Industrial Internship Report on

”Smart City Traffic Patterns”

Prepared by

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Executive Summary
This report provides details of the Industrial Internship provided by upskill Campus and The IoT Academy in collaboration with Industrial Partner UniConverge Technologies Pvt Ltd (UCT). This internship was focused on a project/problem statement provided by UCT. Had to finish the project including the report in 6 weeks’ time. My project was Forecasting smart city traffic patterns which is a crucial area of research and development. Smart city traffic patterns developed with a focus on goal to predict traffic flow, identify congestion-prone areas, and anticipate future traffic demands. By doing so, cities can optimize transportation systems, reduce congestion, and improve air quality. This internship gave me a very good opportunity to get exposure to Industrial problems and design/implement solution for that. It was an overall great experience to have this internship.

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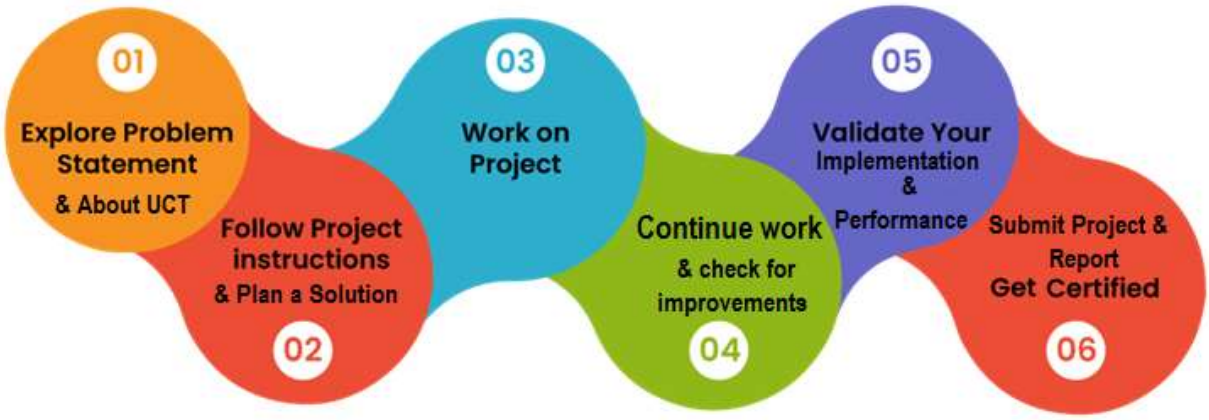
Summary of the whole 6 weeks' work.

About need of relevant Internship in career development.

Brief about Your project/problem statement.

Opportunity given by USC/UCT.

How Program was planned



I would like to thank upskillCampus which is collaborated with uniconverge technologies for creating an opportunity to improve my learnings and gain knowledge on machine learning models by contributing real time project. Its really fruitful for me to understand the project under your guidance throughout the way.

2 Introduction

2.1 About UniConverge Technologies Pvt Ltd

A company established in 2013 and working in Digital Transformation domain and providing Industrial solutions with prime focus on sustainability and RoI.

For developing its products and solutions it is leveraging various **Cutting Edge Technologies e.g. Internet of Things (IoT), Cyber Security, Cloud computing (AWS, Azure), Machine Learning, Communication Technologies (4G/5G/LoRaWAN), Java Full Stack, Python, Front end** etc.

i. UCT IoT Platform (UCT Insight)

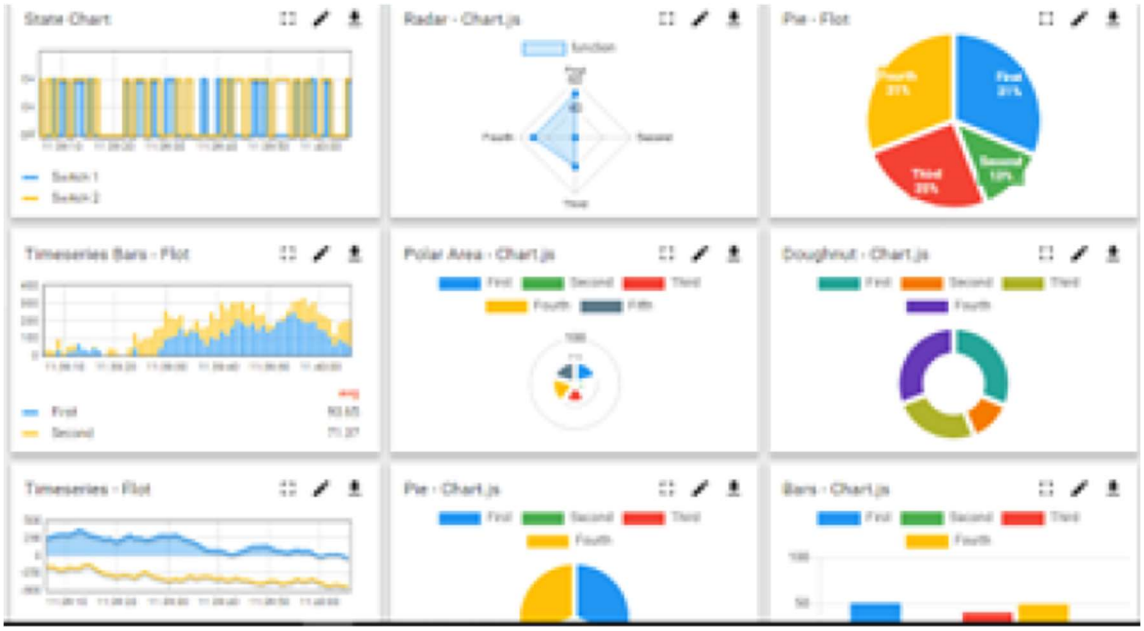
UCT Insight is an IOT platform designed for quick deployment of IOT applications on the same time providing valuable "insight" for your process/business. It has been built in Java for backend and ReactJS for Front end. It has support for MySQL and various NoSql Databases.

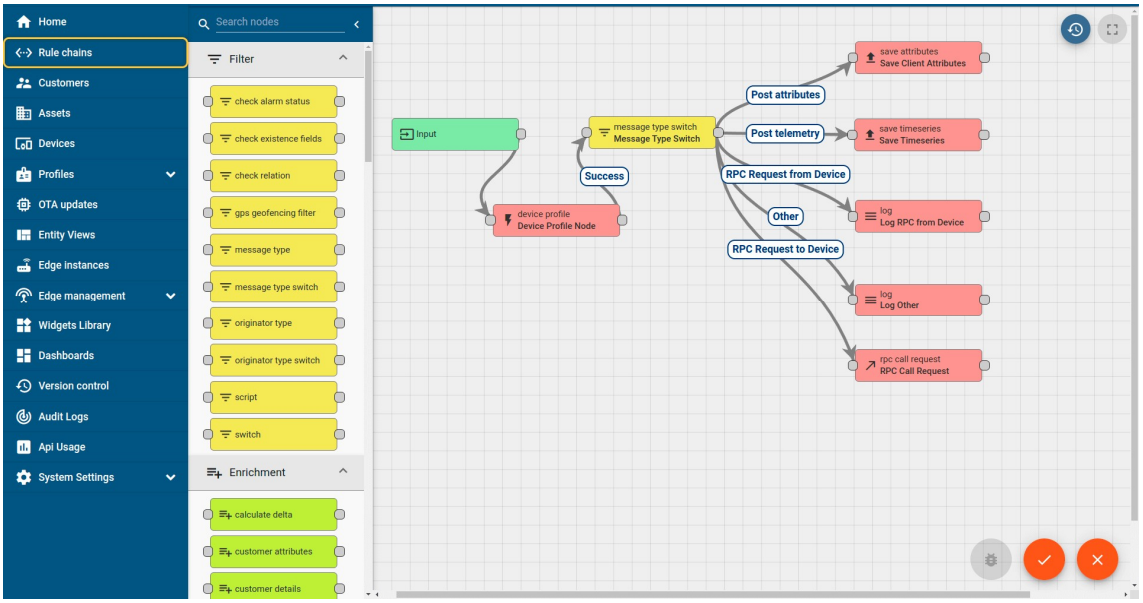
- It enables device connectivity via industry standard IoT protocols - MQTT, CoAP, HTTP, Modbus TCP, OPC UA

- It supports both cloud and on-premises deployments.

It has features to

- Build Your own dashboard
- Analytics and Reporting
- Alert and Notification
- Integration with third party application(Power BI, SAP, ERP)
- Rule Engine





ii. **Smart Factory Platform (** FACTORY WATCH **)**

Factory watch is a platform for smart factory needs.

It provides Users/ Factory

- with a scalable solution for their Production and asset monitoring
- OEE and predictive maintenance solution scaling up to digital twin for your assets.
- to unleased the true potential of the data that their machines are generating and helps to identify the KPIs and also improve them.
- A modular architecture that allows users to choose the service that they what to start and then can scale to more complex solutions as per their demands.

Its unique SaaS model helps users to save time, cost and money.

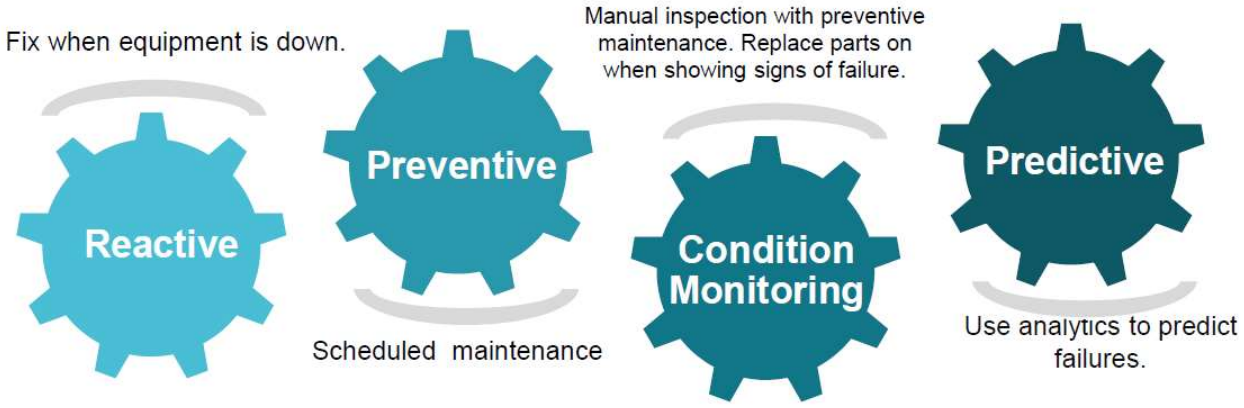
Machine	Operator	Work Order ID	Job ID	Job Performance	Job Progress		Output		Rejection	Time (mins)				Job Status	End Customer
					Start Time	End Time	Planned	Actual		Setup	Pred	Downtime	Idle		
CNC_S7_81	Operator 1	WO0405200001	4168	58%	10:30 AM		55	41	0	80	215	0	45	In Progress	i
CNC_S7_81	Operator 1	WO0405200001	4168	58%	10:30 AM		55	41	0	80	215	0	45	In Progress	i

iii. LoRaWAN based Solution

UCT is one of the early adopters of LoRAWAN teschnology and providing solution in Agritech, Smart cities, Industrial Monitoring, Smart Street Light, Smart Water/ Gas/ Electricity metering solutions etc.

iv. Predictive Maintenance

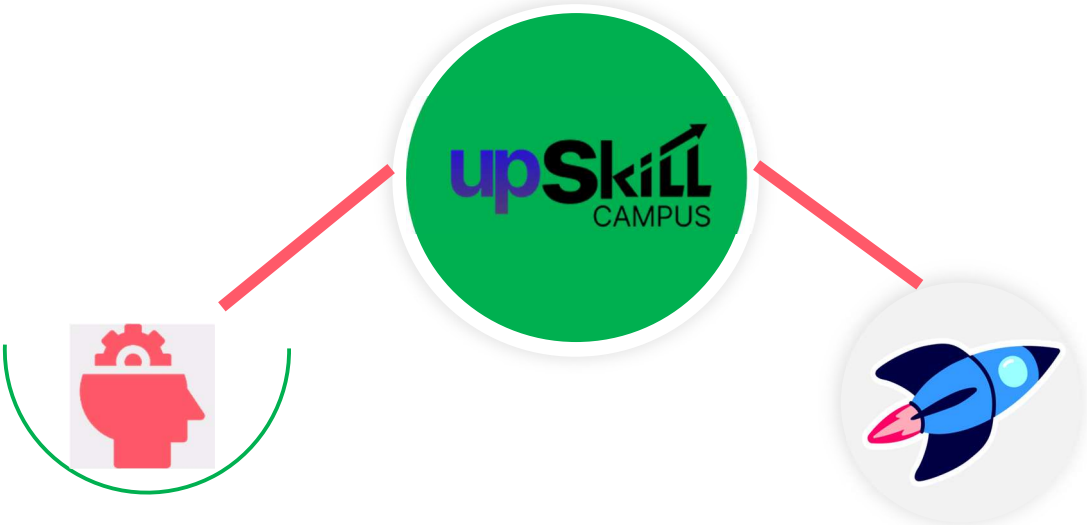
UCT is providing Industrial Machine health monitoring and Predictive maintenance solution leveraging Embedded system, Industrial IoT and Machine Learning Technologies by finding Remaining useful life time of various Machines used in production process.



2.2 About upskill Campus (USC)

upskill Campus along with The IoT Academy and in association with Uniconverge technologies has facilitated the smooth execution of the complete internship process.

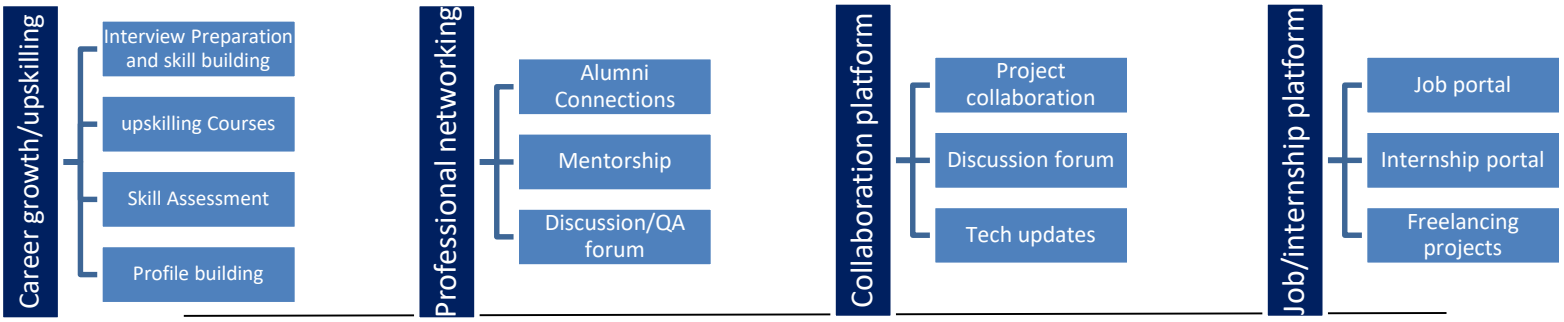
USC is a career development platform that delivers **personalized executive coaching** in a more affordable, scalable and measurable way.



Seeing need of upskilling in self paced manner along-with additional support services e.g. Internship, projects, interaction with Industry experts, Career growth Services

upSkill Campus aiming to upskill 1 million learners in next 5 year

https://www.upskillcampus.com/



2.3 The IoT Academy

The IoT academy is EdTech Division of UCT that is running long executive certification programs in collaboration with EICT Academy, IITK, IITR and IITG in multiple domains.

2.4 Objectives of this Internship program

The objective for this internship program was to

- ☛ get practical experience of working in the industry.
- ☛ to solve real world problems.
- ☛ to have improved job prospects.
- ☛ to have Improved understanding of our field and its applications.
- ☛ to have Personal growth like better communication and problem solving.

3 Problem Statement

The problem statement for predicting smart city traffic patterns is to develop a predictive model that can accurately forecast traffic congestion, flow, and patterns in urban areas. This model should leverage historical traffic data, real-time sensor data, weather conditions, events, and other relevant factors to provide accurate predictions of traffic conditions in the city. The goal is to help city planners, transportation authorities, and commuters make informed decisions to optimize traffic flow, reduce congestion, and improve overall transportation efficiency in the city.

4 Existing and Proposed solution

Existing solution for traffic pattern prediction in smart cities include:

Rule-based Systems: Some cities use rule-based systems that rely on predefined traffic rules, historical data, and simple algorithms to predict traffic patterns. However, these systems may struggle to adapt to dynamic and complex traffic conditions.

Limitations of existing solution in traffic pattern prediction may include:

- Reliance on Historical Data: Many existing solutions heavily rely on historical data and struggle to adapt to rapidly changing traffic conditions, events, and other dynamic factors.

- Lack of Predictive Analytics: Some solutions focus on real-time monitoring and reporting rather than predictive analytics, limiting their ability to provide proactive insights into future traffic patterns.

- Incomplete Data Integration: Existing solutions may not fully integrate diverse data sources such as weather conditions, events, and road closures, leading to incomplete or inaccurate predictions.

Proposed Solution:

1. Collect Historical Data:

Start by gathering historical traffic data from previous years (e.g., 2019-2023). This data will serve as training set.

2. Feature Engineering:

Extract relevant features from the data. Common features include:

Time of day: Traffic patterns vary based on the time (morning rush hour, evening congestion, etc.).

Day of the week: Weekdays and weekends may have different traffic behaviors.

Weather conditions: Rain, snow, or extreme temperatures can impact traffic.

Special events: Consider holidays, festivals, or local events.

Road network information: Road types, junctions, and intersections.

3. Data Preprocessing:

Clean the data by handling missing values, outliers, and inconsistencies.

Normalize or standardize numerical features.

Encode categorical features (e.g., one-hot encoding).

4. Choose a Model:

Explore different machine learning models for traffic prediction. Some common choices include:

Time series models: ARIMA, SARIMA, Prophet.

Regression models: Linear regression, decision trees, random forests.

Deep learning models: LSTM (Long Short-Term Memory), GRU (Gated Recurrent Unit), or even transformer-based models.

Experiment with different algorithms to find the best fit for data.

5. Split Data:

Divide dataset into training and validation/test sets. Use the earlier years for training and later years for validation/testing.

6. Model Training and Evaluation:

Train the chosen model using the training data.

Evaluate its performance using metrics like Mean Absolute Error (MAE), Mean Squared Error (MSE), or Root Mean Squared Error (RMSE).

7. Forecasting:

Once the model is trained, use it to predict traffic for the year taken.

8. Visualize Results:

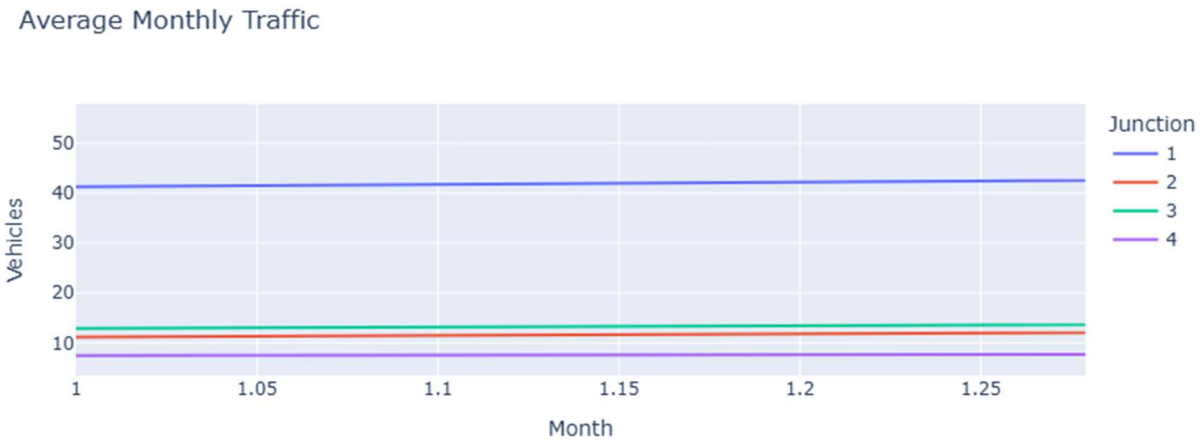
Plot actual vs. predicted traffic patterns to visualize how well the model performs.

4.1 Code submission (GitHub link):
https://github.com/shirisha0728/upskillcampus/blob/main/TrafficPatterns.ipynb

4.2 Report submission (GitHub link) :
https://github.com/shirisha0728/upskillcampus/blob/main/SmartCityTrafficPatterns_shirisha_USC_UCT.pdf

5 Proposed Design/ Model:

Visualizing average Traffic patterns:



6 Performance Test

Conducting a performance test of this Project will help to understand its current performance capabilities, identify areas for improvement, and make informed decisions on optimizing its performance for efficient traffic management.

1. Performance Metrics Analysis: By analyzing this data, Performance metrics such as data processing speed, memory usage, response time, etc. are identified. In populated areas the data processing speed is quite differentiable but overall traffic is predicted which enhance the performance of project. The traffic varying in weather conditions is not included, Hence the project need to be improved for better results.

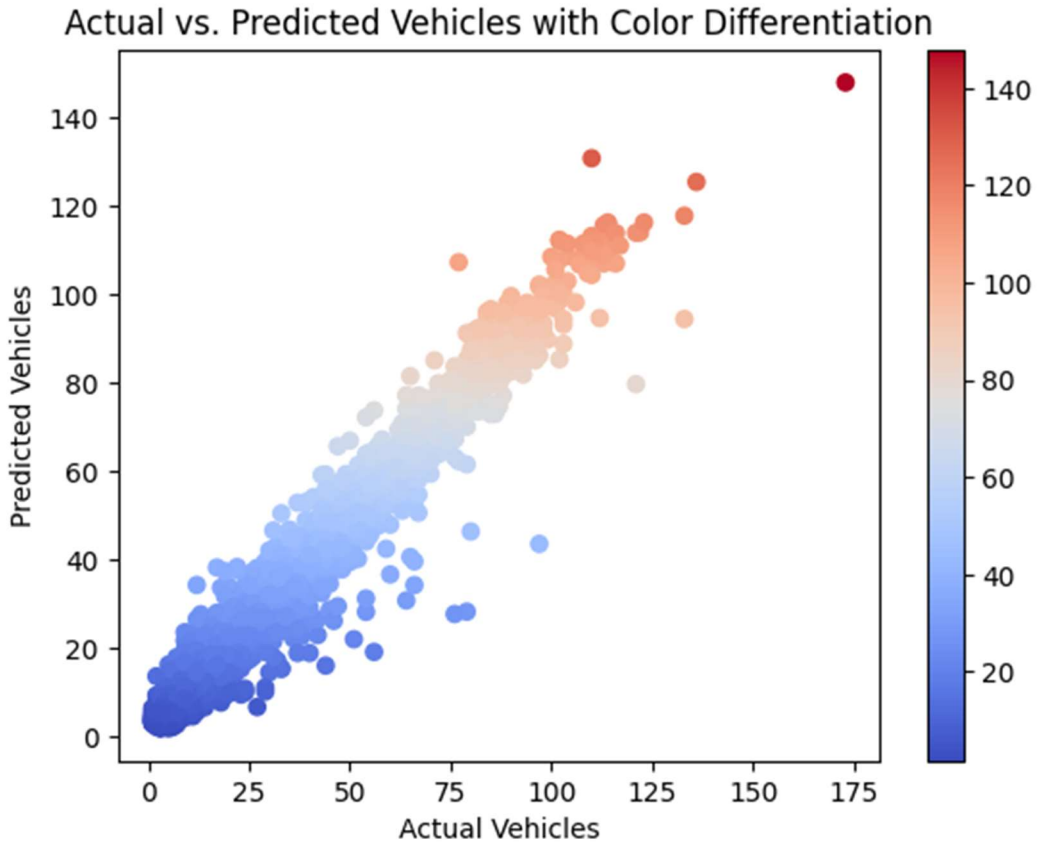
2. Identified Bottlenecks: The performance test may have revealed bottlenecks or areas of inefficiency within the Traffic Patterns Project. This could include slow data processing, high memory consumption, or slow response times under certain conditions.

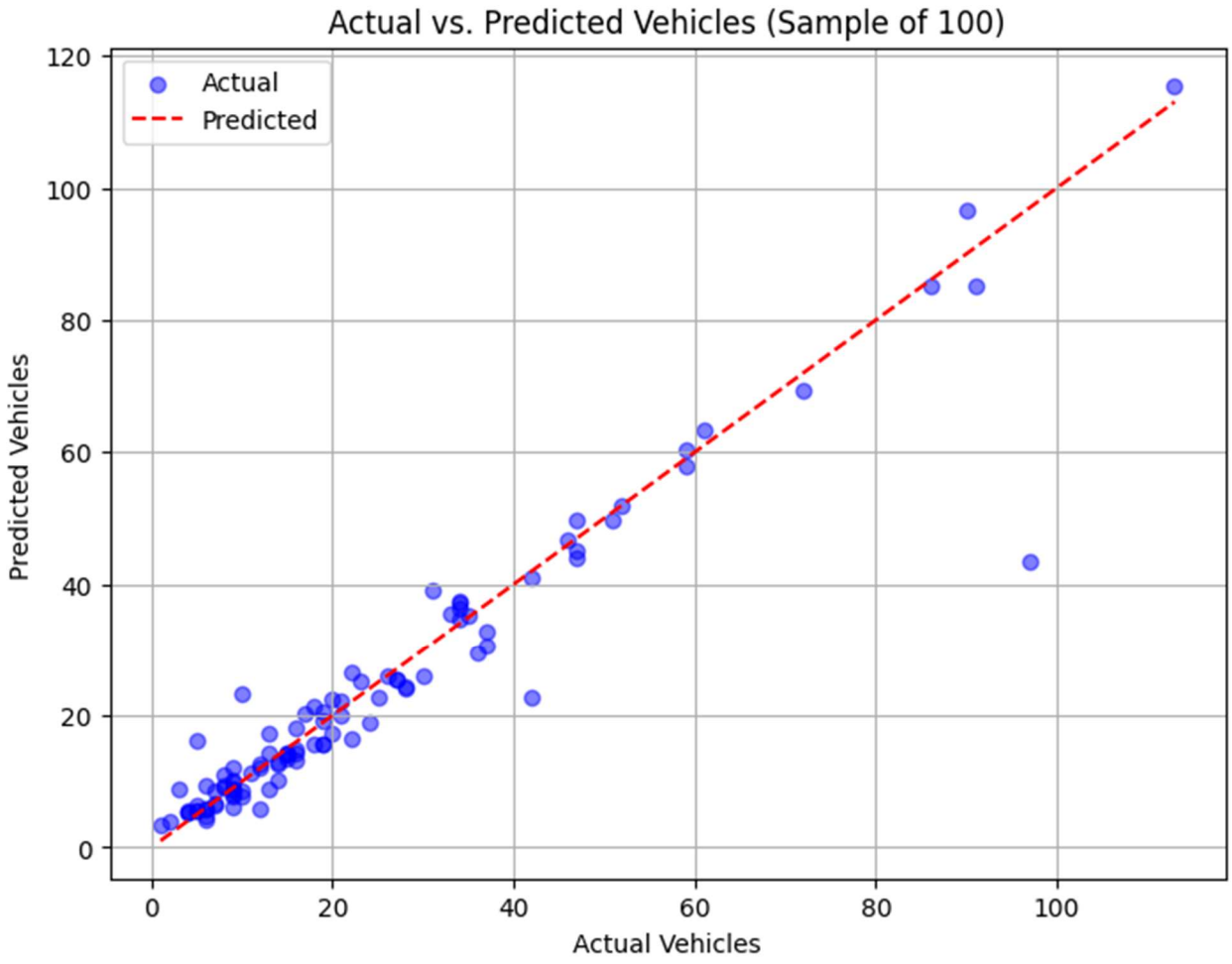
4. Improved Performance: By implementing optimizations based on the test results and retesting the project, one can see improvements in performance metrics such as faster data processing, reduced memory usage, and improved response times.

6.1 Test Plan/ Test Cases

6.2 Test Procedure

6.3 Performance Outcome





7 My learnings

1. *Data Collection and Preprocessing*:

- Understanding the importance of collecting high-quality, diverse traffic data from various sources such as sensors, cameras, and GPS devices.

- Learning the preprocessing steps required to clean and normalize the data for better model performance.

2. *Machine Learning Models*:

- Gaining insights into different machine learning algorithms suitable for traffic prediction, such as regression models, neural networks, and clustering algorithms.

- Experimenting with model training, validation, and testing to find the most accurate and efficient model for traffic pattern prediction.

3. *Real-time Data Processing*:

- Exploring methods for processing real-time traffic data to make dynamic predictions that can adapt to changing traffic conditions.

4. *Deployment and Integration*:

- Understanding the challenges of deploying machine learning models into a real-world smart city infrastructure.

- Learning about the integration of predictive models with traffic management systems to optimize traffic flow and reduce congestion.

8 Future work scope

Some potential future work scopes for a traffic patterns project could include:

1. Integration of Advanced Predictive Analytics: Implementing more advanced predictive analytics techniques, such as machine learning and artificial intelligence, to improve the accuracy of traffic pattern predictions. This could involve developing predictive models that can adapt to real-time data and dynamically changing traffic conditions.

2. Real-time Data Integration: Enhancing the project by integrating real-time data sources, such as weather conditions, road incidents, and events, to provide more comprehensive and accurate traffic pattern predictions. This could involve developing algorithms that can quickly analyze and incorporate real-time data into the prediction models.