Industrial Internship Report on

"Forecasting of 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 "Forecasting of Smart city traffic patterns" provided by UCT. We had to finish the project including the report in 6 weeks' time.

My project was to improve the efficiency of services for the citizens by solving the problem of the traffic. To manage the traffic of the city better and to provide input on infrastructure planning for the future. To implement a robust traffic system for the city by being prepared for traffic peaks.

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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1 Preface

During my six-week internship, I worked on forecasting smart city traffic patterns to assist the government in improving urban infrastructure planning and traffic management. The objective was to analyze and predict traffic trends at key junctions, considering variations due to holidays and special events, to help implement a robust and intelligent traffic system.

A relevant internship plays a crucial role in career development by providing hands-on experience with real-world challenges, enhancing problem-solving skills and deepening domain knowledge. This allowed me to apply data science techniques to a practical scenario.

I am grateful to Upskill Campus, The IoT Academy and UniConverge Technologies for providing this opportunity. The internship was well structured, starting with understanding the problem statement, followed by data collection and etc.

This internship has been an enriching journey, equipping me with industry-relevant skills and insights into the challenges of smart city transformation.
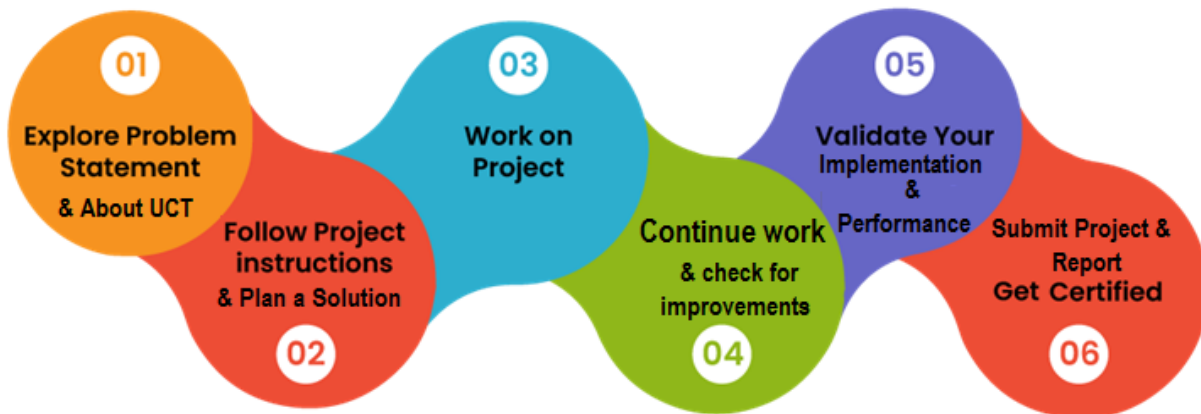
Thanks to all the mentors and teachers (Mrs. Anuradha Singhal, Mr. Lavkush Gupta, Mr. Krish Naik and Mr. Nitish), who have helped me to get the better understanding of the project and models.

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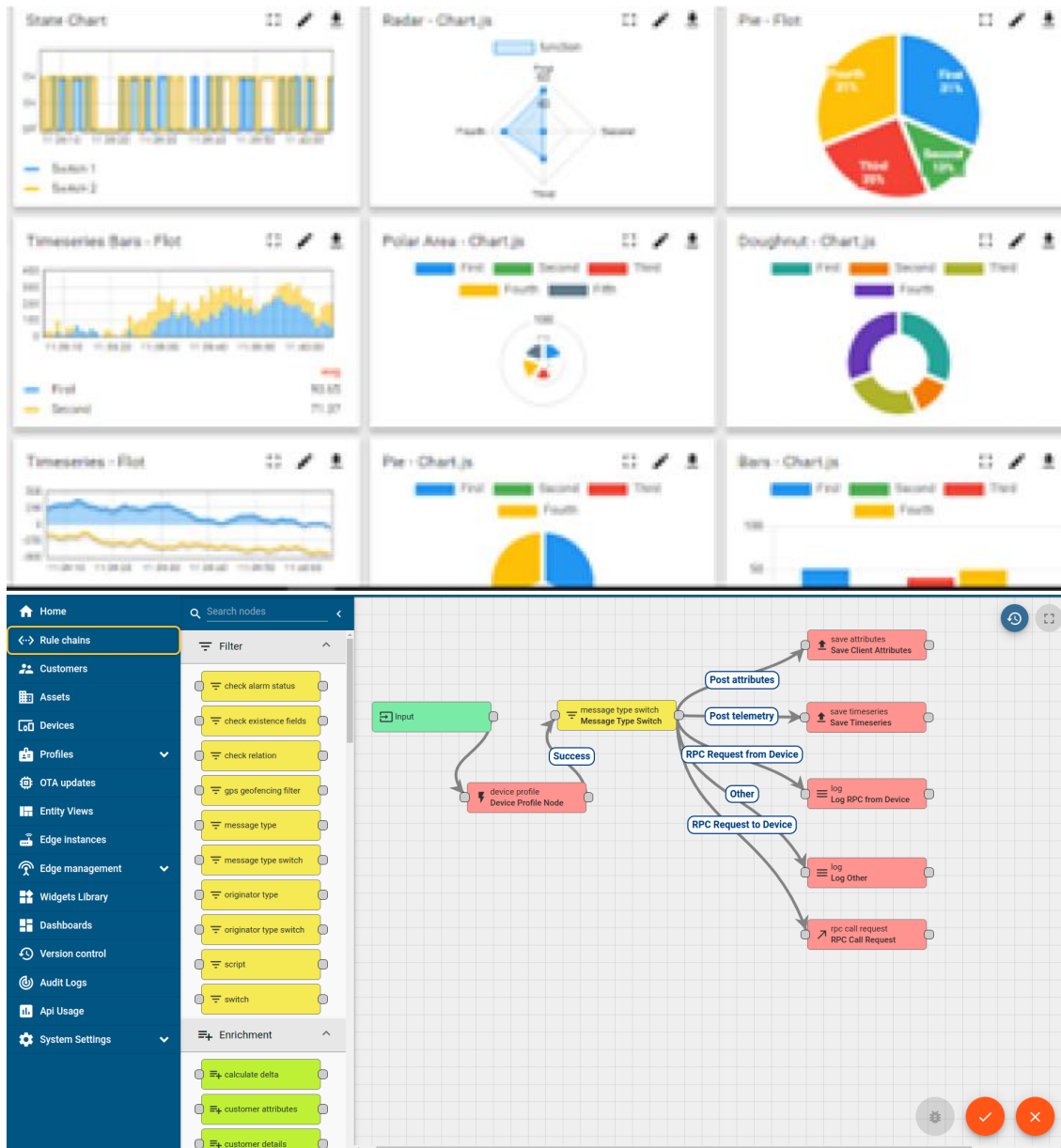
ii. **Smart Factory Platform (FACTORY WATCH)**

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
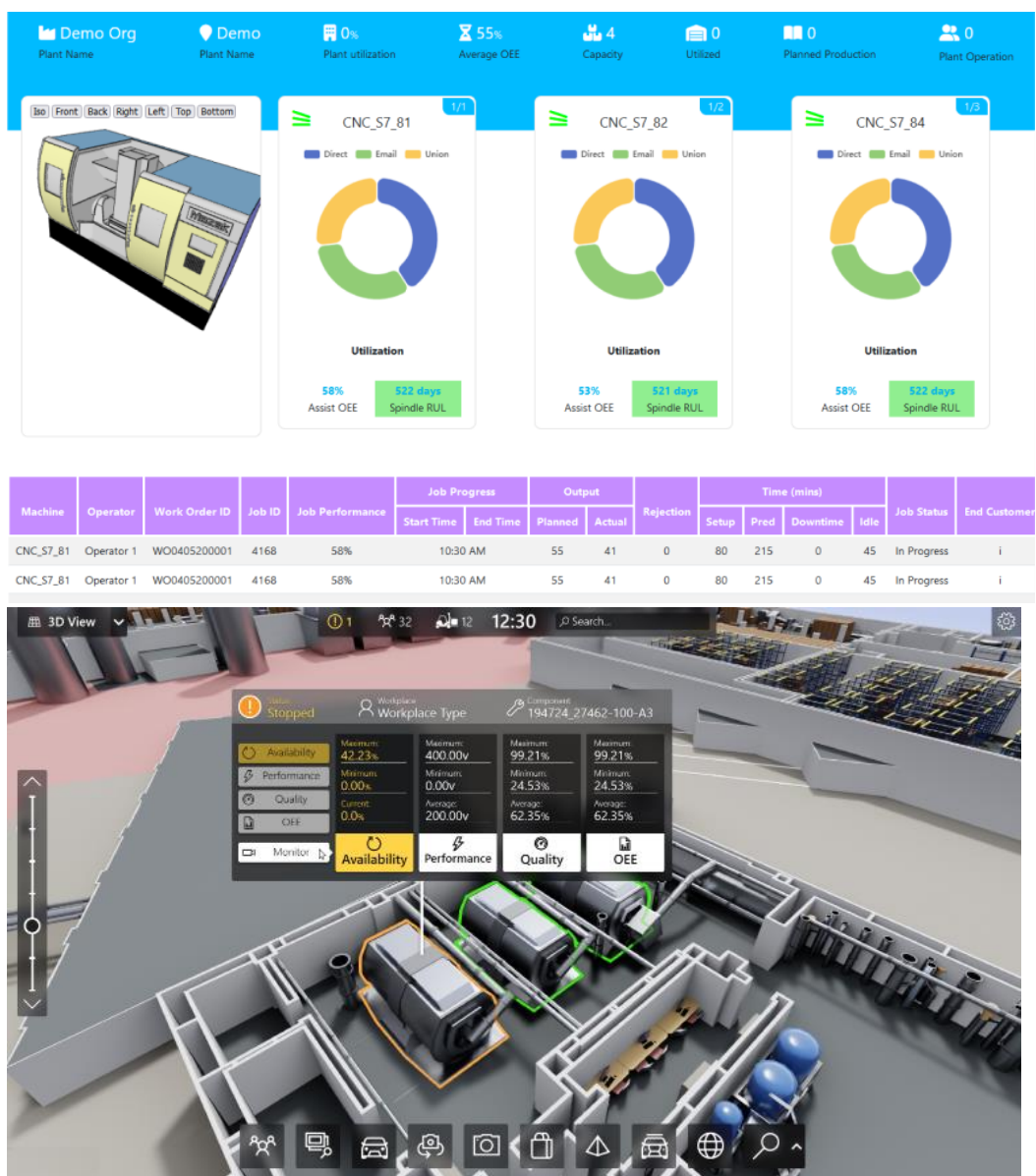
iii. **LoRaWAN** based Solution

UCT is one of the early adopters of LoraWAN technology 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.
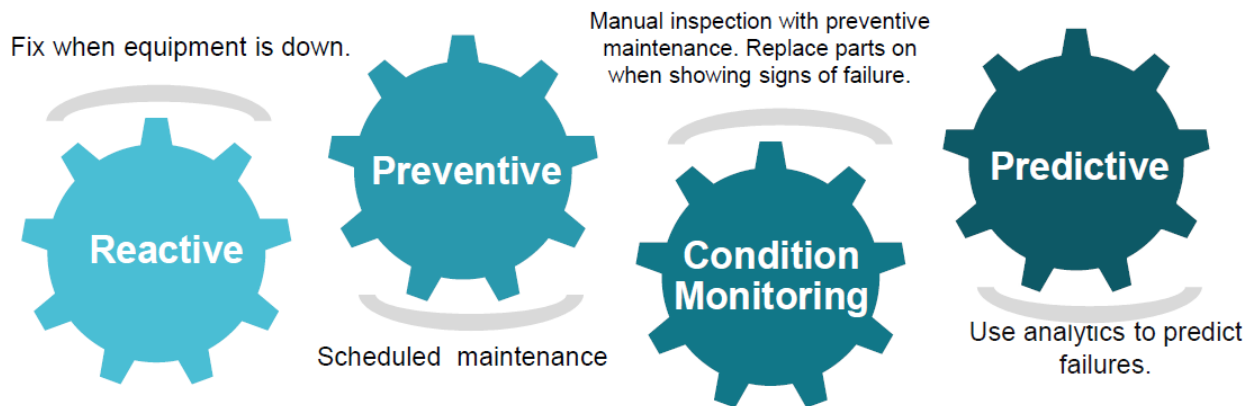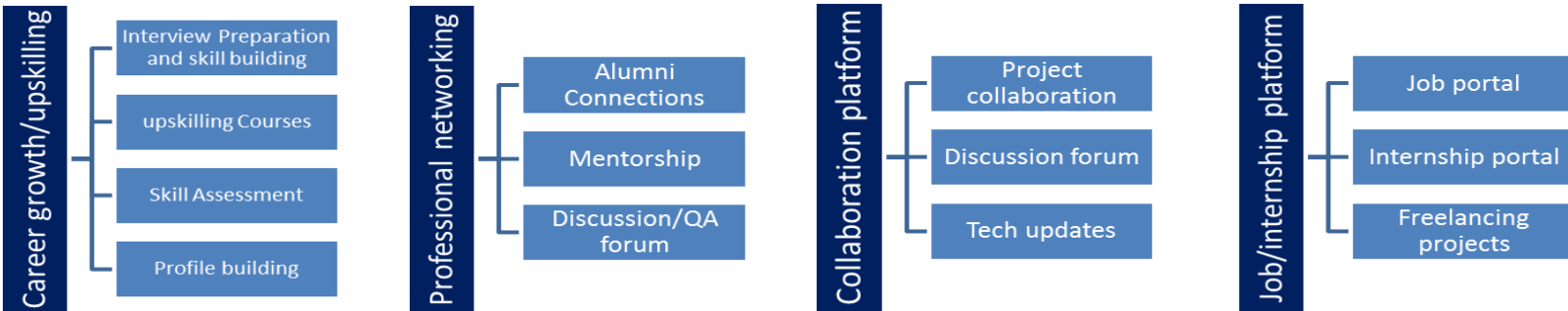

2.2 About Upskill Campus (USC)

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.

Career growth/upskilling	Professional networking	Collaboration platform	Job/internship platform
Interview Preparation and skill building	Alumni Connections	Project collaboration	Job portal
upskilling Courses	Mentorship	Discussion forum	Internship portal
Skill Assessment	Discussion/QA forum	Tech updates	Freelancing projects
Profile building			

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.

2.5   Reference

[1]   documentation on machine learning models

[2]   Book- Introducing Data Science by Davy Cielen and Mohamed Ali

[3]   Book- Introduction to Machine Learning by Alex Smola and S.V.N Vishwanathan

[4]   Book- An Introduction to Probability and Statistics by Vijay K. Rohatgi

[5]   Youtube Channels – CampusX (https://www.youtube.com/@campusx-official) and Krish Naik (https://www.youtube.com/@krishnaik06)

2.6   Glossary

Terms	Acronym
DNN	Deep Neural Network
AI	Artificial Intelligence
ML	Machine Learning
IoT	Internet of things
UCT	UniConverge Technologies
SaaS	Software as a Service

3 Problem Statement

Working with the government to transform various cities into smart cities. The vision is to digitize and optimize urban infrastructure to improve efficiency in services for citizens. One of the major challenges faced by the government is traffic congestion, which impacts daily life and economic productivity.

To address this issue we are developing a robust traffic forecasting system that can predict traffic peaks at key junctions of the city. The system will account for different traffic patterns on holidays, special events and regular working days. By utilizing AI/ML based predictive analytics we aim to assist in traffic management enabling better decision-making for the future.

4   Existing and Proposed solution

Existing solution:-

Previously available solutions uses CCTV cameras, GPS-based tracking to monitor traffic. Usage of historical data to adjust signals and traffic flow. The earlier models are using basic statistical models like ARIMA or time-series analysis. These faces limitations like high infrastructure cost, continuous maintenance, not adaptive to real-time changes and unexpected events like peak hours, special events or holidays

Proposed solution:-

To use AI driven predictive traffic systes that leverages machine learning and deep learning models like XGBoost, LSTM etc. Processing historical data to model the data. Adjusting it for holidays, peak hours and special events.

Value Additions:-

Using live traffic need to make adjustments. Higher accuracy model. Smarter routing system and other ideas can be used to make it more better.

4.1   Code submission (Github link) - https://github.com/Gupta-Vasudha/upskillcampus/blob/main/ForecastingSmartCitiesTrafficPatterns.py

4.2   Report submission (Github link) : [to be updated].

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5   Proposed Design/ Model
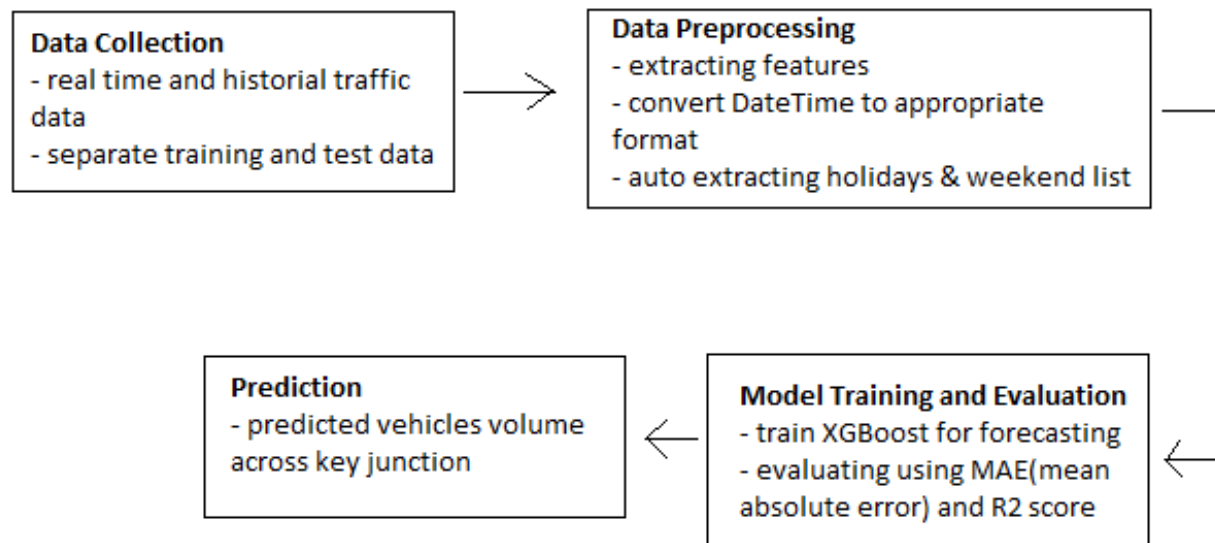
5.1   High Level Diagram (if applicable)

Figure 1: HIGH LEVEL DIAGRAM OF THE SYSTEM

6 Performance Test

Constraint	Impact on Design	Solution Implemented
Accuracy (MAE)	Model should accurately predict vehicle counts	Used **XGBoost** and fine-tuned hyperparameters.
Speed	Must process large traffic data in real-time	Used vectorized operations
Memory usage	Large datasets can cause memory overflow	Used feature selection
Power consumption	Should work efficiently	Used GPU for faster training

6.1 Test Plan/ Test Cases

To evaluate the system, we can define **test cases** as listed below:-

Test Case ID	Test Description	Expected Outcome
01	Model should predict vehicle count for test dataset	Predicted count should be close to actual count
02	Check model accuracy with MAE and R^2 score	MAE should be low, R^2 close to 1
03	Measure inference speed on a large dataset	Model should predict quickly
04	Evaluate model performance on holiday traffic patterns	Should detect traffic peaks accurately on holidays
05	Check memory usage while training on full dataset	Should not exceed available RAM, optimized processing

6.2 Test Procedure

Steps for performance testing

1. Load training and test data
2. Train the model (XGBoost) – optimizing hyperparameters and ensuring the model does not overfit
3. Make predictions on test set – generating predicted vehicle counts and converting it into integer values
4. Evaluating model performance – measured MAE, computed R^2 score

6.3 Performance Outcome

Metric	Value	Interpretation
R^2 score	0.96	96% variance, indicating a highly accurate model
MAE (mean absolute error)	2.37	Prediction error around 2.37 vehicles, meaning model is reliable for forecasting

7   My learnings

Through this project, I gained deep insights into machine learning models, data preprocessing and real world implementation. The hands-on experience of working with a real-life traffic dataset helped with bridge the gap between theoretical knowledge and industry level applications.

Implemented both Random Forest and XGBoost model and learned why XGBoost performs better for large datasets.

Understood how hyperparameter tuning improves model accuracy. Extracted meaningful features to improve predictions.

Learned about key metrics like MAE, RMSE and R^2 score and applied it to the project.

Learned how to interpret errors and optimize predictions for real-time forecasting

Identified data challenges like missing values, non-stationary trends, and memory limitations.

8 Future work scope

- Incorporate weather conditions to improve traffic predictions.
- Consider the effect of road closures, accidents and construction work on traffic patterns.
- Use historical data to factor in traffic spikes due to festivals, protests and major events.
- Improve inference time by optimizing model efficiency and memory usage.

This would enhance real-time accuracy, scalability and adaptability, making the system more effective for smart city traffic management.