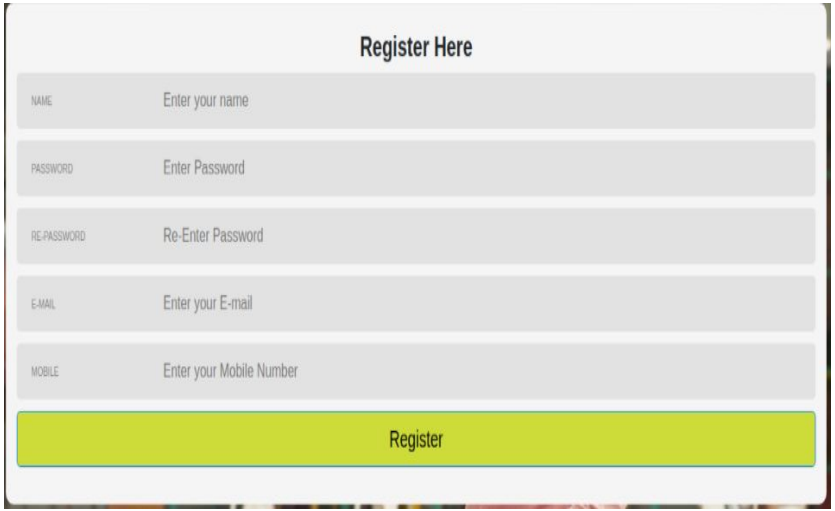
User Dashboard:



Sign In Window: This window is actually created with the purpose that whenever a customer tries to book a cab prior to that he has to register in the database for the same about his activity status.



Signup Window: Registration form wherein the operator will ask for the details of the customer such as name, address etcetera.



Key Highlights / Deliverables

- The taxi runs fine in the environment even when there are a lot of cars present.
- The taxi was able to smoothly move on its trajectory without any sudden jerks and accelerations.
- The taxi changes lanes successfully.
- The taxi was able to avoid most of the obstacles.
- Code to run the taxi runs perfectly.
- The taxi stops at the predefined locations.
- There is a little jerk when the car stops at its location. It can be improved.
- Website has been made successfully and allows users to login/register depending on requirements.
- Users are able to input pickup and drop location.
- On the basis of both locations estimated fare is calculated.
- QR code would be provided in every cab for successful payment.

Future Scope

- The project can be deployed on a large scale in real life situations.
- Many major companies are designing their own self-driving cars and there are a lot of taxi booking systems available in the market.
- The combination of these two is not very far. This is an upcoming field which will be a revolution in the computer science industry.
- Our project is done using a simulator to simulate real life scenarios, although it doesn't consider all the problems that come with real life and only focuses on a few of them.
- This project can be deployed on a large scale with proper technology available.

Role/Contributions Of Individual Team Members

- Harsimranjot (101803224) - Web Design and Development of Website for Taxi Booking.
- Disha Jindal(101803330) - Work with the simulator. Design the autonomous taxi model.
- Prerna Puri (101803332) - Web Design and Development of Website for Taxi Booking.
- Navleen Kaur (101853032) - Work with the simulator. Design the autonomous taxi model.

Thank You.