Industrial Internship Report on

”Smart City”

Prepared by

Hemanth Gowda M

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 working with the government to transform various cities 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. The government wants 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.

TABLE OF CONTENTS

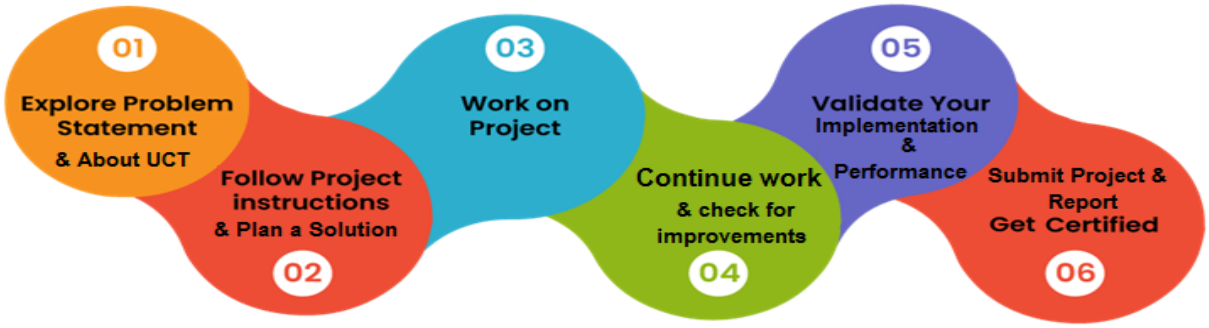
1 Preface

Thank you UCT for giving this opportunity.

Problem Statement: We are working with the government to transform various cities 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.

For the 6 weeks, we analyzed the problem statement. Understood the problem statement and the plan of the program and understood the existing solution. Along with my team member we worked on the project to obtain a proposed solution. Solved the problem statement and obtained crisp representation using Machine learning. In the last week we prepared the report and submitted the project.

How Program was planned



Overall it was a good experience, as we got to learn many things like how to analyze the data, data cleaning and data munching and how to represent the data.

I would like to take this opportunity and thank UCT for providing us with this opportunity. I would like to thank the online websites which we referred and my team member for giving the input and constantly working on the project along with me.

To my juniors I would like to suggest not to miss this opportunity and make proper use of it and not to miss any quiz.

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.

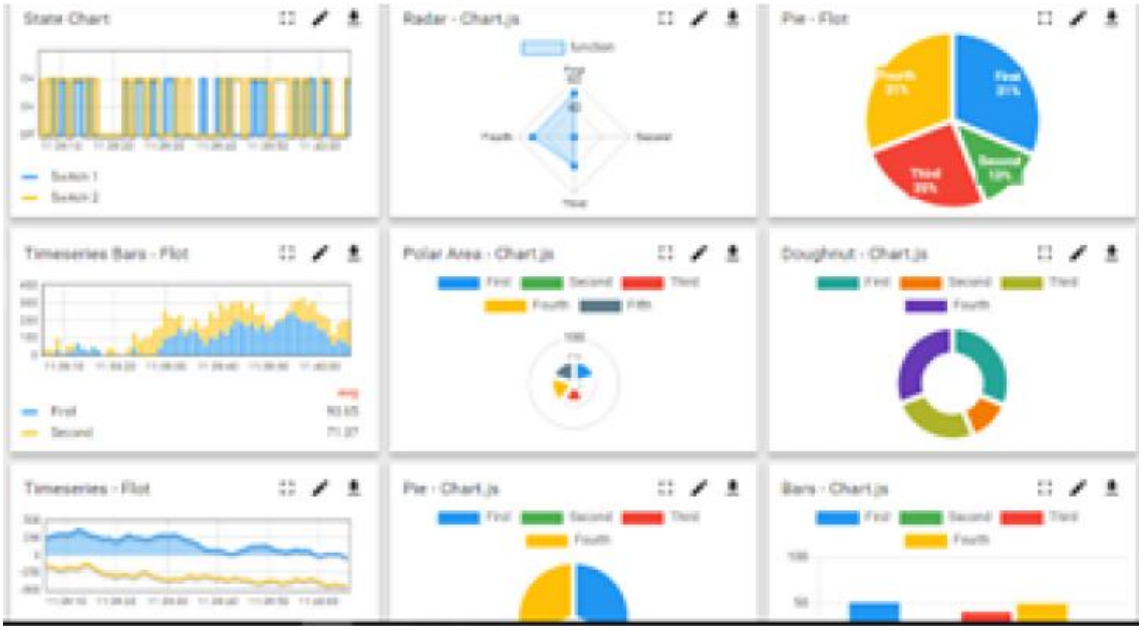
i. UCT IoT Platform (UCT Insight)

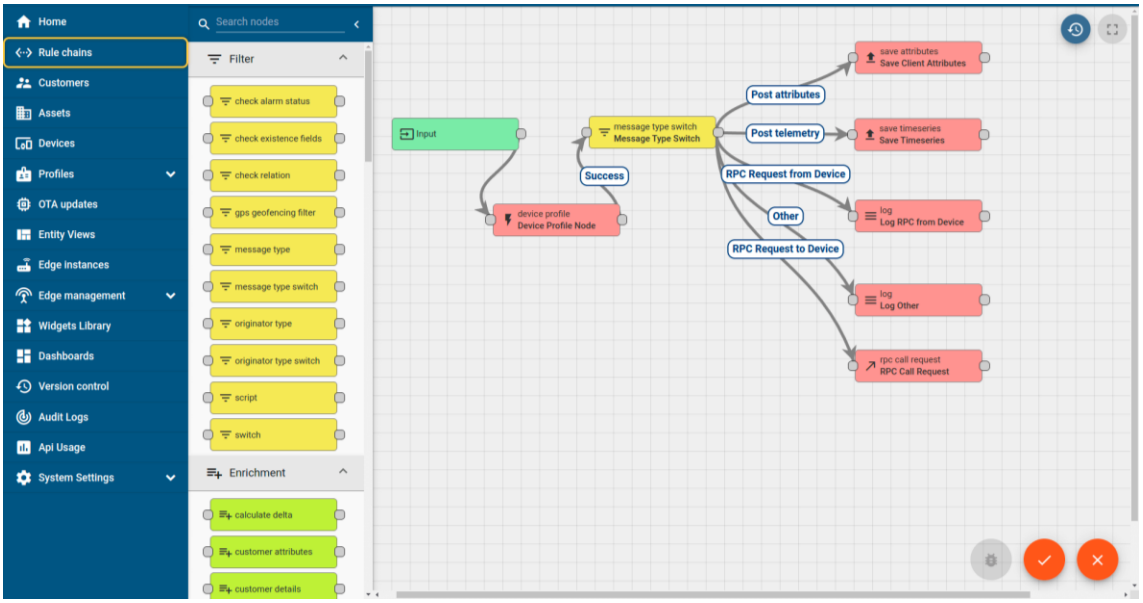
UCT Insight is an IOT platform designed for quick deployment of IOT applications on the same time providing valuable "insight" for your process/business. It has been built in Java for backend and ReactJS for Front end. It has support for MySQL and various NoSql Databases.

- 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.

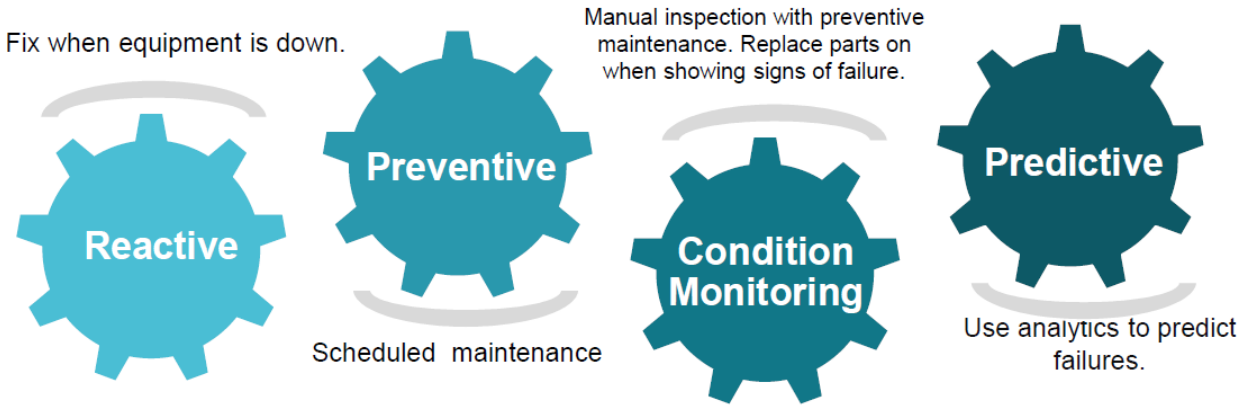
Machine	Operator	Work Order ID	Job ID	Job Performance	Job Progress		Output		Rejection	Time (mins)				Job Status	End Customer
					Start Time	End Time	Planned	Actual		Setup	Pred	Downtime	Idle		
CNC_S7_81	Operator 1	WO0405200001	4168	58%	10:30 AM		55	41	0	80	215	0	45	In Progress	i
CNC_S7_81	Operator 1	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 technology and providing solution in Agritech, Smart cities, Industrial Monitoring, Smart Street Light, Smart Water/ Gas/ Electricity metering solutions etc.

iv. Predictive Maintenance

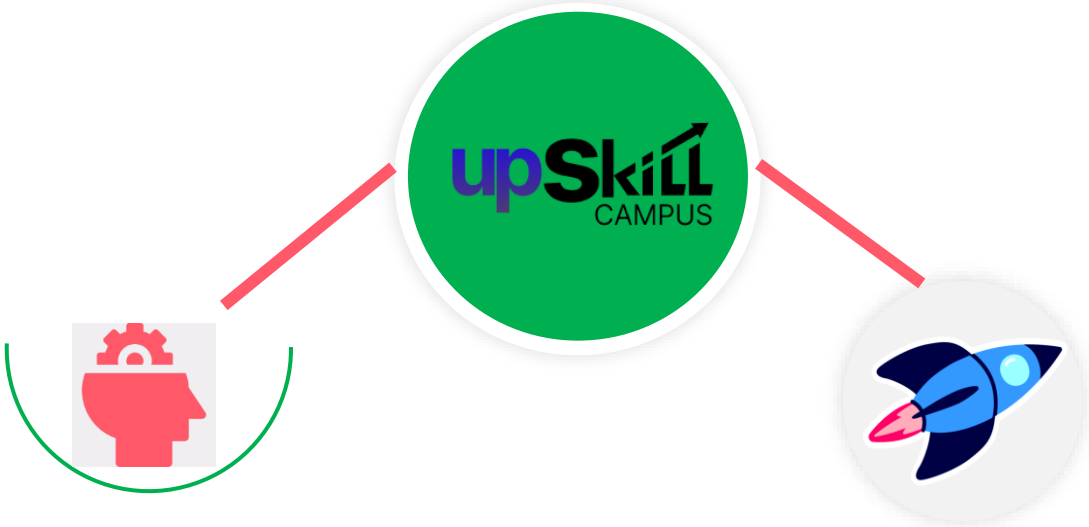
UCT is providing Industrial Machine health monitoring and Predictive maintenance solution leveraging Embedded system, Industrial IoT and Machine Learning Technologies by finding Remaining useful life time of various Machines used in production process.



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.

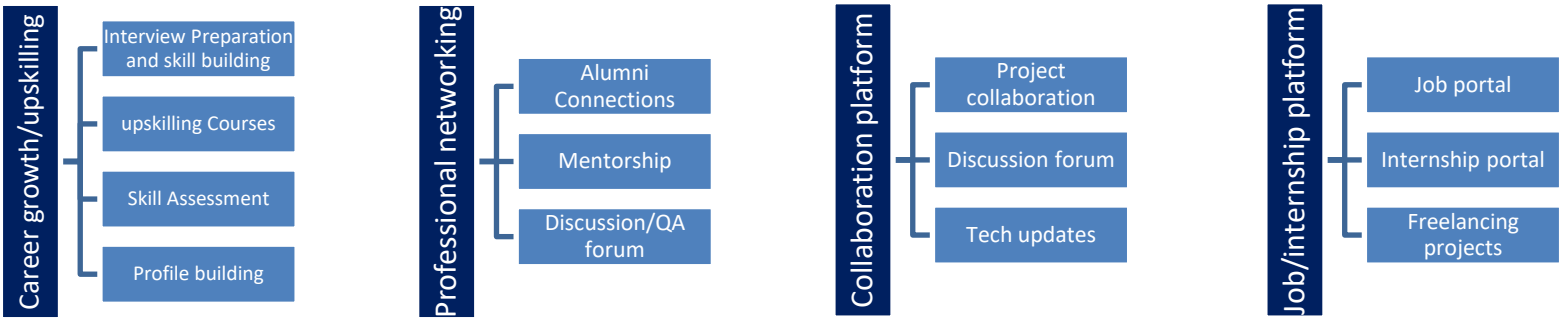
USC is a career development platform that delivers **personalized executive coaching** in a more affordable, scalable and measurable way.



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] https://github.com/mratsim/McKinsey-SmartCities-Traffic-Prediction

[2] https://www.kaggle.com/datasets/utathya/smart-city-traffic-patterns

2.6 Glossary

Terms	Acronym
Smart City	Urban area which uses technology
Traffic Pattern	Recurring and predictable pattern of traffic
Junction	A point where two or more roads meet
Congestion	Heavy traffic conditions
Rerouting	Along a different route

3 Problem Statement

As a data scientist working on managing city traffic and providing input on infrastructure planning, we have a team-based approach to tackle the challenges of transforming cities into smart cities. Our goal is to leverage data science and machine learning to improve the efficiency of services for citizens and address traffic-related issues.

To better understand and manage traffic, we analyze data from the four junctions of the city. This includes studying traffic patterns during normal working days as well as on holidays and special occasions throughout the year. By incorporating this information into our forecasting models, we can accurately predict traffic peaks and plan infrastructure accordingly.

Our team utilizes data-driven techniques to develop a robust traffic system for the city. This involves collecting and analyzing real-time traffic data, such as vehicle counts, speed, and congestion levels. We then apply machine learning algorithms to identify patterns and trends in the data, enabling us to make informed decisions and optimize traffic flow.

By working closely with the government and utilizing the power of data science and machine learning, we aim to create a digital and intelligent city that provides efficient and seamless transportation for its citizens. Together, we can transform cities into smart cities that prioritize the needs and well-being of its residents.

1. Data Collection and Analysis: -Start by collecting historical traffic data for all four junctions. This data should include traffic volume, speed, and congestion information, ideally from several years, to account for seasonal variations.

2. Holiday and Special Occasion Analysis:-Create a calendar of holidays and special events for the city. Identify significant occasions that may affect traffic, such as festivals, parades, sports events, and major public gatherings.

3. Traffic Forecasting:-Develop predictive models that can forecast traffic patterns for the four junctions of the city. These models should consider factors such as time of day, day of the week, weather conditions, and upcoming holidays or events.

4. Public Awareness and Education:-Communicate with the public about the smart city initiatives and how they can contribute to better traffic management. Encourage the use of public transportation, carpooling, and alternative routes during peak traffic times.

4 Existing and Proposed solution

Existing solutions:

1.Data Collection: Collect complete statistics about traffic, including things like volume, congestion, weather conditions and accidents.

2.Data preprocessing: Data is cleaned and processed, and collected at the appropriate time.

3.Exploratory data analysis: Use graphs to identify trends and anomalies, focusing on understanding how holidays and special seasons impact traffic.

Suggested Solution:

1.Traffic forecasting: Use time series forecasting models to forecast traffic at various junctions, taking into account holidays and special events.

2.Scenario Analysis: Determine how traffic varies during holidays and special occasions as compared to normal days to plan for peak traffic.

3.Traffic Management and Optimization: Development of real-time traffic management systems that optimize traffic signal timing, provide dynamic updates, and reroute traffic during rush periods.

4.Infrastructure Planning: Collaborate with city planners to plan infrastructure development based on traffic forecasts.

4.1 Code submission (Github link):

https://github.com/Hemanth-gowda-m/upskillcampus/blob/main/smartcity.ipynb

4.2 Report submission (Github link) :

https://github.com/Hemanth-gowda-m/upskillcampus/blob/main/SmartCityTrafficPattern_Hemanth_Gowda_M_USC_UCT.pdf

5 Proposed Design/ Model

This proposed design outlines a comprehensive traffic management system that leverages data, technology and user engagement to optimize traffic flow, enhance road safety and improve the overall quality of life in a smart city. The successful implementation of such a system can significantly contribute to the city's efficiency and sustainability while addressing the challenges of traffic congestion.

5.1 High Level Diagram:

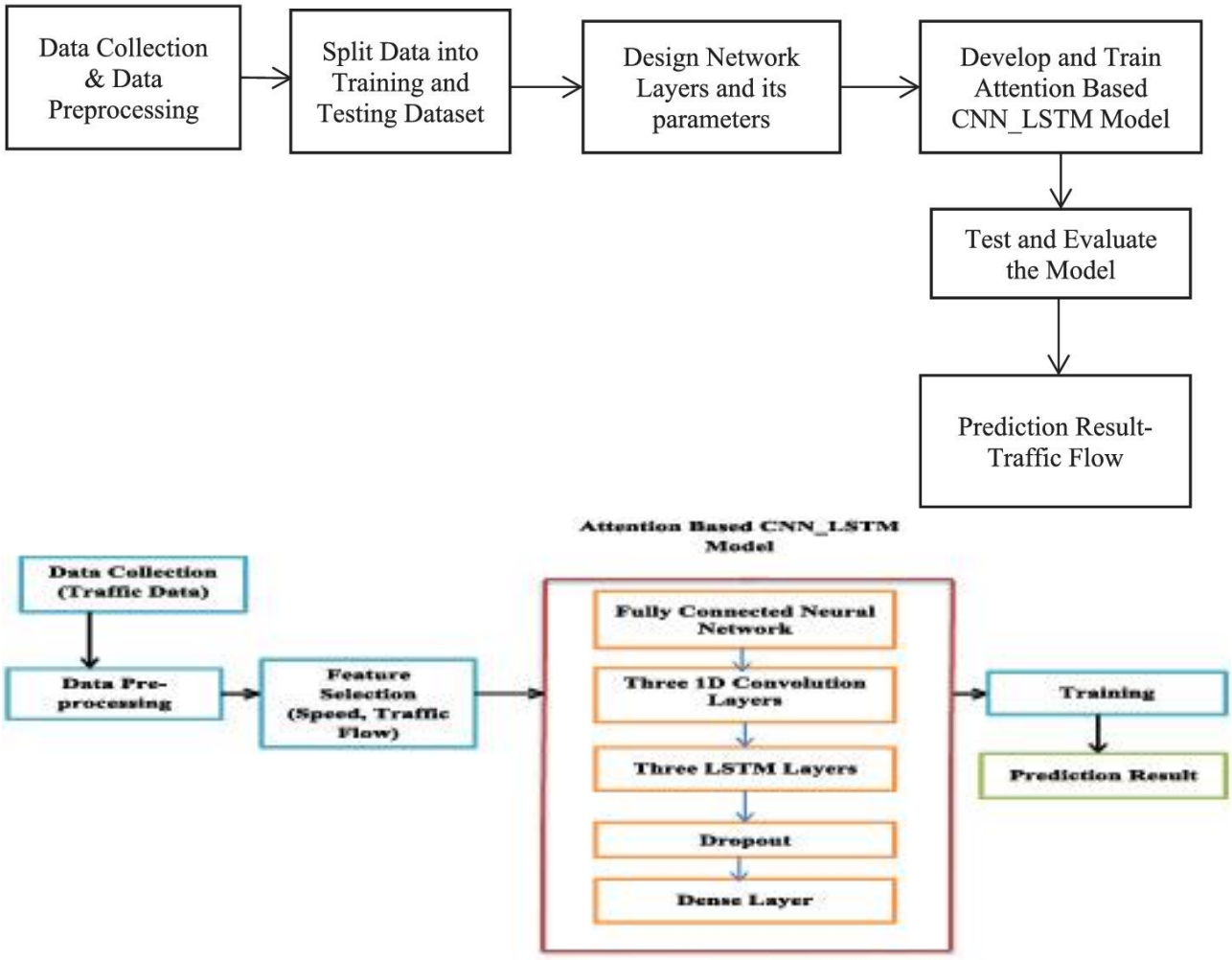


Figure 1: HIGH LEVEL DIAGRAM OF THE SYSTEM

6 Performance Test

The first step in performance testing is to adequately define performance metrics to measure system performance. These metrics should be based on system requirements and expected workload. For example, the performance specifications in a traffic management system might include:

Response time: The time it takes for the system to respond to a request.

Throughput: The maximum number of requests a system can process at any one time.

Resource consumption: The amount of CPU, memory, and bandwidth used by the system.

System stability: The ability of the system to operate consistently under heavy loads.

Once the performance metrics are defined, the next step is to perform load testing. Load testing involves simulating the expected traffic loads on the system. This is done by gradually increasing the number of simulated users or devices until the system reaches its performance limit. Performance requirements are the areas where system performance begins to deteriorate. Effective performance testing ensures that the traffic management system can handle traffic peaks, holidays, and various other occasions as specified in the initial requirements. It also helps guarantee a positive user experience, system reliability, and efficient traffic management in a smart city.

6.1 Test Plan/ Test Cases

6.2 Test Procedure

The approach to traffic optimization in a smart city can be divided into four steps.

Data Collection: The first step is to collect historical traffic data from various sources. This data can be used to understand current traffic conditions and identify congested areas. Data can be collected from a variety of sources including traffic cameras, sensors, GPS devices and mobile apps.

Simulation: The second step is to use traffic simulation software to simulate current traffic conditions. This software can be used to test different traffic patterns and monitor roads to see how they affect traffic. The simulation environment can be used to test a variety of scenarios, such as changes in traffic volume, road closures, and special events.

Traffic Pattern Optimization: The third study involves fine-tuning and modifying traffic patterns in the simulation to optimize traffic flow and control algorithms We can use machine learning and AI algorithms to predict and optimize traffic conditions a changing the character. The goal is to find traffic patterns that minimize congestion and improve the efficiency of the transportation system.

Real-world testing: The final step is to implement a customized traffic management system and control methods in a controlled real-world scenario in a smart city This allows the city to drive alternative routes check and ensure effectiveness in congestion. The city can monitor and collect real-time data from traffic sensors, cameras, and other sources to adjust traffic as needed

6.3 Performance Outcome

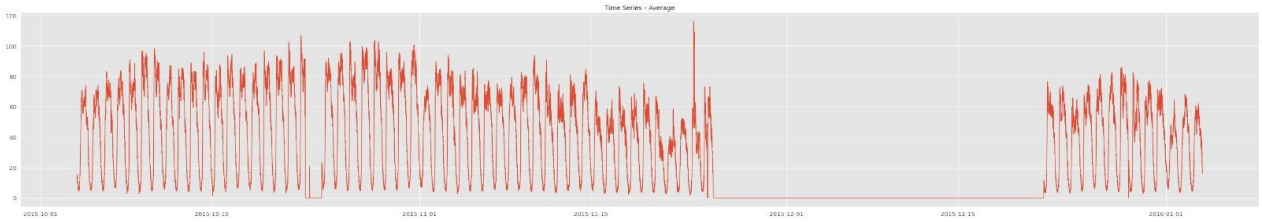


Fig1:Hourly traffic count mean

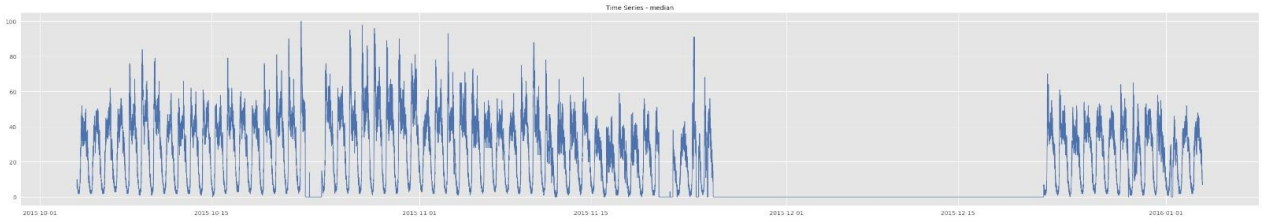


Fig2: Hourly traffic count median

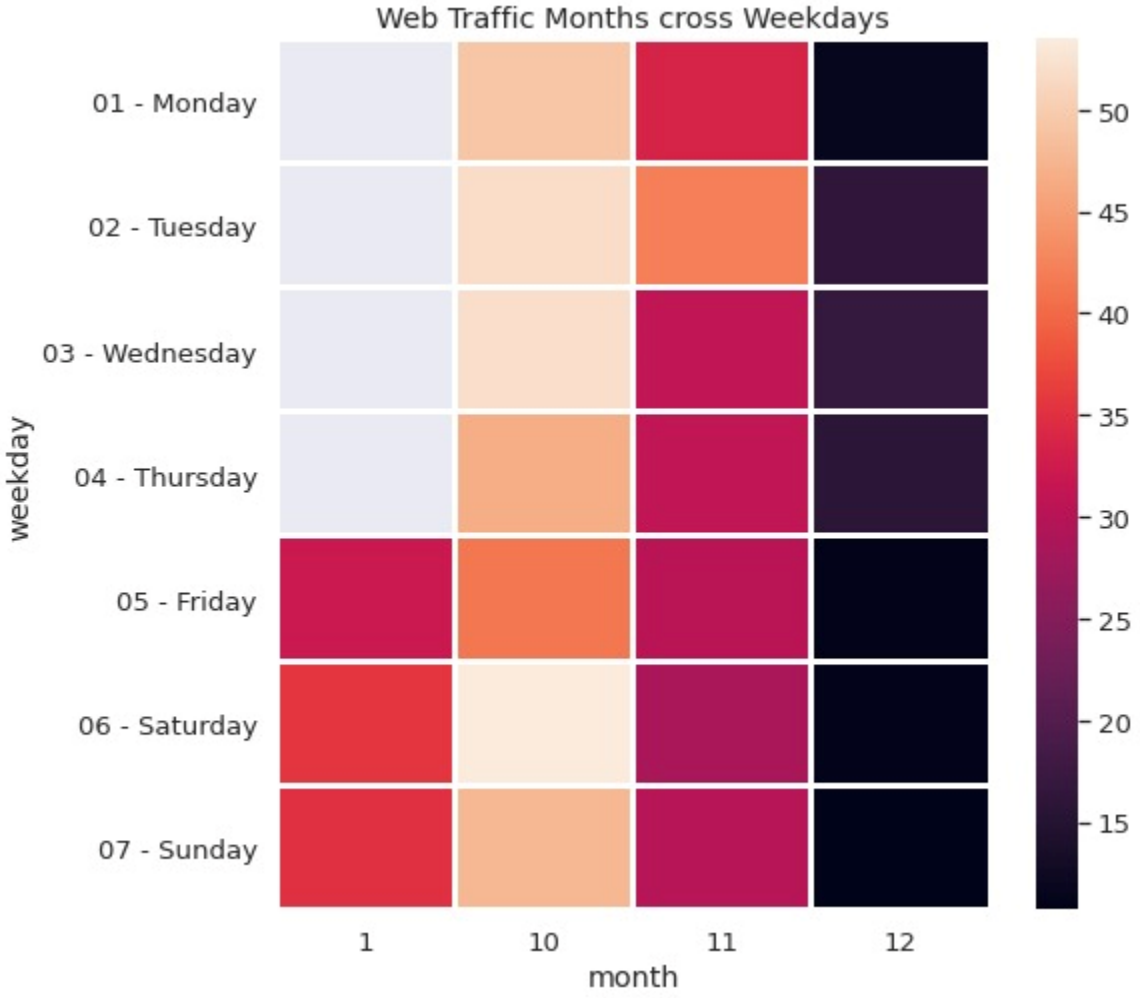


Fig3: Web traffic months cross weekdays

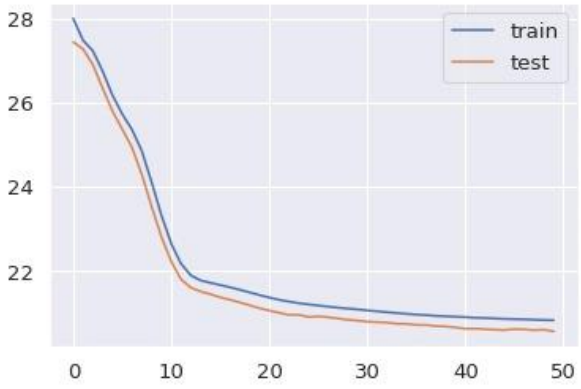


Fig4: Train test plot

7 My learnings

From my perspective, my involvement in the project to transform a city into a smart city and manage traffic patterns as a data scientist has provided me with invaluable skills and experiences that have significantly contributed to my career growth. Here are some of the key learnings and their potential impact on my career:

1.Data Analysis and Modeling Skills: Through this project, I have gained expertise in collecting, cleaning, and analyzing large datasets to derive meaningful insights. These skills have not only been instrumental in optimizing traffic management but are also highly transferable to various industries, including finance, healthcare, and e-commerce. The ability to work with data effectively is a cornerstone of modern decision-making.

2.Predictive Analytics and Forecasting: My experience in forecasting traffic patterns has honed my skills in predictive analytics and forecasting. This expertise can be seamlessly applied to other domains, such as demand forecasting in supply chain management or predicting customer behavior in marketing. The power of predictive analytics extends far beyond traffic management.

3. Machine Learning and AI: The application of machine learning algorithms in traffic management has opened doors to solving complex problems in other fields, such as natural language processing, image recognition, and recommendation systems. The foundation I've built in machine learning and AI can be leveraged for tackling a wide array of challenges across industries.

4.Data Monitoring and Decision-Making: Setting up real-time data monitoring systems and making quick decisions based on data have been central to my role in this project. These skills are directly applicable to roles that require real-time analytics, such as financial trading or network security. Being able to make informed decisions rapidly is a skill highly valued in fast-paced environments.

5.Problem-Solving and Critical Thinking: Addressing the intricate challenges of traffic management and finding innovative solutions has sharpened my problem-solving and critical thinking abilities. These skills are not confined to a single field but can be a valuable asset in any role that demands analytical thinking and the ability to navigate complex issues.

In summary, my experiences and learnings from working on a smart city project have not only elevated my technical skills but have also provided me with a well-rounded skill set that is transferable to a wide range of career paths. Whether I choose to continue in urban planning, data science, project management, or explore other fields, my expertise in data-driven decision-making and innovative problem-solving will undoubtedly be highly sought after and beneficial for my career growth.

8 Future work scope

Improve the accuracy of the traffic forecast. Current machine learning models for traffic forecasting are still not very accurate, especially in real-time applications. More research is still being done in this area, and as models improve, they can better predict traffic conditions and help prevent congestion

1. Develop a more efficient traffic signal management system. Traffic signal control systems are used to regulate traffic lights to improve traffic flow. More research is being done in this area to develop more efficient algorithms that can take into account factors such as traffic density, road conditions and weather forecasts
2. Use machine learning to detect and prevent traffic accidents. Machine learning can be used to analyze traffic data to identify roads that may be causing accidents. This information can then be used to develop preventive measures, such as warning drivers of potential hazards or changing traffic signs to reduce the risk of accidents
3. Use machine learning to generate traffic information for drivers. Machine learning can be used to analyze a driver's past travel patterns, create personalized traffic profiles and personalize them. This could include providing them with real-time traffic updates, suggesting alternative routes, or notifying them of upcoming road closures.
4. Use machine learning to improve the use of public transportation. Machine learning can be used to analyze ridership data to improve public transport systems. This could include improving the quality of bus routes, forecasting passenger demand, or developing dynamic pricing policies.
5. Applying machine learning to optimize traffic patterns. Machine learning can be used to analyze traffic data to determine the most efficient routes for vehicles. This can help reduce congestion and improve journey times.
6. Applying machine learning to parking management. Machine learning can be used to optimize parking and pricing. This can help reduce traffic congestion and improve parking.
7. Using machine learning to improve vehicle safety. Machine learning can be used to detect and prevent traffic accidents. This could include the use of cameras to monitor traffic and identify potential hazards, or the use of sensors to detect drunk drivers.
8. Using machine learning to make traffic environmentally friendly. Machine learning can be used to improve traffic flow and reduce carbon emissions. This could include the use of real-time traffic data to adjust traffic signs, or the use of sensors to detect and warn drivers of congestion.

The future of intelligent city traffic management is bright. With the help of machine learning, we can develop effective and efficient ways to manage traffic and improve the lives of urban dwellers.