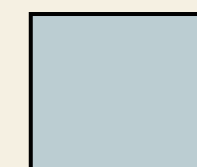
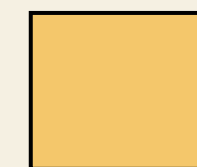




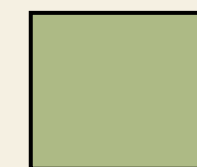
GPS Toll-Based System Simulation Using Python



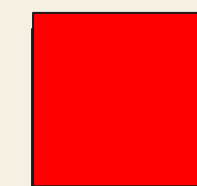
Mabelle George



Alina Manu



Sambhram Sakalesh



Ryan G Arakkal

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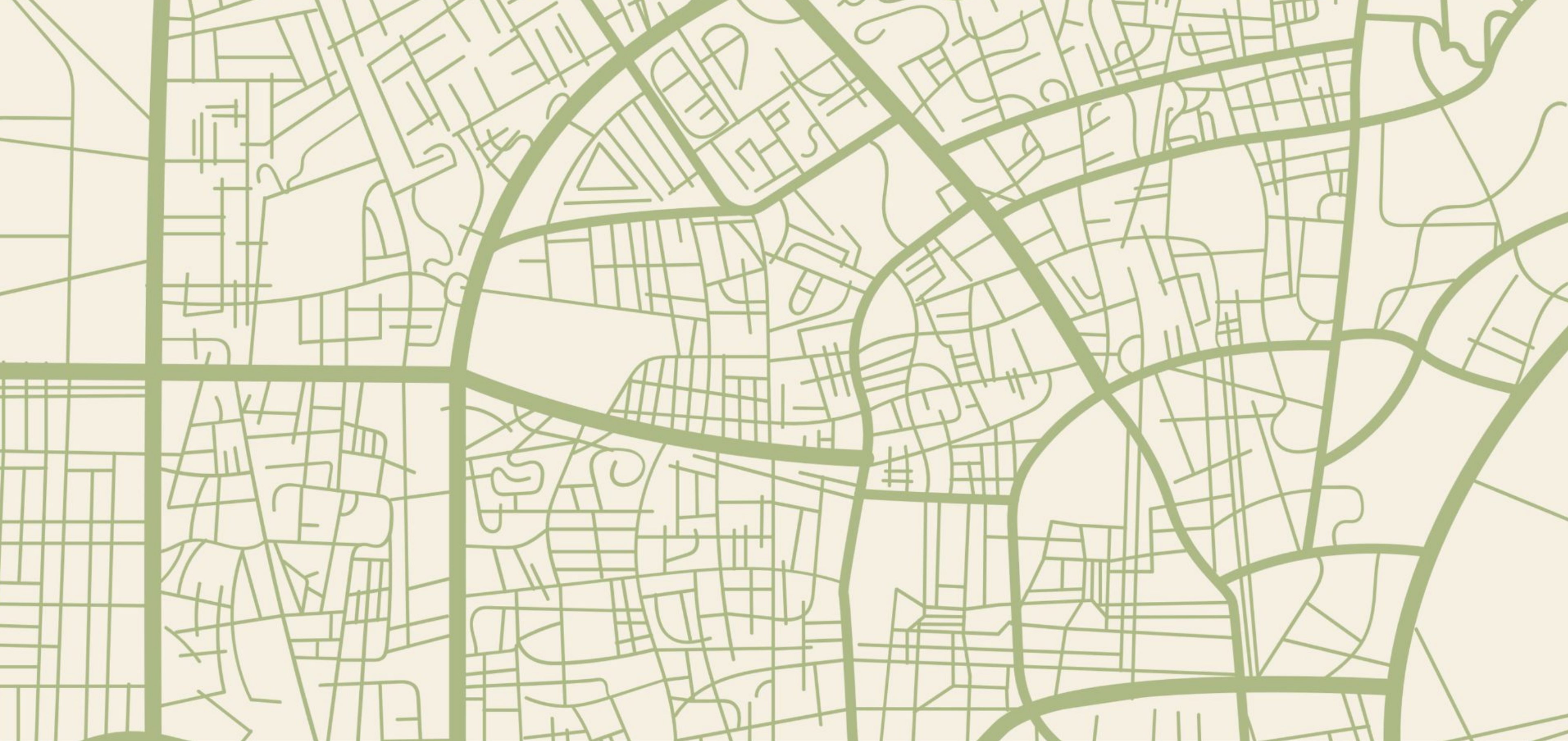
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01.Problem Statement

Problem Statement

Objective:

Develop a Python-based simulation of a GPS Toll-Based System that calculates and collects toll fees for vehicles based on their GPS-tracked routes. The system should be able to handle multiple vehicles, different toll zones with varying rates, and provide reports on toll collection.

Requirements:

1. Vehicle Management :

- **Vehicle Registration** : Allow registration of vehicles with unique IDs, types (e.g., car, truck, motorcycle), and owners.
- **GPS Tracking** : Simulate GPS tracking for each vehicle to record their movement through predefined toll zones.

2. Toll Zones :

- **Zone Definition** : Define multiple toll zones with specific geographical boundaries (latitude and longitude) and toll rates.
- **Dynamic Pricing** : Support different toll rates based on vehicle type and time of day (e.g., peak hours, off-peak hours).

3. Toll Calculation :

- **Entry and Exit Detection** : Detect when a vehicle enters and exits a toll zone using simulated GPS data.
- **Fee Calculation** : Calculate the toll fee based on the vehicle's type, the duration spent in the toll zone, and the applicable toll rate.

4. Payment System :

- **Account Management** : Maintain a virtual account for each vehicle owner to store toll charges.
- **Automatic Deduction** : Automatically deduct toll fees from the vehicle owner's account upon exiting a toll zone.
- **Notifications** : Notify vehicle owners of toll charges via email or SMS (simulation of notifications).

Problem Statement

5. Reports and Analytics :

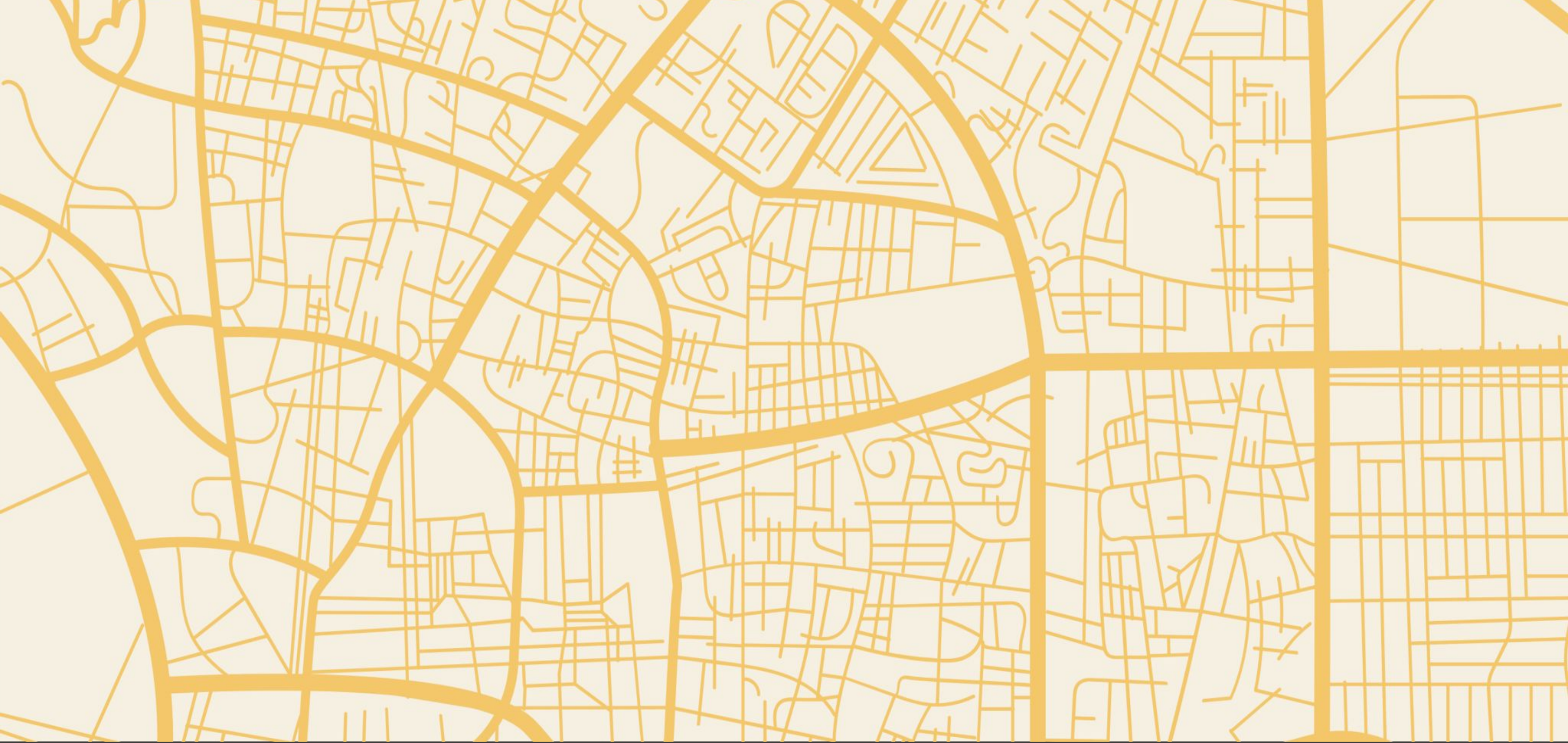
- **Toll Collection Report** : Generate daily, weekly, and monthly reports showing total toll collection, broken down by vehicle type and toll zone.
- **Vehicle Usage Report** : Generate reports on individual vehicle usage, showing toll zones visited, total toll charges, and travel history.

6. Simulation Environment :

- **Real-time Simulation** : Simulate vehicle movement through toll zones in real-time or with accelerated time.
- **Interactive Map** : Display an interactive map showing toll zones, vehicle locations, and movement in real-time.

Points to Consider:

- **Scalability** : Ensure the system can handle a large number of vehicles and toll zones efficiently.
- **Extensibility** : Design the system to allow easy addition of new features, such as new types of vehicles or toll zones with complex pricing rules.
- **User Interface** : Provide a simple command-line interface (CLI) for interaction and a web-based interface for visualization and reports (optional).



02.Unique Idea Brief (Solution)

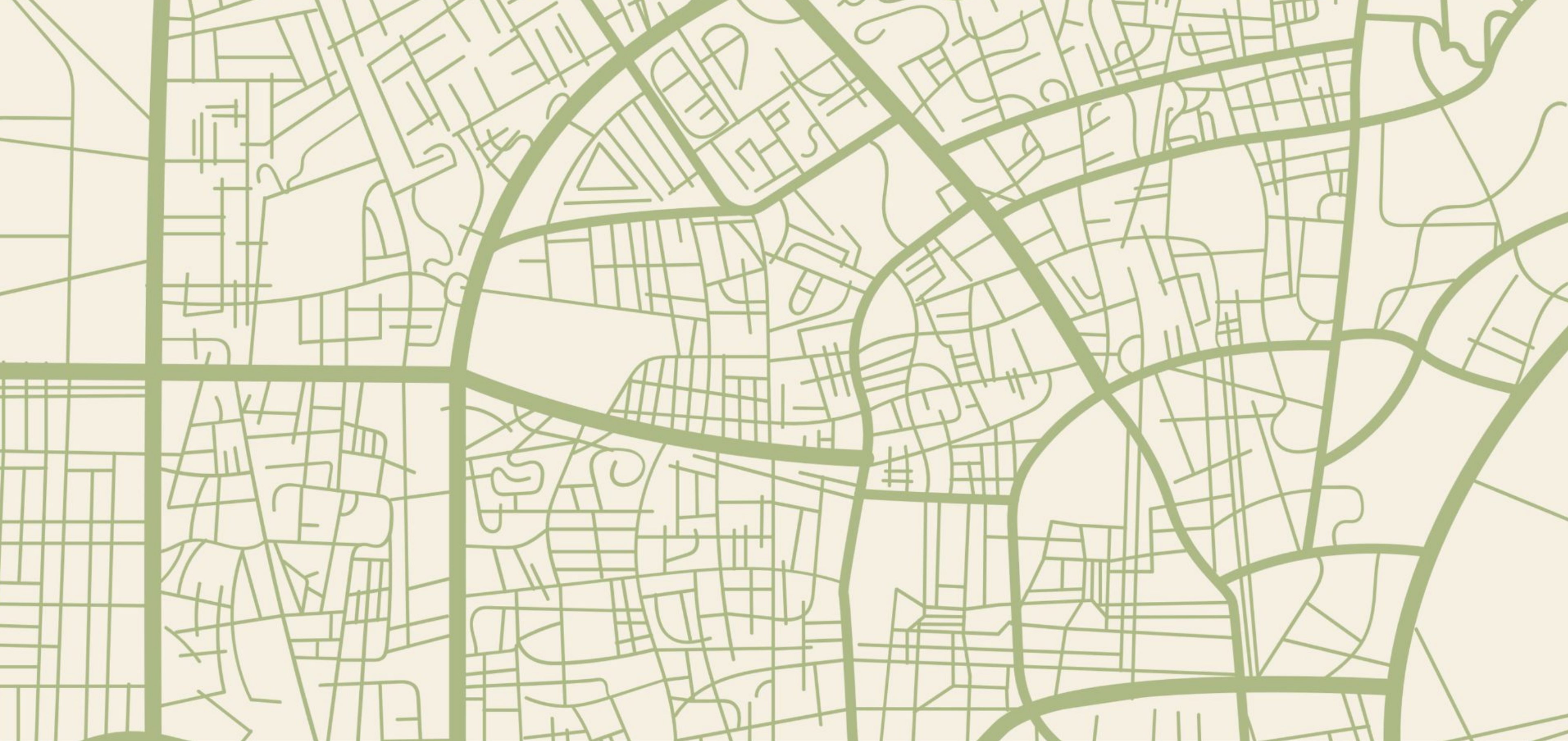
Unique Idea

Brief Solution Overview:

- We plan on tracking the vehicle and when the ping of the vehicle is 8m away from the coordinate of the toll road according to the geojson file, our code starts working.
- The ping is then checked to see whether it is on the toll road. Each ping comes through every five seconds and if it is on the toll road, the calculation is continued. The moment the vehicle pings show that it has left the toll road, the final toll price as well as the address of exit is printed.
- We plan to charge the vehicles according to the following table:

<u>Vehicle Type</u>	<u>Pricing/Km</u>
Car/Van/Jeep	Rs2.0
LCV	Rs2.5
Bus/Truck	Rs3.0
Upto 3 axle	Rs3.5
4 to 6 axle	Rs4.0
HCM/EME	Rs4.5

- This pricing is editable.

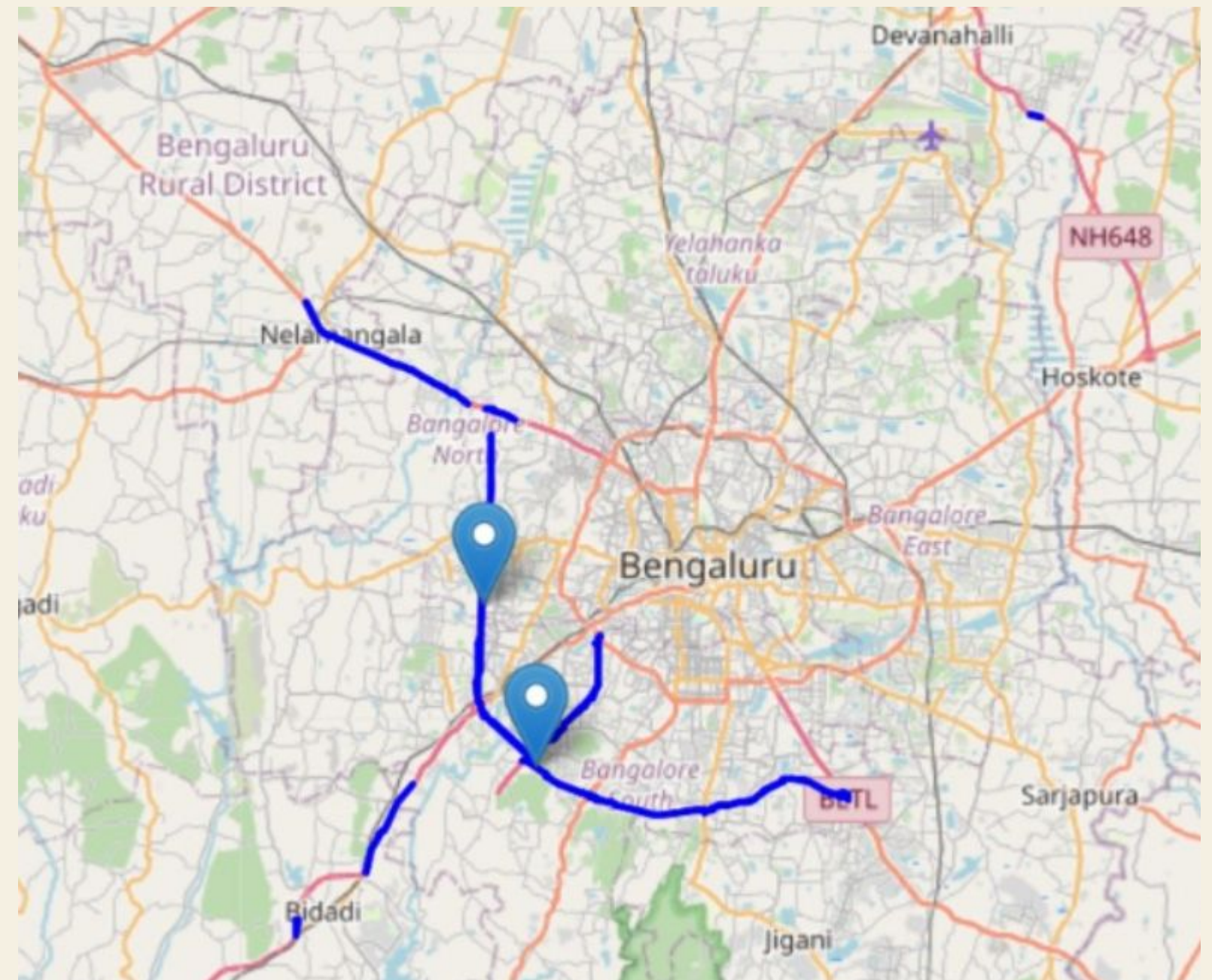


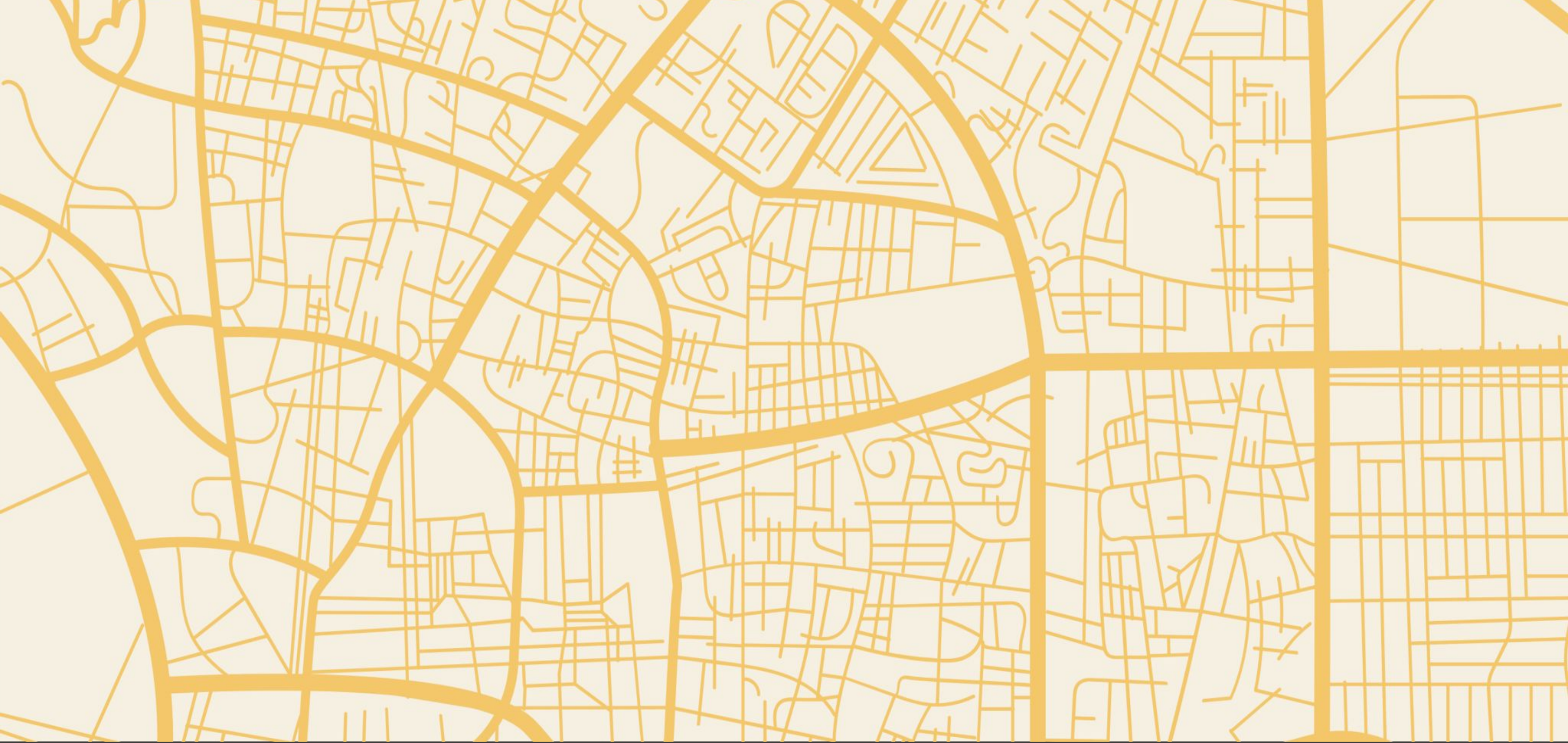
03.Features Offered

Features Offered

Key Features Offered:

- Accurate and effective toll calculation.
- It is a scalable solution as we can input a geojson file of the toll roads of any location and thus map out the roadway.
- It visually displays the movement of the vehicles on a map and thus it is easy to comprehend.
- It saves the toll charged and the coordinates in a csv table
- It removes waiting time at toll gates.
- Reduces the need of toll gate infrastructure and thus reduces cost for the government.
- Using Google API key, we are able to know the locations of the entry and exit points.





04.Process Flow

PROCESS FLOW

Stage 1

Legating the libraries among
to familiarize with them and
ming up with the flowchart.

Stage 4

Creating a front-end user
interface and a back-end
application to implement our
project.

Stage 2

Simulating vehicular movement
along the outlined toll roads.
Creating a database of vehicle

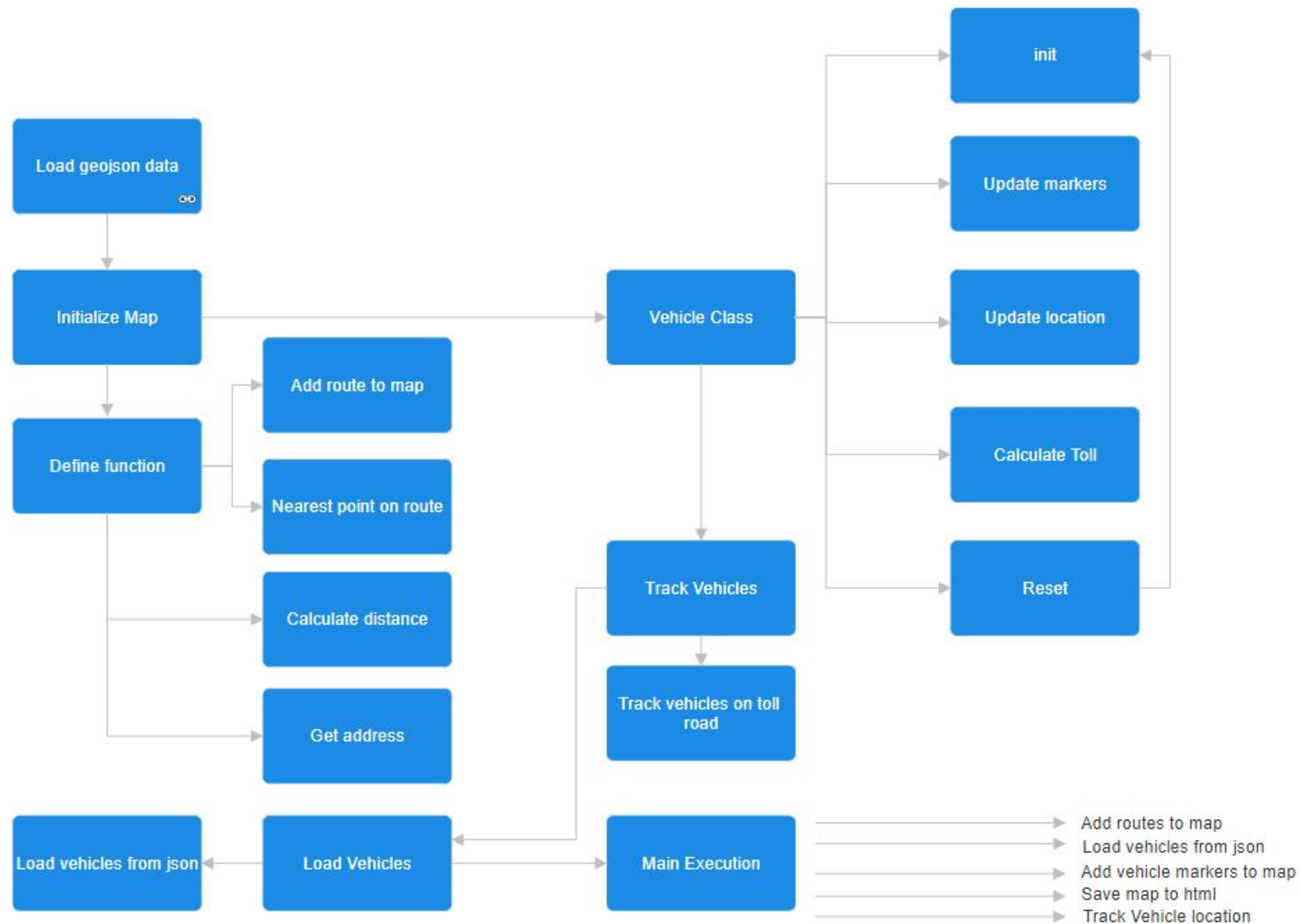
Stage 3

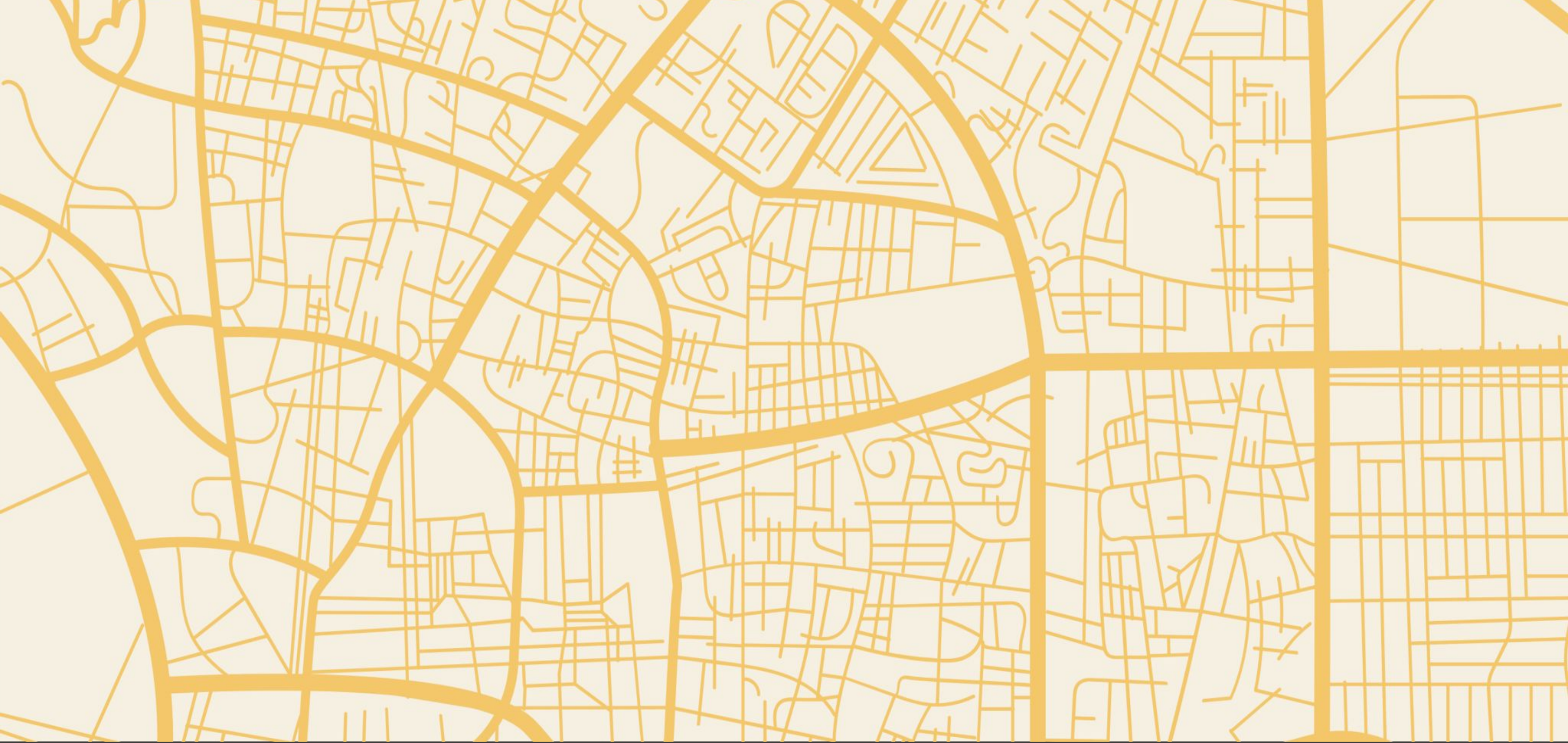
Calculating toll amount based on
the vehicle type and time.



05.Architecture Diagram

Architecture Diagram



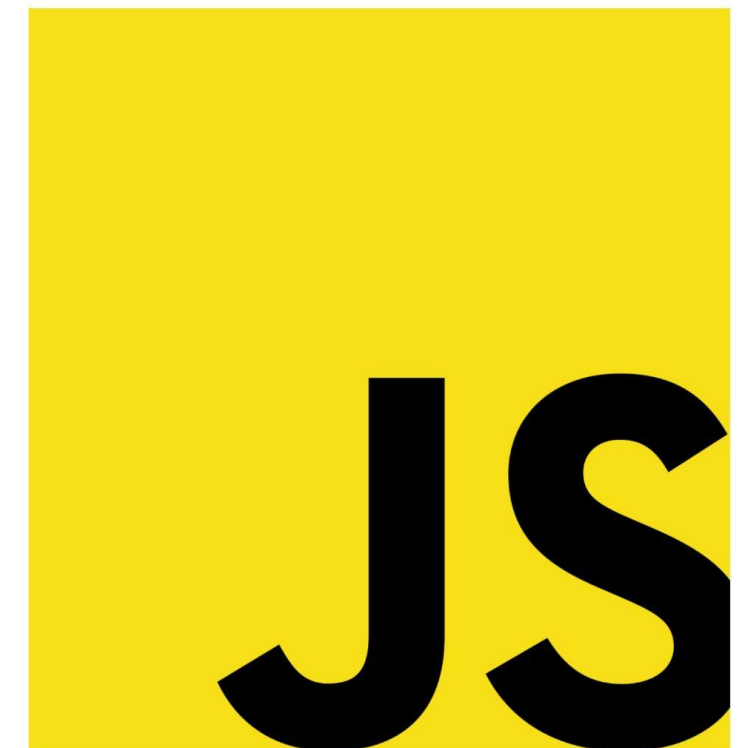


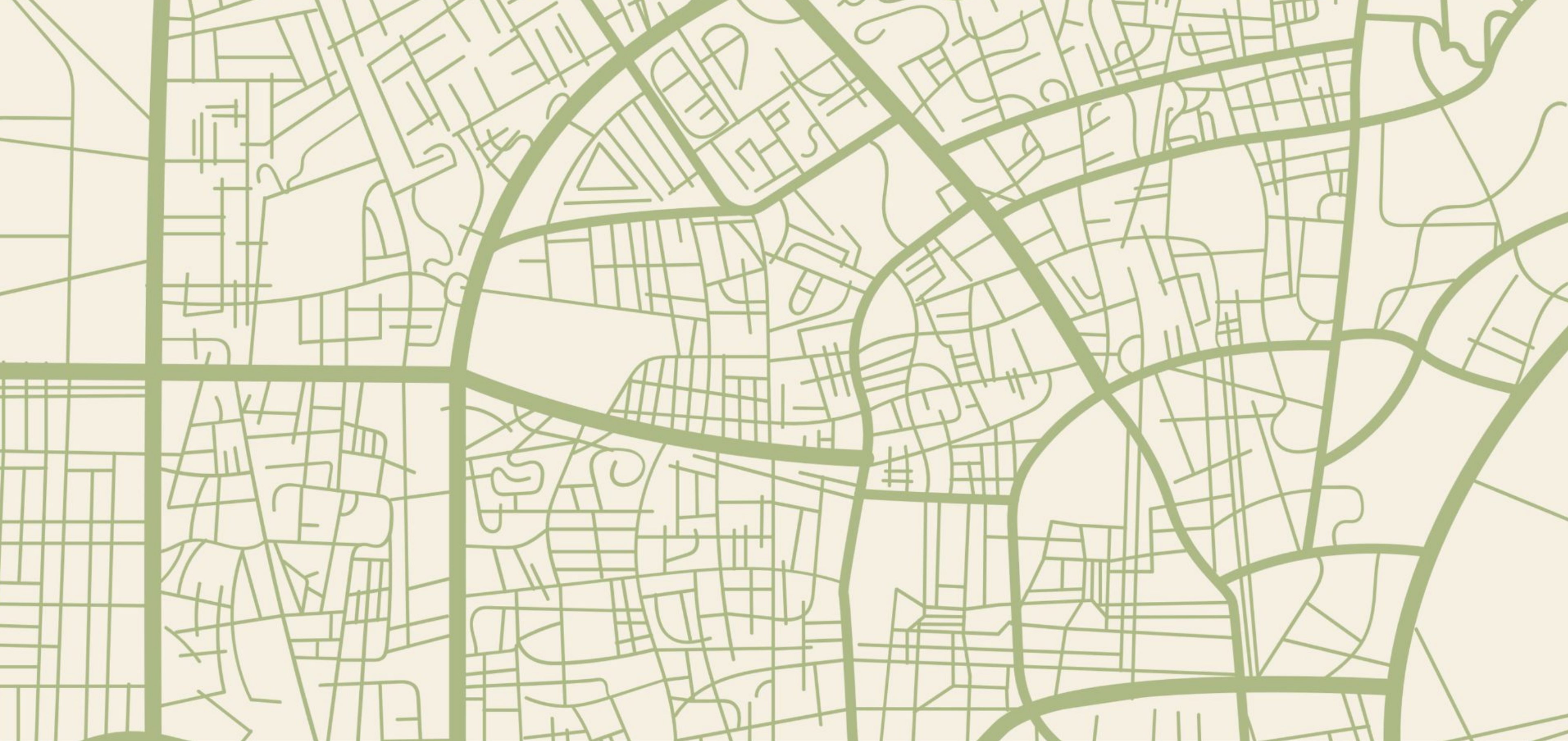
06.Technologies Used

Technologies Used

Technologies Used:

- Gretel AI - To generate the synthesized data for initial trial simulations.
- Python, Jupyter, Anaconda- Programming language used to carry out the concept.
- JavaScript, Visual Studio Code- Programming language used to carry out the back-end.
- Open Street Maps- To implement the map and outline the toll roads.





07.Team Members & Their Contributions

Roles



Sambhram Sakalesh

Developing back-end and front-end.
Framework Development.



Ryan G Arakkal

. Getting the datasets and routing the maps.
Developing back-end for the database. Framework
Development.



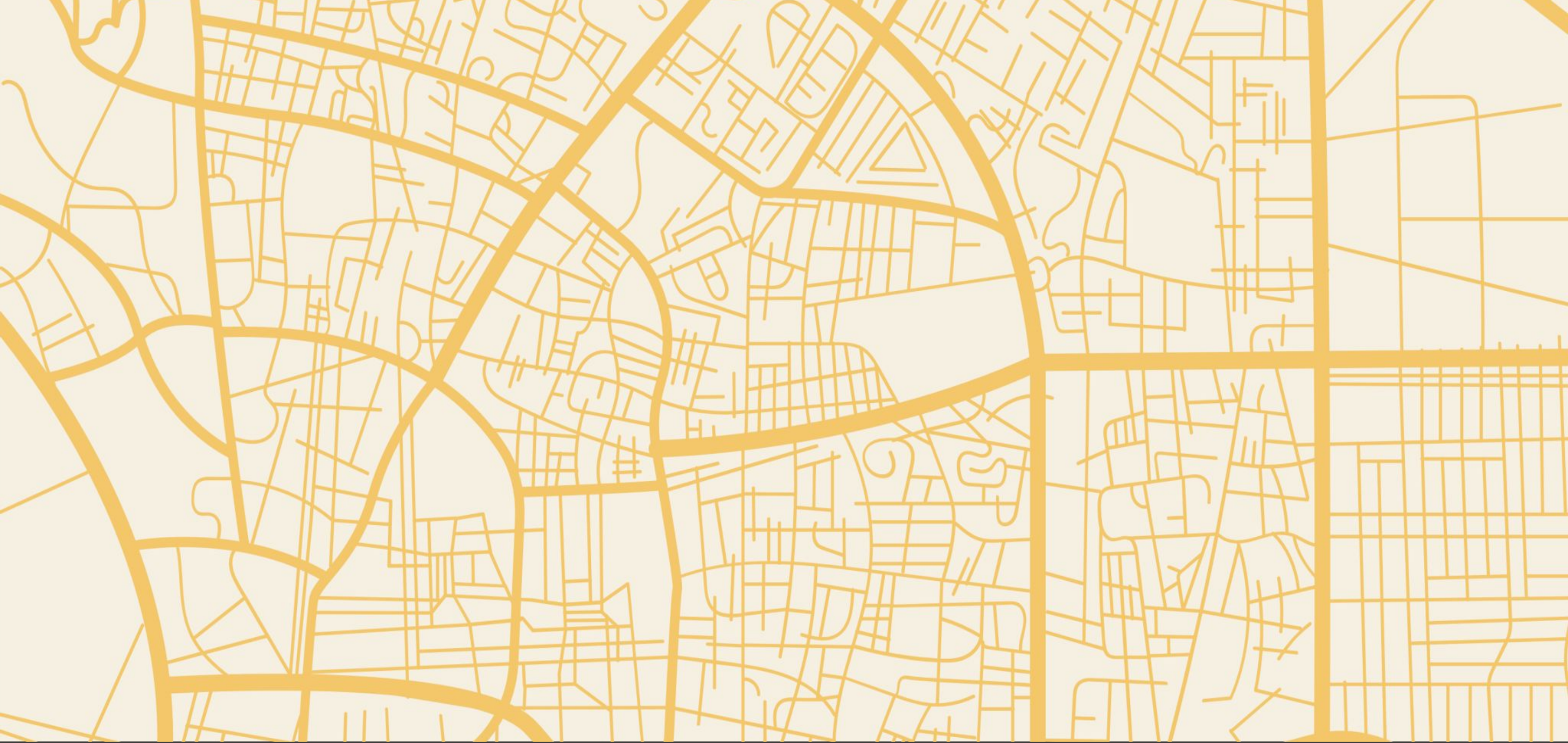
Alina Manu

Getting the datasets and working on the
front-end. Framework Development.



Mabelle George

Simulating the vehicles and developing the back-end
and front-end. Framework Development.

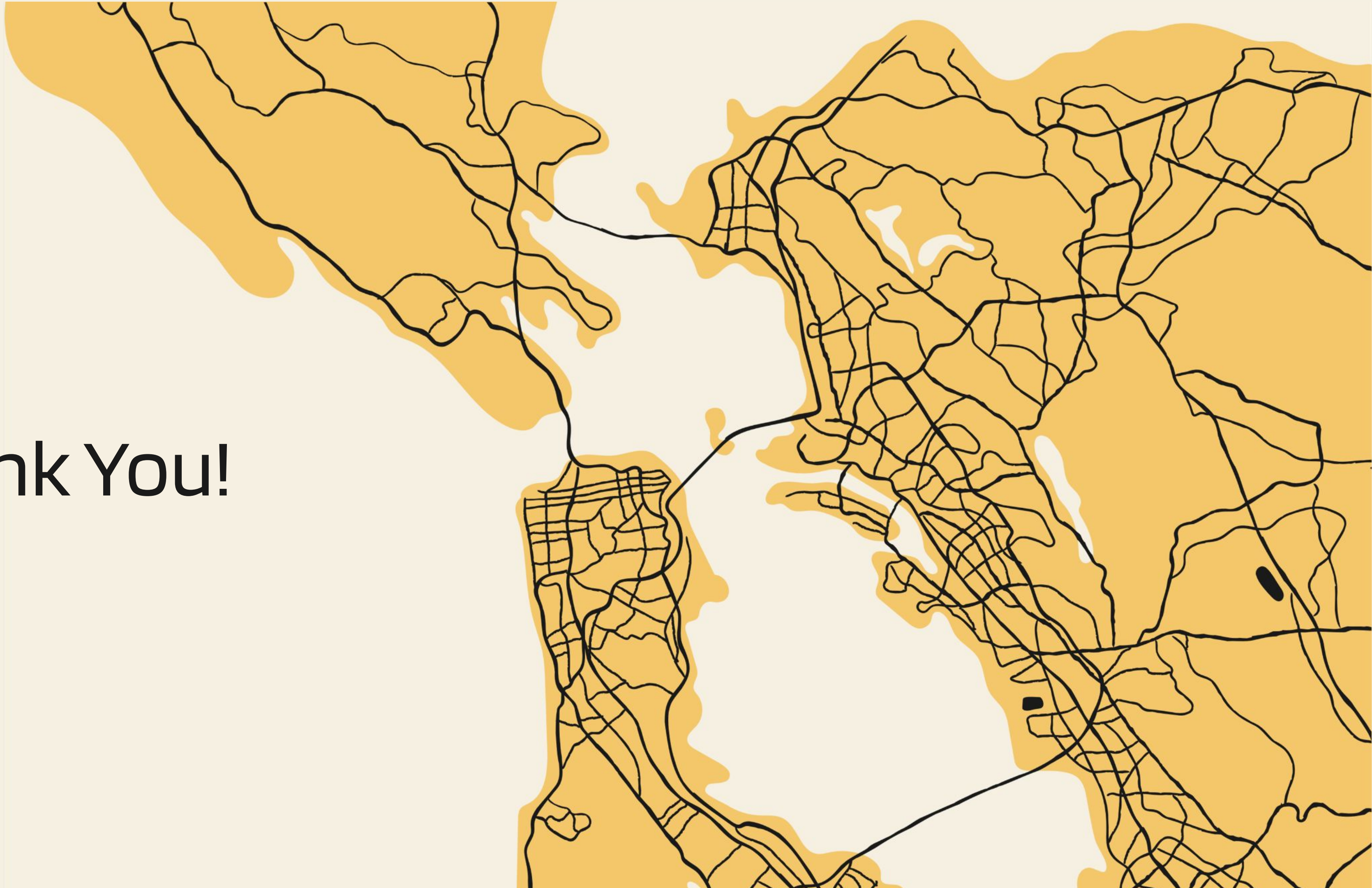


08.Conclusion

Conclusion

- The implementation of a GPS Toll-Based System represents a significant advancement in modern toll collection and traffic management.
- The GPS Toll-Based System eliminates the need for physical toll booths, reducing congestion and wait times. Vehicles can travel without stopping, leading to smoother traffic flow and reduced fuel consumption.
- GPS tracking ensures precise calculation of toll fees based on actual road usage, distance traveled, and specific toll zones entered. This method increases accuracy of the System.
- The system can easily accommodate dynamic pricing models, adjusting toll rates based on factors such as time of day, traffic conditions, and vehicle type. This flexibility allows for more effective traffic management and revenue optimization thus making it flexible.
- For road users, the system offers a hassle-free toll payment experience.
- By reducing the need for idling at toll booths and optimizing traffic flow, the system contributes to lower vehicle emissions and a smaller carbon footprint, promoting environmental sustainability.
- In conclusion, the GPS Toll-Based System offers a transformative solution for modern toll collection, providing significant benefits in terms of efficiency, accuracy, and user experience.

Thank You!



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