Industrial Internship Report on

”Smart City Pattern ”

Prepared by

[Vani Jain]

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. We had to finish the project including the report in 6 weeks’ time. My project was Smart City pattern Working with the government to transform your city into a smart city. The vision is to convert it into a digital and intelligent city to improve the efficiency of services for the citizens. One of the problems faced by the government is traffic. You are a data scientist working to manage the traffic of the city better and to provide input on infrastructure planning for the future. The government wants to implement a robust traffic system for the city by being prepared for traffic peaks. They want to understand the traffic patterns of the four junctions of the city. Traffic patterns on holidays, as well as on various other occasions during the year, differ from normal working days. This is important to take into account for your 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.

TABLE OF CONTENTS

1 Preface

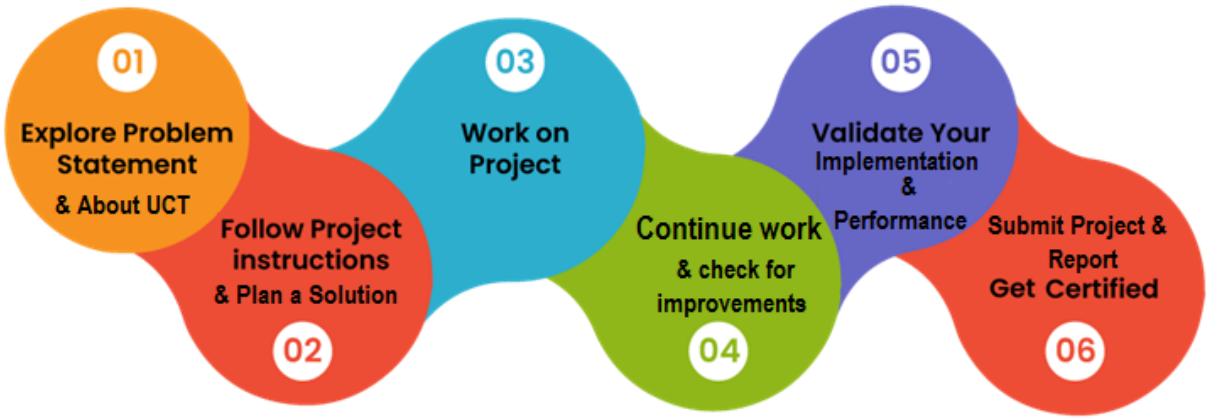
Summary of the whole 6 weeks' work.

About need of relevant Internship in career development.

Brief about Your project/problem statement.

Opportunity given by USC/UCT.

How Program was planned



Your Learnings and overall experience.

Thank to all (with names), who have helped you directly or indirectly.

Your message to your juniors and peers.

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)

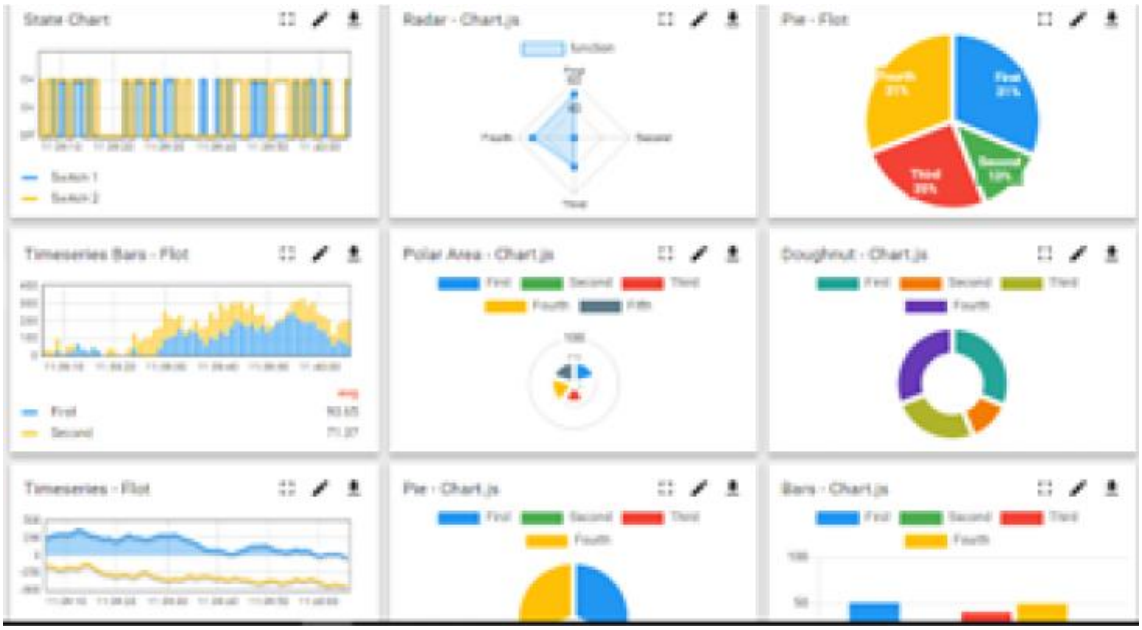
UCT Insight is an IOT platform designed for quick deployment of IOT applications on the same time providing valuable "insight" for your process/business. It has been built in Java for backend and ReactJS for Front end. It has support for MySQL and various NoSql Databases.

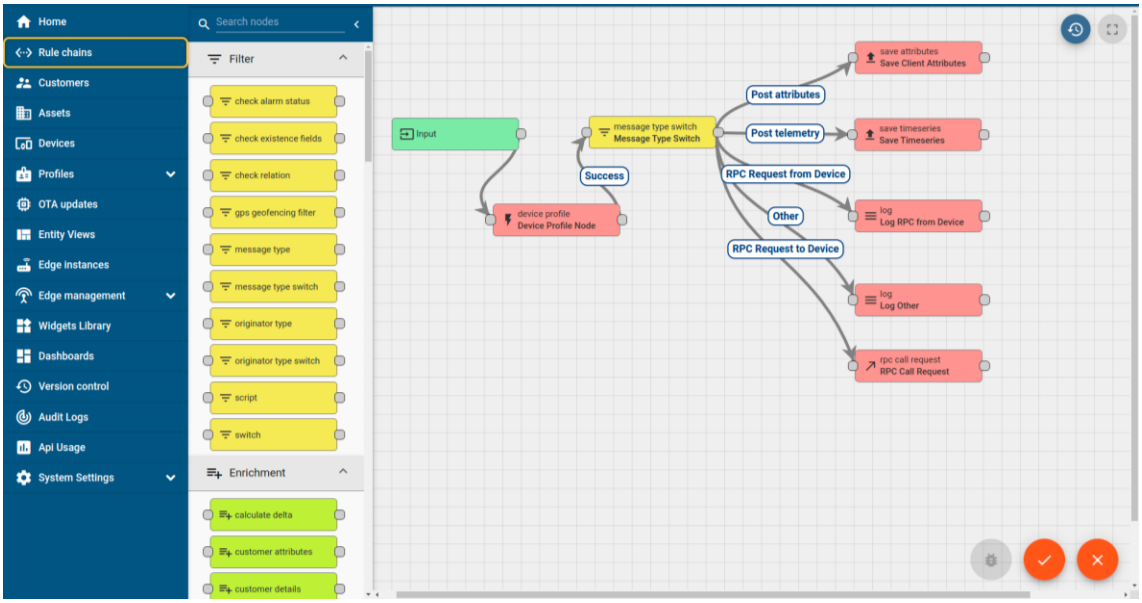
- It enables device connectivity via industry standard IoT protocols - MQTT, CoAP, HTTP, Modbus TCP, OPC UA

- 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


State Chart
Radar - Chart.js
Pie - Plot
Timeseries Bars - Plot
Polar Area - Chart.js
Doughnut - Chart.js
Timeseries - Plot
Pie - Chart.js
Bars - Chart.js


Home
Rule chains
Customers
Assets
Devices
Profiles
OTA updates
Entity Views
Edge instances
Edge management
Widgets Library
Dashboards
Version control
Audit Logs
Api Usage
System Settings
Search nodes
Filter
check alarm status
check existence fields
check relation
gps geofencing filter
message type
message type switch
originator type
originator type switch
script
switch
Enrichment
calculate delta
customer attributes
customer details
Input
message type switch
Message Type Switch
Success
device profile
Device Profile Node
Post attributes
Post telemetry
RPC Request from Device
Other
RPC Request to Device
save attributes
Save Client Attributes
save timeseries
Save Timeseries
log
Log RPC from Device
log
Log Other
rpc call request
RPC Call Request

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.

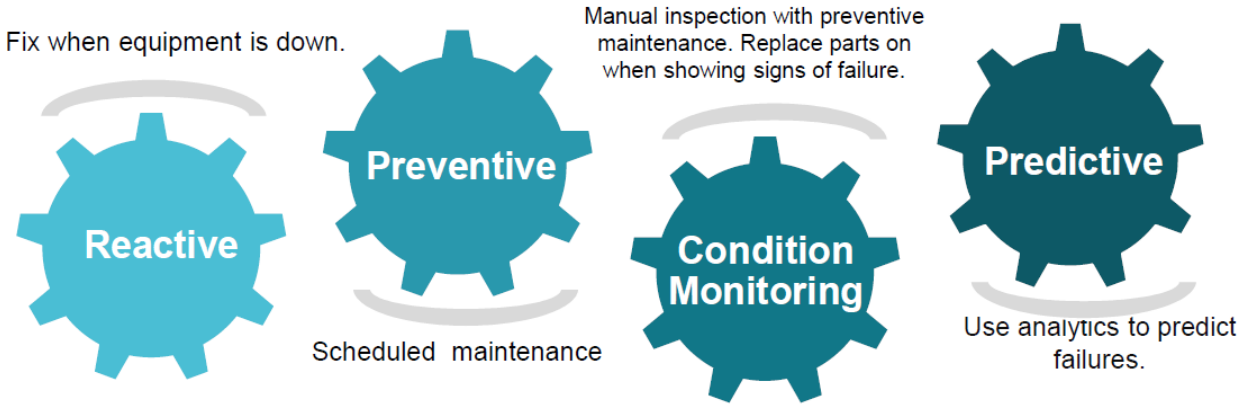
Machine	Operator	Work Order ID	Job ID	Job Performance	Job Progress		Output		Rejection	Time (mins)				Job Status	End Customer
					Start Time	End Time	Planned	Actual		Setup	Pred	Downtime	Idle		
CNC_S7_81	Operator 1	WO0405200001	4168	58%	10:30 AM		55	41	0	80	215	0	45	In Progress	i
CNC_S7_81	Operator 1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

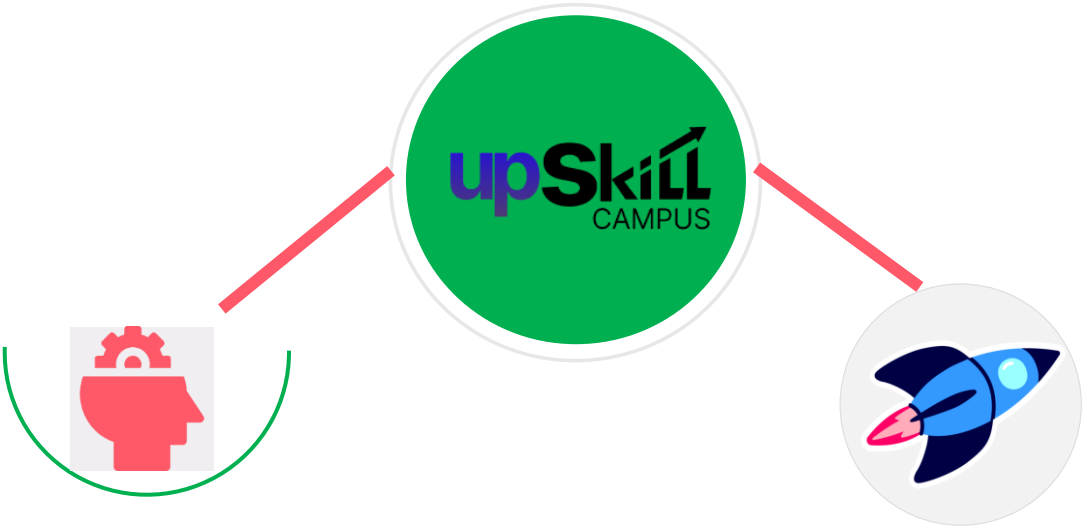
UCT is providing Industrial Machine health monitoring and Predictive maintenance solution leveraging Embedded system, Industrial IoT and Machine Learning Technologies by finding Remaining useful life time of various Machines used in production process.



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.

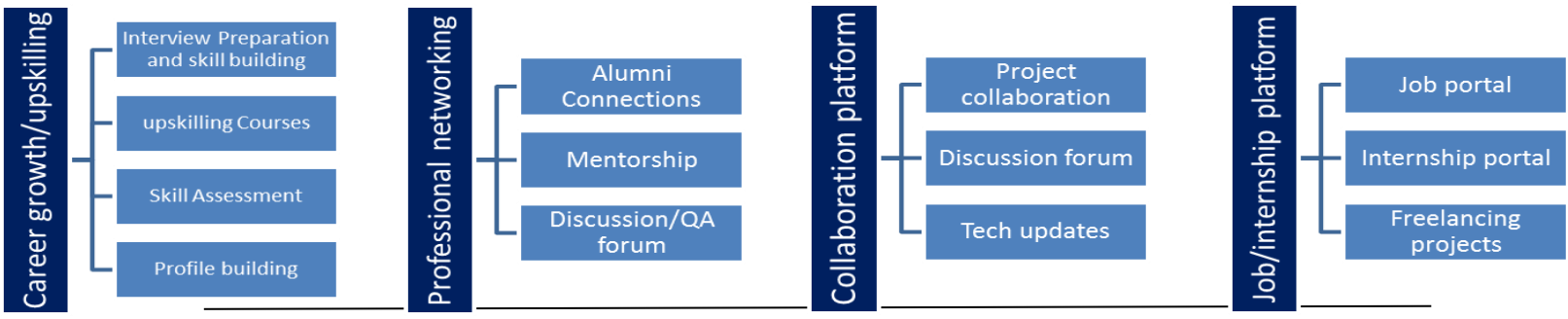
USC is a career development platform that delivers **personalized executive coaching** in a more affordable, scalable and measurable way.



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.

2.5 Reference

[1] Google

[2] Kaggle

2.6 Glossary

Terms	Acronym
Smart City	A city that uses technology and data-driven solutions to enhance the efficiency of services, infrastructure, and overall quality of life for its

	residents.
GRU	Gated Recurrent Unit - A type of recurrent neural network (RNN) architecture used in machine learning and natural language processing. GRUs are designed to capture sequential dependencies in data.
Traffic Forecasting	The process of using historical traffic data and predictive models to estimate future traffic patterns and volumes.

3 Problem Statement

smart-city-traffic-patterns

Working with the government to transform your city into a smart city. The vision is to convert it into a digital and intelligent city to improve the efficiency of services for the citizens. One of the problems faced by the government is traffic. You are a data scientist working to manage the traffic of the city better and to provide input on infrastructure planning for the future.

The government wants to implement a robust traffic system for the city by being prepared for traffic peaks. They want to understand the traffic patterns of the four junctions of the city. Traffic patterns on holidays, as well as on various other occasions during the year, differ from normal working days. This is important to take into account for your forecasting. I have used dataset given to me and apply many forecasting models like ARIMA model, Prophet , GRU model . At last I have selected the GRU neural network for my project .

4 Existing and Proposed solution

Existing

The solution was proposed at Kaggle by one of author in which it perform EDA ,Data Transformation and Preprocessing ,model building . later fit the model and perform inverse transformation over data . model building is performed by author by using GRU model .

Proposed Solution

In my solution I have performed various steps

a. Importing Libraries
b. Loading Data
c. Data Exploration
d. Data Transformation And Preprocessing
   Feature Engineering
   EDA
e. Model Building
f. Fitting the model

NOTE : I have also use GRU Model But I have used tunning parameters like learning rate od also create the optimizer with learning rate schedule .I have used SGD optimizer from keras library and runs up to 50 epochs for each junction while calculating RMSE value and set learning rate as 0.01n . I have imported the Adam optimizer from TensorFlow's Keras API. The Adam optimizer is a popular optimization algorithm used in deep learning for updating the weights of a neural network during training which is not proposed by authors in existing solution.

4.1 Code submission (Github link)

https://github.com/vanijain8781/upskillcampus/blob/main/smart_city_traffic_pattern.ipynb

4.2 Report submission (Github link)

https://github.com/vanijain8781/upskillcampus

Proposed Design/ Model

1.Data Collection:

I have used the dataset provided to me during problem statement .

2. Data Storage and Processing:

Data Storage: Store the data in excel file in csv format and upload it on my colabnotebook.

Data Preprocessing: Implement data preprocessing techniques to clean and prepare the data for analysis. This includes handling missing data, outliers, and data normalization.

3. Traffic Analysis and Forecasting:

GRU Model: Use a Gated Recurrent Unit (GRU) model for traffic analysis and forecasting. The GRU is suitable for capturing sequential dependencies in traffic data.

Training: Train the GRU model using historical traffic data, incorporating features like time of day, day of the week, and historical traffic patterns.

Real-time Prediction: Implement a real-time prediction component that continuously updates traffic forecasts as new data arrives.

Implement redundancy and failover mechanisms to maintain system availability.

4. Maintenance and Support:

Provide ongoing maintenance and support to ensure the system's reliability and effectiveness.

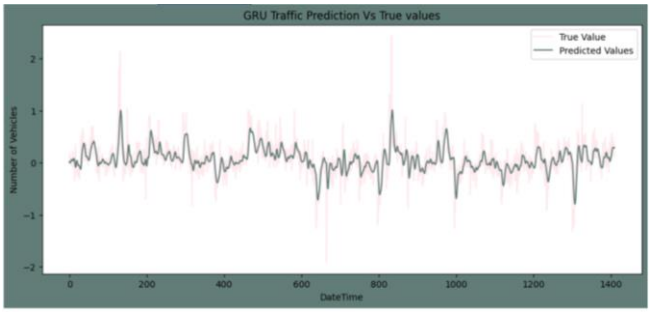
This proposed model and design outline a comprehensive smart traffic management system that combines real-time data collection, predictive analytics, infrastructure planning, and user-friendly interfaces to improve traffic flow and efficiency in the city while allowing for future scalability and adaptability.

5 Performance Test

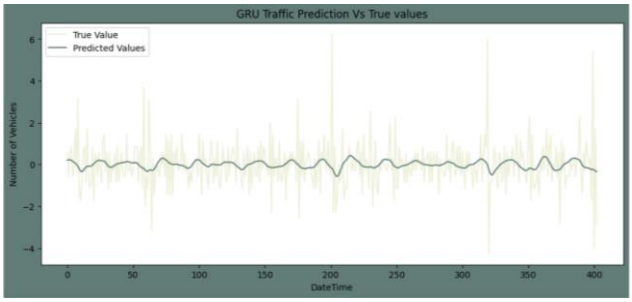
I have calculate the RMSE value for each junction and plot the graph for each junction . In this way I have evaluate the performance of model at each junction by using data visualization tools .

JUNCTIONS	RMSE VALUE
1	0.2698631194280897
2	0.5754676533333426.
3	0.6235629447941445 .
4	1.1030918710707318.

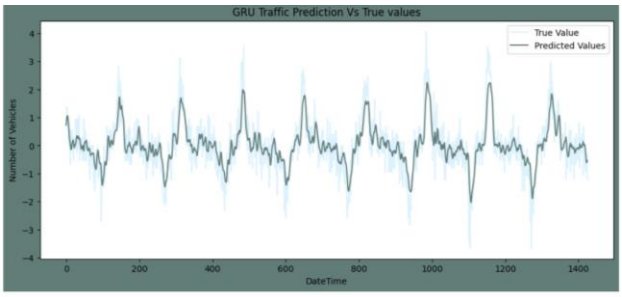
As above table shown that my model is working very well at junction 1,2,3 and working okay for junction 4. Let understand with help of diagram .



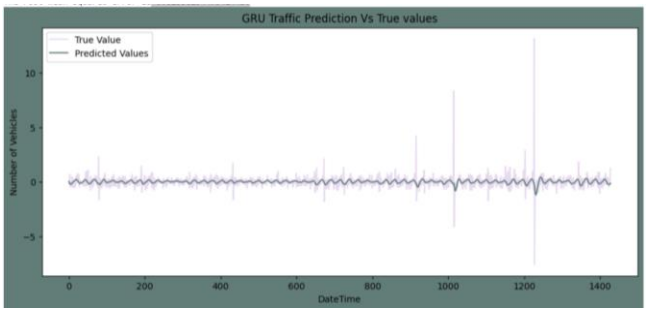
JUNCTION 1



JUNCTION 4



JUNCTION 2



JUNCTION 3

In future I can consider another dataset for testing so as to improve the performance of model and can also use advanced machine learning and deep learning algorithms to increase the performance of model.

6 My learnings

Technical Insights:

I have implemented the GRU model for traffic analysis and forecasting. During model building I have used various technologies like ARIMA model but later used GRU model as providing me the better accuracy . during this I have faced technical challenges while performing EDA but with help of kaggle and google I have overcome those challenges .

I have Create the optimizer with the learning rate schedule which is not being used in model proposed by authors at Kaggle.

Data Handling and Preprocessing:

I have performed data preprocessing in ensuring the quality and accuracy of your model's predictions. And also to remove outliers and missing values from the dataset.

Model Performance:

I have analyze the performance of your GRU model by calculating RMSE value for each junction and plot the graph for each junction to analyze the accuracy of my model. it meet my expectations.

Highlight any lessons learned in terms of project management and teamwork.

Future Directions: we can explore more advanced machine learning models, such as deep learning neural networks, to improve the accuracy of traffic forecasting and anomaly detection. we can develop algorithms that can automatically detect and respond to traffic incidents, accidents, and road closures in real time, improving incident management

7 Future work scope

1.Advanced Machine Learning Models: we can explore more advanced machine learning models, such as deep learning neural networks, to improve the accuracy of traffic forecasting and anomaly detection.

2.AI-Powered Incident Detection: we can develop algorithms that can automatically detect and respond to traffic incidents, accidents, and road closures in real time, improving incident management.

3.Public Engagement: we can develop mobile apps or web platforms that allow citizens to access real-time traffic information, report incidents, and provide feedback on traffic-related issues.

4.Predictive Analytics for Urban Development: we can utilize data from your traffic management system to make data-driven decisions for urban development projects, optimizing city planning and resource allocation.

5.Machine Learning for Infrastructure Maintenance: we can apply machine learning algorithms to predict and schedule maintenance for traffic infrastructure, minimizing disruptions and costs.