

PROJECT REPORT

GPS Based Toll Simulation Using Python

INTRODUCTION

Project Background and Context

In today's fast-paced world, efficient toll collection is crucial for maintaining smooth traffic flow and reducing congestion at toll booths. Currently, toll collection is primarily done through two methods: manual toll collection and FASTag.

Manual Toll Collection: This traditional method involves toll operators manually collecting cash or cards from drivers. While straightforward, it often results in long queues, increased travel time, and higher chances of human error and fraud.

FASTag : An RFID-based system introduced to alleviate some of the issues with manual toll collection. FASTag allows for automatic deduction of toll charges as vehicles pass through toll gates. While significantly reducing waiting times, it still has limitations, such as dependency on RFID technology and infrastructure, occasional tag reading failures, and the need for users to recharge their FASTag accounts.

Given these challenges, there is a growing need for more advanced and efficient toll collection systems. This project explores the potential of using GPS technology to develop an automated toll collection system.

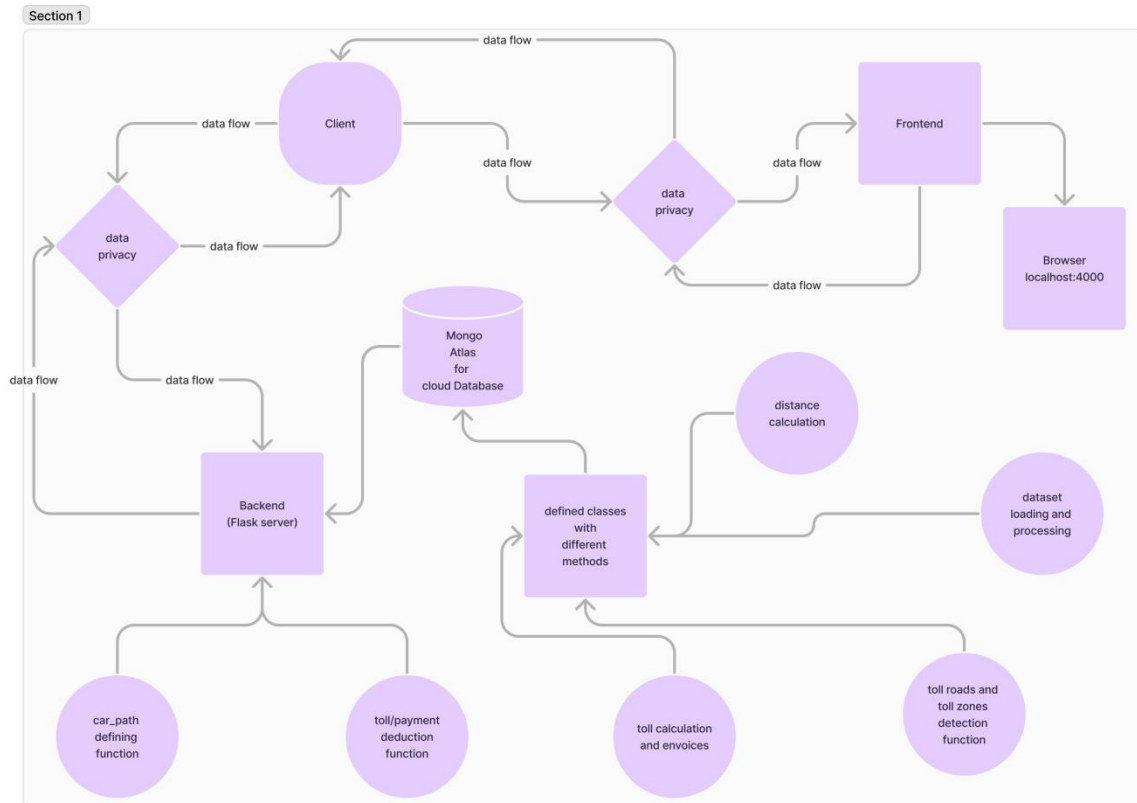
Objectives and Scope

The primary objective of this project is to develop a GPS-based toll simulation system using Python. The scope includes designing a system that can:

- Track vehicle movements using GPS data.
- Automatically calculate toll charges based on predefined routes and toll points.
- Toll collection on the basis of distance travelled at toll zones.
- Provide a simulation environment to test and validate the toll calculation algorithms.

Methodology

FlowChart of Code/Application



Technologies Used

Python – As Programming Language

Geopandas – Toll Zones/Toll Roads defining and visualization

Shapely – In Calculating Intersections between Vehicle Paths and toll zones

Pandas – In managing and analyzing data

Flask – to create a web-based interface

Pymongo – to store and retrieve car info and user account info

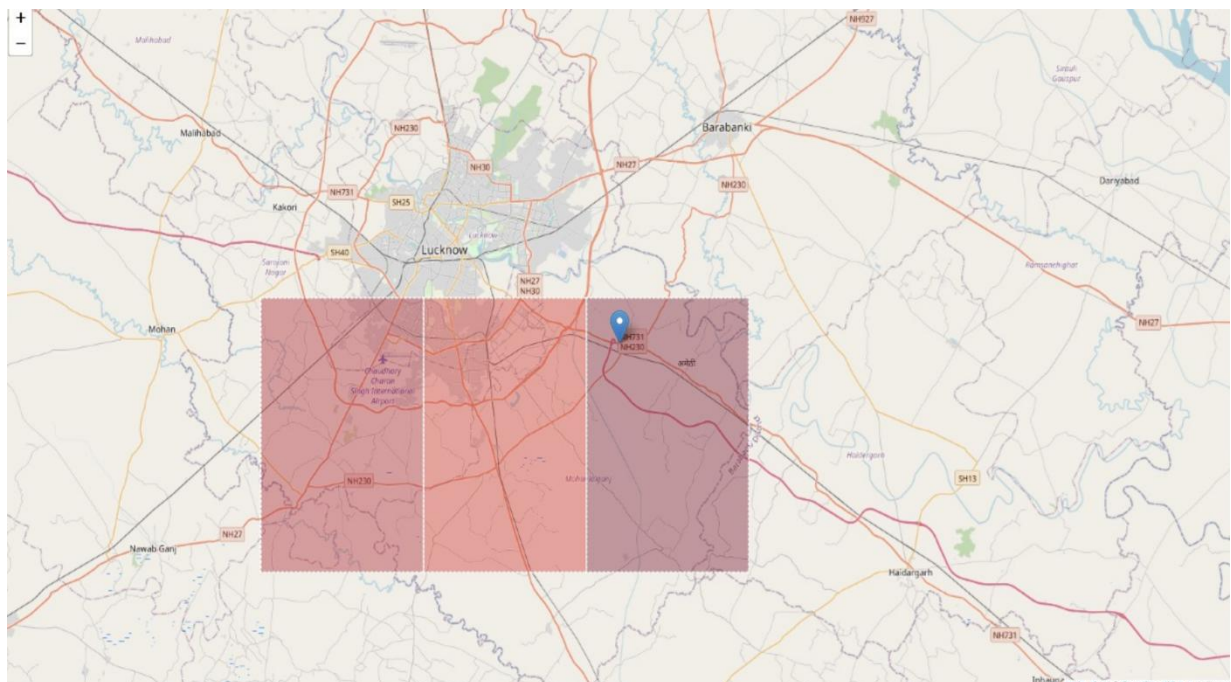
Cryptography – data privacy using encryption/decryption methods

Data Collection and Analysis Methods

1. GPS toll co-ordinates – required to create a perfect simulating model
2. Data Collection – required to implement in project
3. Data Security – required to secure user's data

Results:-

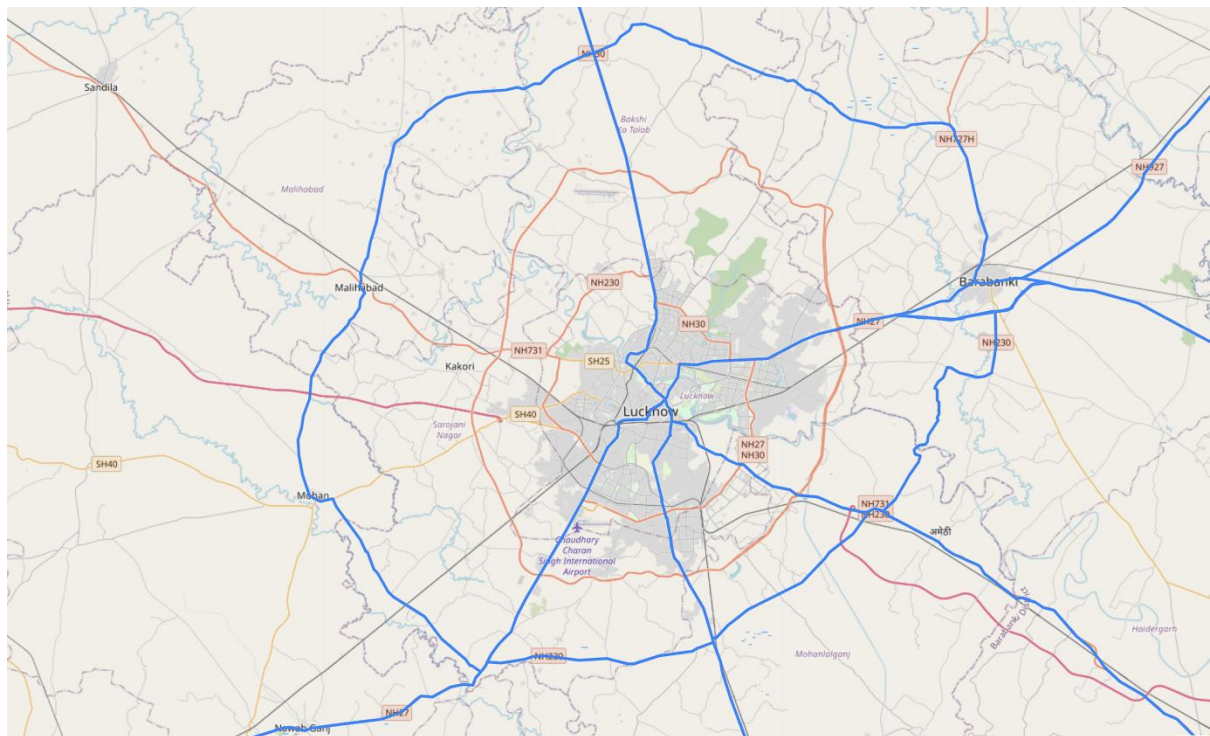
Real Time car location and zones



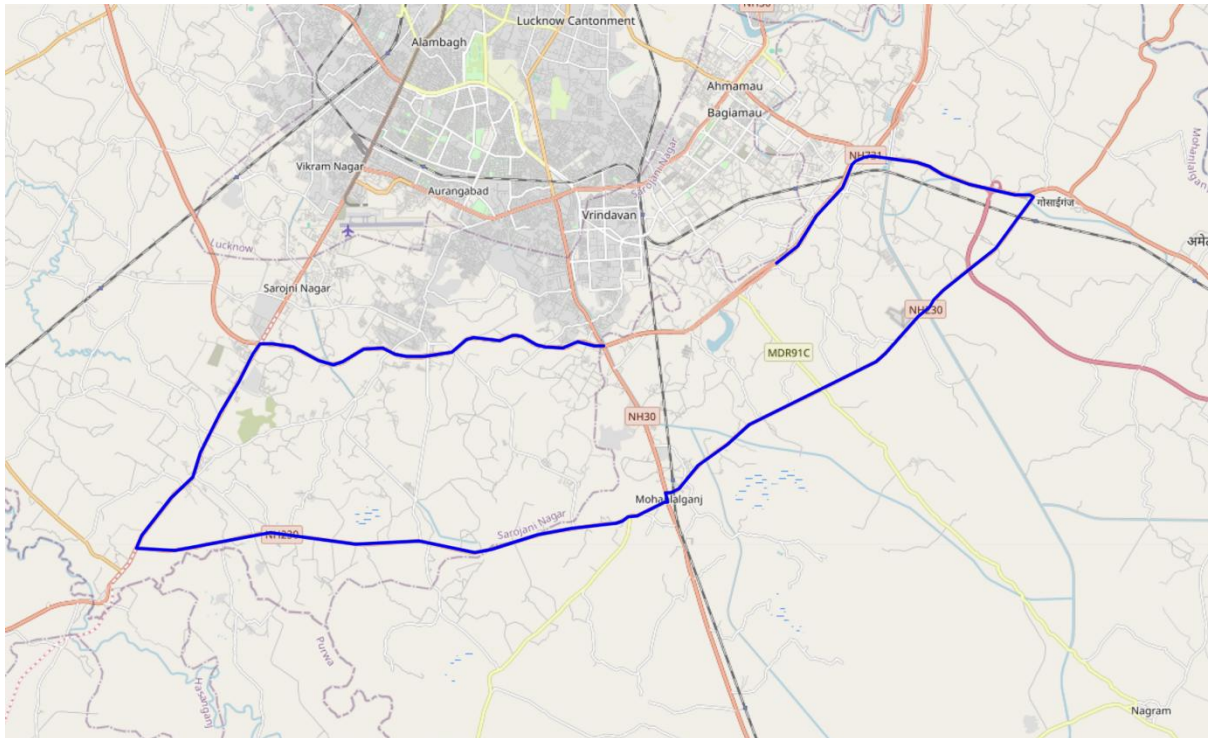
National Highways(India)



smaller region(for testing purpose)



Car_path(path of car where it will travel)



HOW TO USE THE APPLICATION-

1. Create a Virtual Environment
2. Copy the complete code base to environment folder
3. Install all the necessary modules/frameworks
4. Setup the MongoDB using your Email and password
5. Make sure you are in correct directory I.e base directory
6. In Application folder - run the Application.py script
7. In any browser - localhost:4000

Discussion

Interpretation of Results and Implications

1. Fast toll collection
2. No Payment Issue – Money is deducted directly from bank account.
3. Personalised Toll Collection – toll is deducted according to amount of path travelled on toll road.
4. Scalable Toll Collection System

Conclusion

Summary:-

This project develops a GPS-based toll simulation system using Python, Flask for the web interface, PyMongo for data management, and cryptography for data security. The system accurately tracks vehicle movements, calculates toll charges, and provides a user-friendly interface for interaction and visualization. It aims to automate toll collection, make it faster, and ensure data accuracy, benefiting transportation management and user convenience.

Appendices

Additional Resources or Supporting Documents

- **Appendix A:** System Architecture Diagram [Flowchart]
- **Appendix B:** Sample GPS Dataset [Toll Co-ordinates data]
- **Appendix C:** Python Code for Toll Calculation Algorithm
- **Appendix D:** Flask Application Code
- **Appendix E:** PyMongo Integration Code
- **Appendix F:** Cryptography Implementation

PROJECT MEMBERS

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