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 project/problem statement provided by UCT. We had to finish the project including the report in 4 weeks' time.

My project was **Forecasting of Smart city traffic patterns.**

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. We 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.

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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Preface

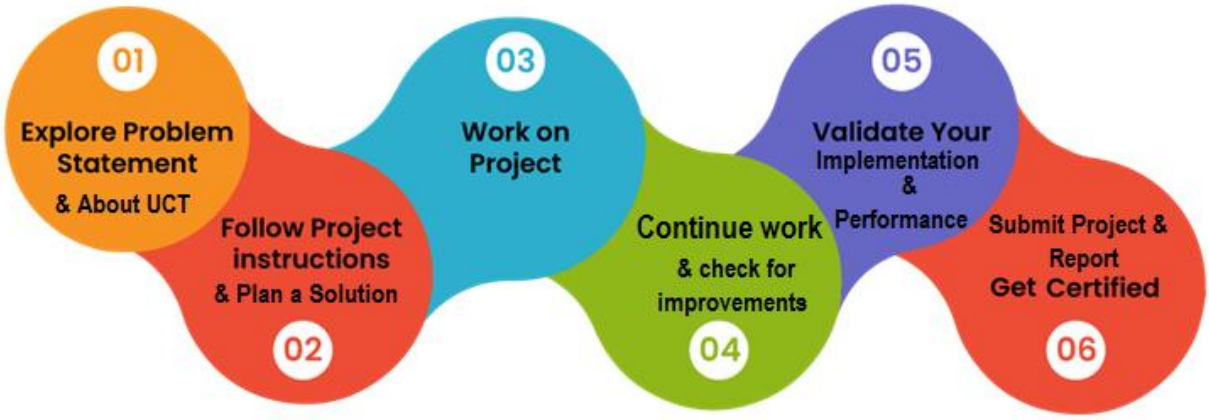
Over the course of four weeks, I participated in an immersive and dynamic educational experience that significantly contributed to my professional development. Through active participation in projects, collaborative discussions, I deepened my comprehension of fundamental principles in data science and machine learning. This not only refined my technical abilities but also cultivated essential skills in problem-solving, critical thinking, and effective teamwork. Engaging in a relevant internship proved crucial in bridging the divide between theoretical knowledge and real-world application. This experience broadened my skill set, exposing me to practical hurdles and innovative solutions essential for success in today's competitive landscape. It also empowered me to adapt to dynamic work environments and intensified my enthusiasm for continual learning and advancement.

My primary project focused on **Forecasting of Smart city traffic patterns.** The objective is to digitally transform city into intelligent urban centers to enhance service efficiency for residents. One challenge the government faces pertains to traffic management. As data scientists, our focus is on optimizing city traffic flow and providing insights for future infrastructure planning.

The government aims to establish a resilient traffic management system, capable of handling peak traffic loads. They seek to comprehend traffic dynamics at the city's four junctions, considering variations on holidays and other occasions throughout the year, distinct from regular workdays. Accounting for these fluctuations is crucial for accurate forecasting.

The opportunity provided by USC/UCT was transformative. The institution's dedication to delivering a comprehensive educational experience through hands-on exposure, mentorship, and industry-aligned projects was remarkable. By aligning the curriculum with industry demands and providing access to state-of-the-art tools and resources, USC/UCT facilitated the acquisition of skills and knowledge essential for a prosperous career in the technology sector.

The program was meticulously crafted to provide a well-rounded learning journey. It incorporated a blend of theoretical lectures and project-based learning, allowing participants to apply classroom theories in practical settings. Continuous assessments and feedback loops ensured ongoing learning, while expert guidance from faculty and mentors offered invaluable insights. The structured curriculum and hands-on challenges fostered a thorough understanding of the subject matter.



Throughout this experience, I've been fortunate to gather invaluable insights and skills that have profoundly influenced my development. Every phase of this project has contributed to my professional growth, from refining technical expertise to improving problem-solving abilities.

Handling intricate data sets and devising effective solutions have all played pivotal roles in expanding my proficiency. Alongside technical proficiency, I've gained valuable insights into adaptability, and project management, all of which are indispensable in real-world scenarios.

I extend my sincere appreciation to all those who have contributed to the success of this project. UpSkillCampus, UCT have provided unwavering support throughout this journey, offering guidance, resources, and mentorship crucial to both my project and personal advancement. Additionally, I'm grateful for the indirect contributions from peers and mentors, as well as those who posed challenging questions, pushing me to think innovatively. Your collective influence has had a profound impact on my learning.

To my juniors and peers, I encourage you to view every project, challenge, and endeavor as an opportunity for growth. Embrace each moment with curiosity and enthusiasm, as they will guide you toward new achievements. Collaboration and seeking guidance aren't signs of weakness but paths to shared success. As you embark on your journeys, remember that setbacks are integral to success, and learning from failures is a crucial aspect of progress. Stay resilient, stay curious, and never underestimate your potential. Your journey holds as much value as your destination.

Introduction

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.

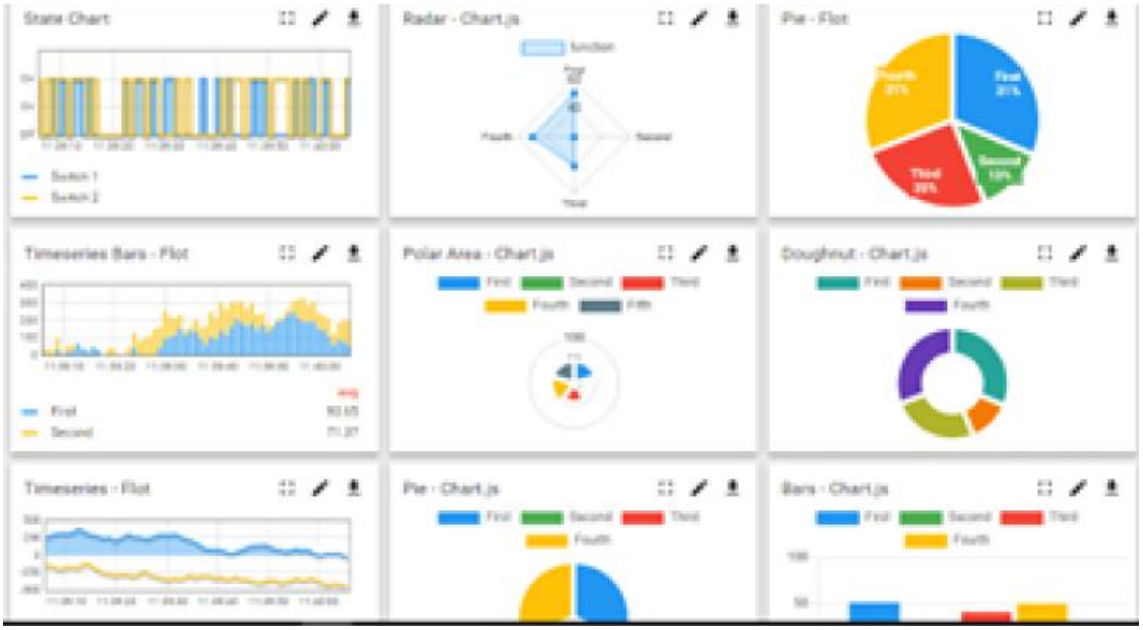
i. UCT IoT Platform (UCT Insight)

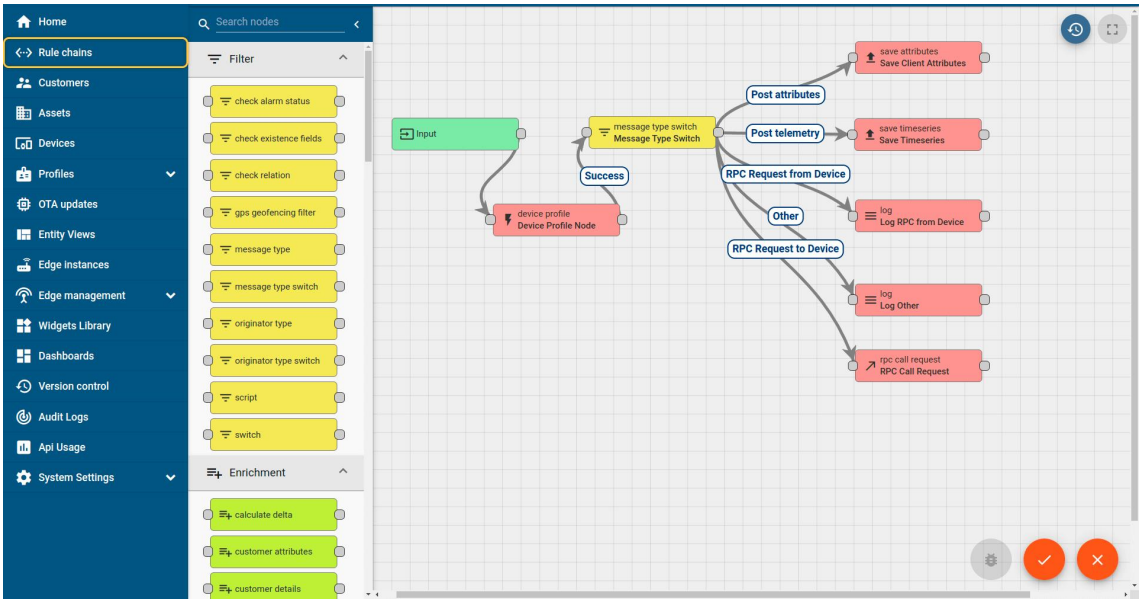
UCT Insight is an IOT platform designed for quick deployment of IOT applications on the same time providing valuable "insight" for your process/business. It has been built in Java for backend and ReactJS for Front end. It has support for MySQL and various NoSql Databases.

- 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
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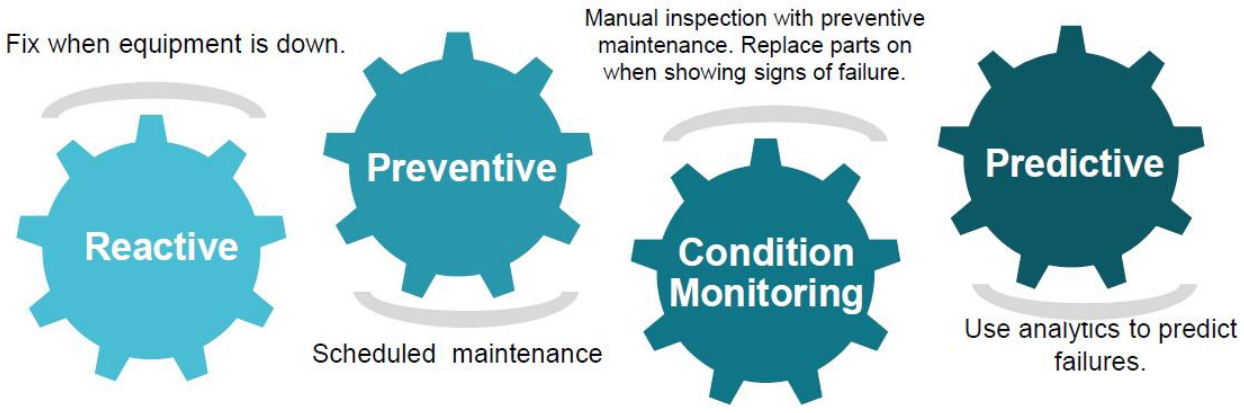
iii. LoRaWAN based Solution

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

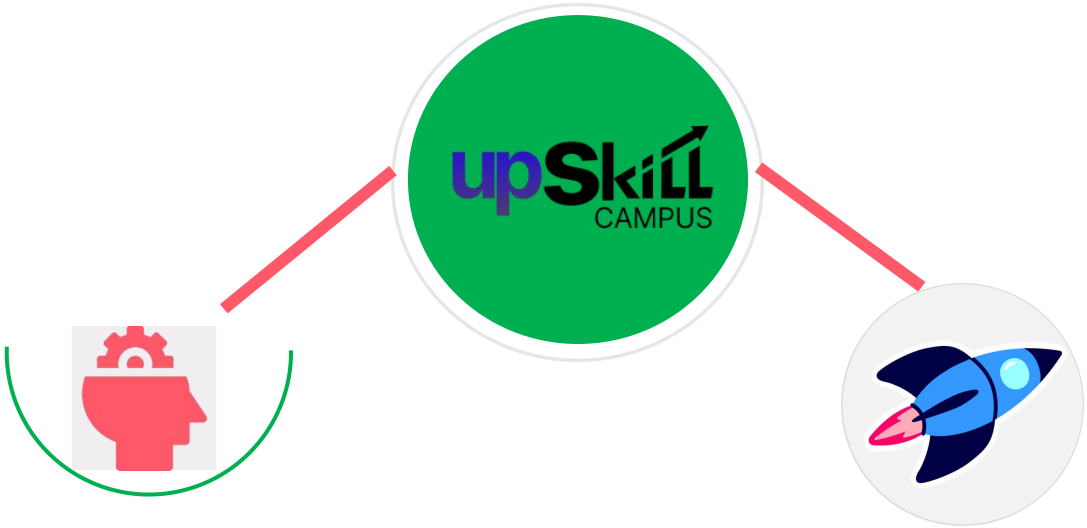
UCT is providing Industrial Machine health monitoring and Predictive maintenance solution leveraging Embedded system, Industrial IoT and Machine Learning Technologies by finding Remaining useful life time of various Machines used in production process.



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.

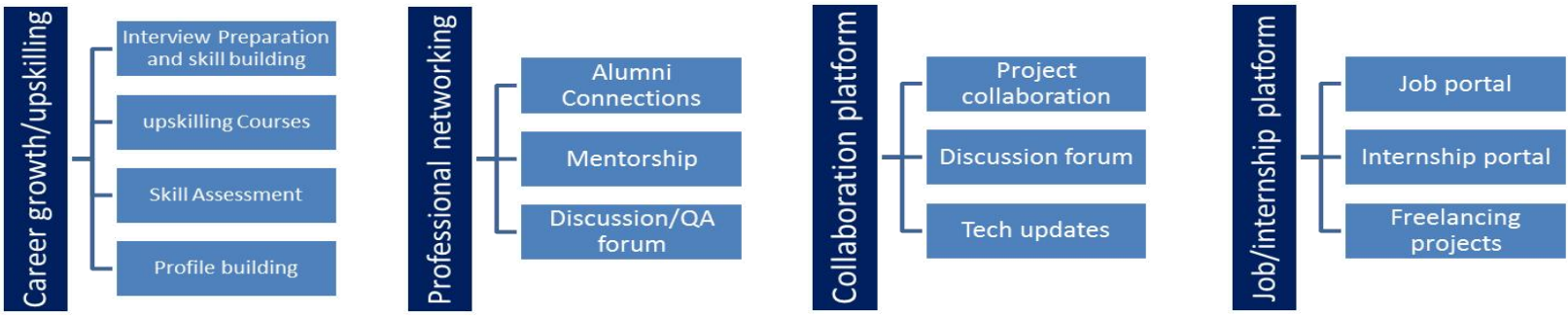
USC is a career development platform that delivers **personalized executive coaching** in a more affordable, scalable and measurable way.



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/



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.

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.

Problem Statement

In the assigned problem statement **Project – 9 : Forecasting Smart City Traffic Patterns**

Our project aligns with government initiatives to develop smart cities, aiming to improve urban infrastructure and citizen services through digital innovation. By tackling the ongoing issue of traffic congestion, we utilize data science to optimize traffic flow and support well-informed decisions regarding infrastructure.

Our objective is to establish a resilient traffic management system capable of anticipating and mitigating congestion during peak periods. Concentrating on four crucial intersections within the city, we aim to thoroughly analyze traffic patterns across different situations, including holidays and special events. These fluctuations are critical factors in our predictive models, which will assist in efficiently managing traffic and guiding future infrastructure improvements.

Data set Link **:**

https://drive.google.com/file/d/1y61cDyuO9Zrp1fSchWcAmCxk0B6SMx7X/view?usp=sharing

Proposed solution :

In response to the complexities of urban traffic management and to support the evolution of smart cities, this project utilizes state-of-the-art machine learning algorithms to accurately predict traffic patterns. Through the utilization of advanced methodologies, our goal is to offer significant insights to aid the government's endeavor in city transformation. We evaluate the performance of three machine learning models.

Support Vector Machine (SVM)

Decision Tree Classifier

Random Forest Classifier

Code submission (Github link) :

upskillCampus/Untitled11.ipynb at main · abha42/upskillCampus (github.com)

Report submission (Github link) :

Methodology :

In our endeavor to optimize urban traffic management, our project utilized a range of machine learning algorithms to predict traffic patterns in smart cities. Collaborating with governmental initiatives aimed at establishing intelligent urban environments, our goal was to enhance citizen services and improve infrastructure planning, with a particular emphasis on addressing traffic congestion and its variability, especially during peak times and special occasions.

Our approach involved the application of various machine learning algorithms, each tailored to provide unique insights into the traffic forecasting process. The algorithms employed included :

- Decision Tree Classifier : Leveraging its interpretable structure, the Decision Tree Classifier facilitated the identification of traffic patterns based on distinct conditions at each junction, thereby aiding in the extraction of valuable insights from the data.
- Random Forest Classifier: By aggregating predictions from multiple decision trees, the Random Forest Classifier helped mitigate overfitting and improved generalization. Its versatility in handling diverse data scenarios enhanced prediction accuracy.
- Support Vector Machine : Supervised learning algorithm used for classification and regression tasks. SVM aims to find the hyperplane that best separates the classes in the feature space.

These algorithms were systematically applied to analyze historical traffic data, considering variations during holidays and special events. The outputs were combined and evaluated to provide comprehensive insights into traffic behavior, empowering the government to make informed decisions regarding infrastructure planning and traffic management. The diverse application of machine learning techniques ensured the accuracy and reliability of our traffic pattern forecasts, supporting the evolution of cities into smarter, more efficient urban environments.

Performance Assessment :

In the course of my analysis, I explored a diverse range of machine learning algorithms, including the Decision Tree Classifier, Support Vector Machine (SVM), and Random Forest Classifier. These methodologies were applied to unravel the intricate dynamics of traffic fluctuations, adapting to various scenarios such as holidays and special events. Following a rigorous evaluation process, one algorithm emerged as particularly promising.

Among the array of algorithms considered, the Decision Tree Classifier showcased exceptional capabilities in predicting traffic patterns. Its adeptness at handling complex relationships within the data, coupled with its intuitive interpretability, proved pivotal in generating remarkably accurate predictions. This proficiency in capturing the nuances of traffic dynamics ensured that the algorithm surpassed others in terms of accuracy and reliability.

By harnessing the predictive potential of the Decision Tree Classifier, significant strides were made towards equipping the city with a robust traffic management system. The insights gleaned from this performance evaluation have not only optimized urban planning efforts but also laid the groundwork for a smarter and more efficient transportation ecosystem, aligning with our mission to develop intelligent cities.

My Insights :

Throughout my engagement in the Project, my responsibilities centered around optimizing city traffic management and providing insights for future infrastructure planning.

To tackle the issue of traffic congestion, I leveraged a variety of machine learning algorithms, including SVM, Decision Tree Classifier, and Random Forest Classifier. Among these, the Decision Tree Classifier stood out as a top performer, consistently delivering highly accurate predictions.

By employing the Decision Tree Classifier, I was able to uncover intricate traffic patterns across the city's four junctions, enabling us to anticipate and manage peak traffic scenarios more effectively. This predictive approach is essential not only for ensuring smooth traffic flow but also for making informed decisions during holidays and special events.

As I reflect on this journey, I am reminded of the significant role machine learning plays in transforming urban transportation. My experience reaffirms the importance of data-driven strategies in reshaping smart city ecosystems for the better.

Future Work Opportunities :

While the Decision Tree Classifier has exhibited promising outcomes in enhancing algorithmic efficiency and accuracy, there are opportunities for further enhancement through hyperparameter tuning and exploration of ensemble techniques. The integration of real-time data sources, such as live GPS feeds, weather conditions, and special events, holds the potential to augment the predictive capabilities of the models.

The implementation of AI-based anomaly detection can aid in identifying unusual traffic patterns or incidents, thereby contributing to proactive traffic management and emergency response systems. Extending the model to encompass multiple cities and integrating it with smart traffic signal systems can facilitate automated adjustments in signal timings, thereby mitigating congestion and optimizing traffic flow.

It is important to acknowledge the limitations of the current model, which include constraints related to data quality and availability, the static nature of the feature set, model complexity, external factors, and variability in human behavior. While accurate traffic prediction hinges on high-quality and diverse datasets, the identified limitations underscore the necessity for ongoing development aimed at crafting a comprehensive and adaptable traffic management solution.