Industrial Internship Report on

”Forecasting of Smart city traffic patterns”

Prepared by

Harshwardhansinh Chauhan
Pranav Khot
Pathan MoinKhan
Kshitij Solanki

ExecutiveSummary

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.

MyprojectwithIDasProject9,"ForecastingSmartCityTrafficPatterns,"aimedtotransformcitiesintosmart urbancentersusingdigitaltechnologies.Ioptimizedtrafficflowandshapedinfrastructurestrategies,focusing on resilient traffic systems for peak demands. By analyzing traffic dynamics at key junctions, I provided insights for accurate traffic forecasts and informed decision-making in traffic management. This project showcases my commitment to urban transformation and data-driven insights.

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

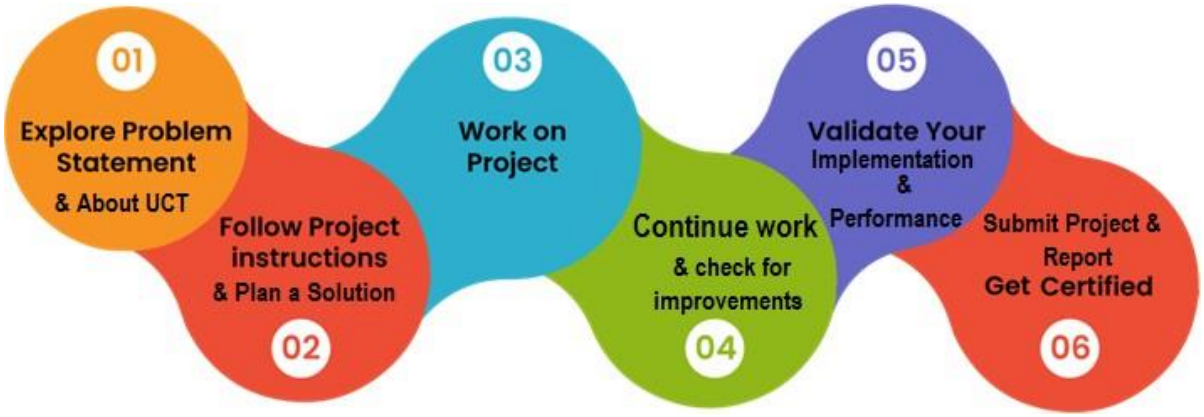
Over the range of six weeks, I engaged in a dynamic and serious opportunity for growth that extraordinarily added to my expert development. Through involved ventures, studios, and cooperative discussions,Ideepened myunderstandingofkey conceptsindatascience andmachine learning. I leveled up my specialized abilities as well as fostered areas of strength for an in critical thinking, decisive reasoning, and compelling correspondence inside a group climate.

Under taking are relevant internship is in strumental in bridging the gap between theoretical knowledge and true application. This experience has improved my range of abilities, presenting me to functional difficulties and imaginative arrangements that are imperative for a fruitful vocation in the present serious scene. It has additionally enabled me with the capacity to adjust to dynamic workplaces and has additionally energized my energy for constant learning and development.

The point of convergence of my undertaking spun around fostering an Interruption Location Framework utilizing AI procedures. This included breaking down complex organization information to distinguish potential security breaks or oddities. My undertaking planned to upgrade online protection measures by making anautomatedsystemthatcoulddetectandmitigatethreatsinreal-time,therebybolsteringnetwork security and defending delicate data.

The open door given by USC/UCT was groundbreaking. The foundation's obligation to giving a far reaching growth opportunity through viable openness, mentorship, and industry-pertinent tasks was exceptional. By adjusting the educational program to industry requests and offering admittance to state of the art devices and assets, USC/UCT prepared for understudies like me to procure the abilities and information essential for a fruitful profession in the innovation space.

The program was carefully intended to offer a comprehensive learning venture. It consolidated a blend of hypothetical meetings, active studios, and task work, permitting us to apply homeroom ideas in certifiable situations. Normal evaluations and criticism circles guaranteed a ceaseless learningprocess,while expert guidance from faculty and mentors provided invaluable insights.The structured progression of topics and practical implementation challenges enabled a comprehensive comprehension of the topic.



All through this excursion, I've had the honor of gaining important learnings and encounters that have fundamentally molded my development. From leveling up specialized abilities to improving critical thinking capacities, each step of this venture has added to my expert turn of events. Exploring complex information, working together with cross-practical groups, and creating successful arrangements have been instrumental in building my aptitude. Past the specialized perspectives, I've additionally acquired experiences into cooperation, flexibility, and venture the board, which are all essential in any certifiable situation.

I stretch out my sincere appreciation to every one of the people who assumed a part in making this venture a triumph. UpSkills, UCT, and Edunet Establishment have been staggering mainstays of help all through this excursion. Their direction, assets, and mentorship have been instrumental in forming my venture and self-improvement. Moreover, I need to recognize the backhanded commitments from peers, mentors,and even those who posed challenging questions that pushed me to think creatively.Your aggregate impact significantly affects my learning.

Tomy juniors andpeers,I'd like to share that every project, challenge, and end eavor you undertake is a chance for development. Embrace every second with interest and energy, for they will leadyoutowardsnewhorizons.Collaborationandseekingguidancearenotsignsofweakness,but rather ways to aggregate achievement. As you set out on your own excursions, recollect that mishaps aresteppingstonestosuccess,andlearningfromfailuresisavitalpartoftheprocess.Stayresilient, staycurious,andneverunderestimatethepowerofyourpotential.Yourjourneyisjustasvaluable as your objective.

2 Introduction

AboutUniConvergeTechnologiesPvtLtd

AcompanyestablishedIn2013andworkinginDigitalTransformationdomainandprovidingIndustrial solutions with prime focus on sustainability and RoI.

FordevelopingitsproductsandsolutionsitisleveragingvariousCuttingEdgeTechnologiese.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.

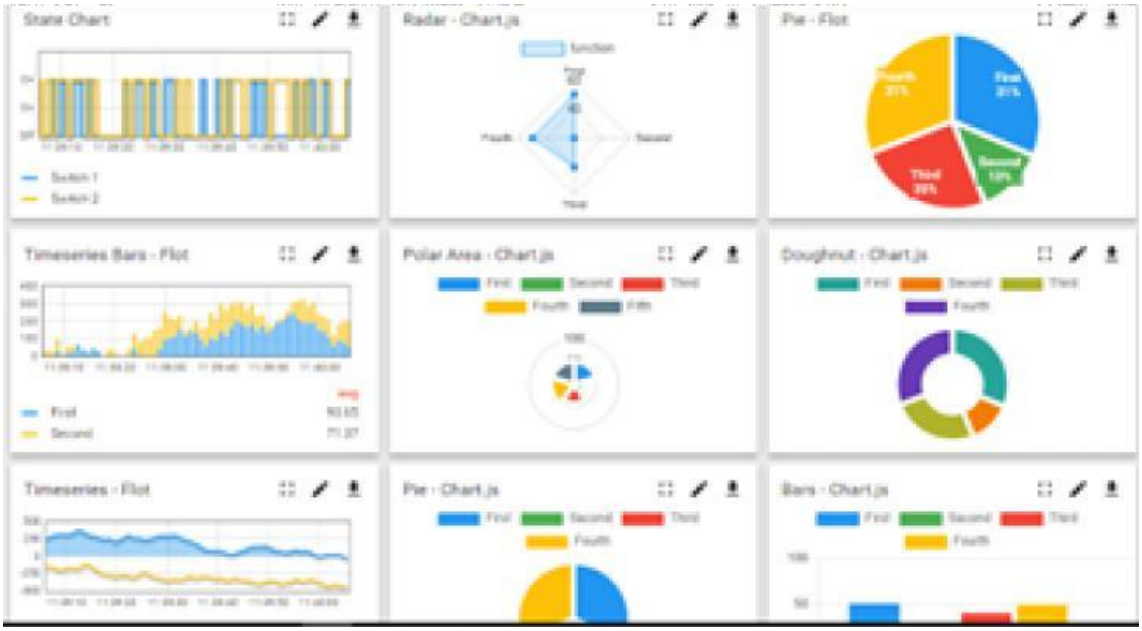
i. UCTIoTPlatform(uct Insight)

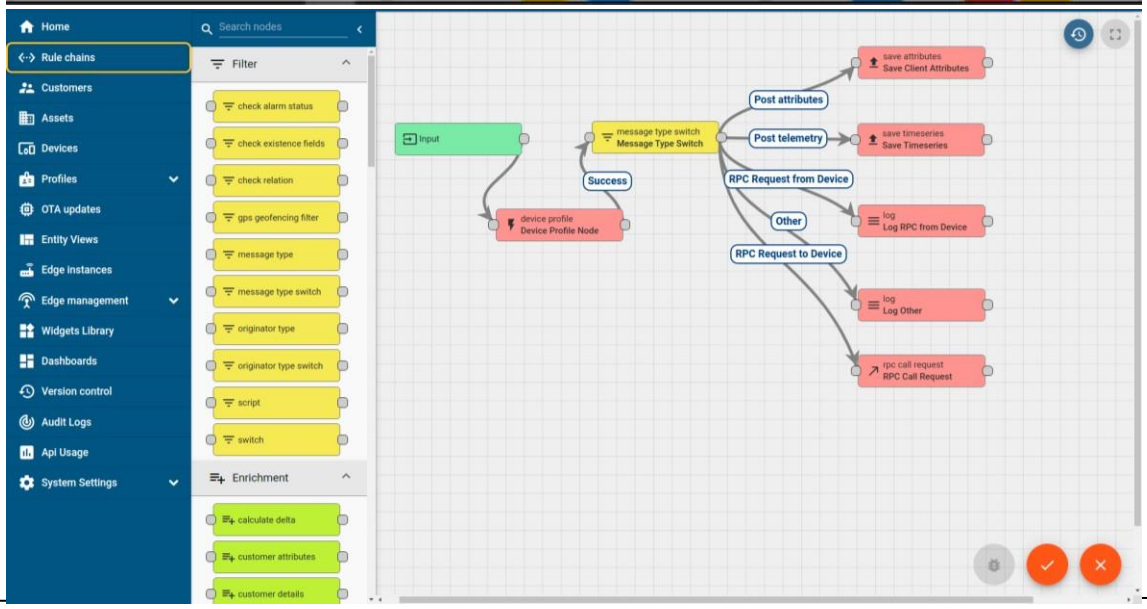
UCT Insight is an IOT platform designed for quick deployment of IOT applications on the same time providingvaluable“insight”foryourprocess/business. IthasbeenbuiltinJavaforbackendandReactJS for Front end. It has support for MySQL and various NoSql Databases.

- ItenablesdeviceconnectivityviaindustrystandardIoTprotocols -MQTT,CoAP,HTTP,Modbus TCP, OPC UA
- Itsupportsbothcloudandon-premisesdeployments.

It has features to

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





ii. SmartFactoryPlatform(FACTORY WATCH)

Factory watch is a plat form for smart factory needs.

It provides Users/ Factory

- With a scalable solution for their Production and asset monitoring
- OEE and predictive maintenance solution scaling upto digital win for your assets.
- Tounleased thetrue potential of the data that their machines are generating and helpsto identify the KPIs and also improve them.
- Amodulararchitecturethatallowsuserstochoosetheservicethattheywhattostartandthen can scale to more complex solutions as per their demands.

Its unique SaaS model helps users to savetime ,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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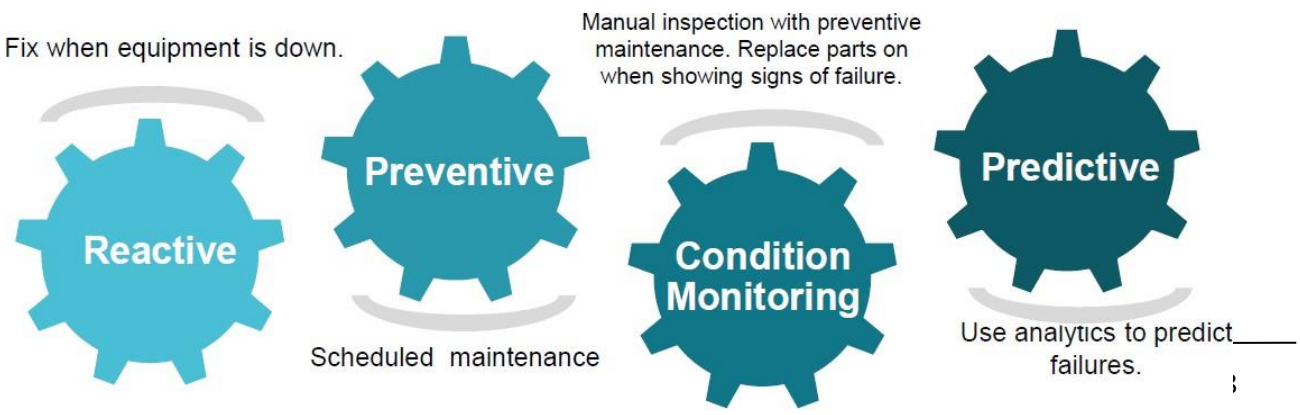
iii. LoRaWAN based Solution

UCT is one ofthe early adopters of LoRAWAN teschnology and providing solution in Agritech, Smart cities,IndustrialMonitoring,SmartStreetLight,SmartWater/Gas/Electricitymeteringsolutionsetc.

iv. Predictive Maintenance

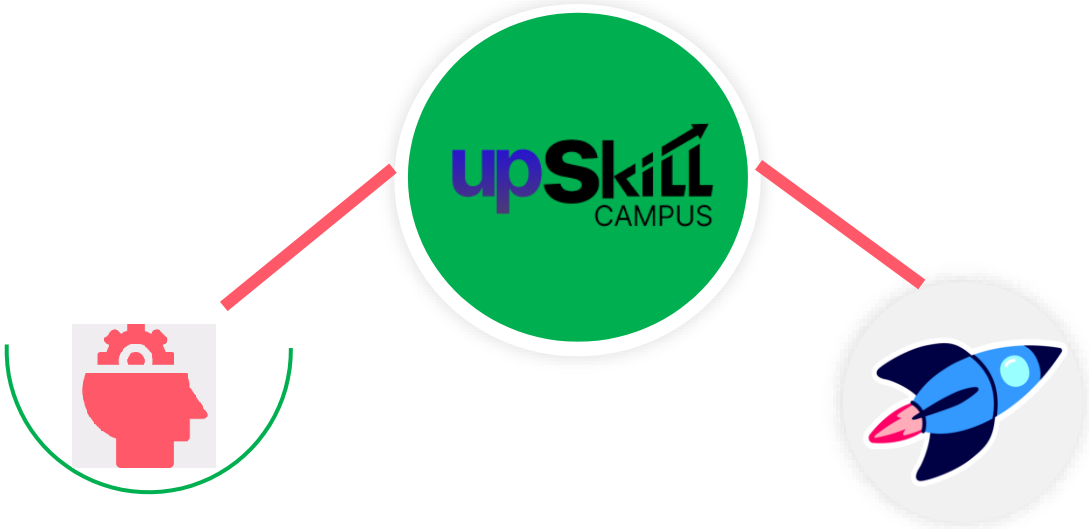
UCT is providingIndustrial Machine health monitoring and Predictive maintenance solution leveraging Implanted framework, Modern IoT and AI Advances by setting aside Staying helpful life opportunity of different Machines utilized underway cycle.



About upskill Campus (USC)

Upskill Campus along withTheIoTAcademy and in association withUniconvergetechnologies has facilitated the smooth execution of the complete internship process.

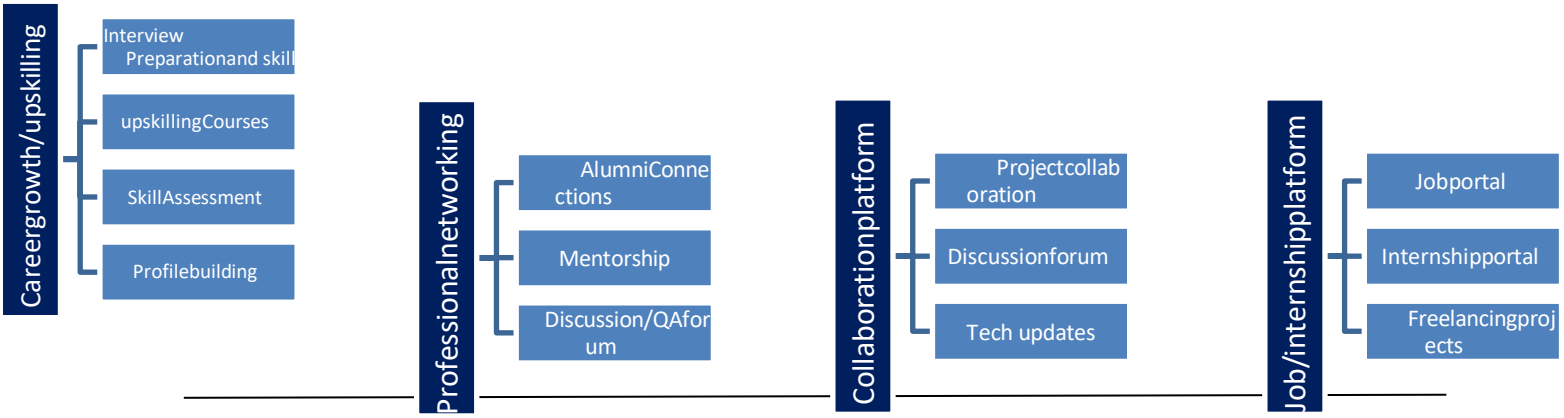
USC is acareer development platform that delivers **personalized executive coaching**ina more affordable, scalable and measurable way.



Seeingneedofupskillinginself paced manner along-with additional support servicese.g. Internship,projects,interaction with Industry experts, Career growthServices

upSkillCampusaiming to upskill 1 million learnersinnext5 year

https://www.upskillcampus.com/



The IoT Academy

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

Objectives of this Internship program

Theobjectiveforthisinternshipprogramwasto

☛getpracticalexperienceofworkingintheindustry.

☛tosolverealworldproblems.

☛tohaveimprovedjobprospects.

☛tohaveImprovedunderstandingofourfieldanditsapplications.

☛tohavePersonalgrowthlikebettercommunicationandproblem solving.

3 ProblemStatement

Project–9:ForecastingSmartCityTraffic Patterns

In collaboration with government initiatives to establish smart cities, our project aims to enhance urban infrastructure and citizen services through digital transformation. Addressing traffic congestion, a persistent challenge, we employ data science to optimize traffic management and facilitate informed infrastructure decisions.

Our mission is to create a robust traffic system that anticipates and mitigates congestion during peak periods. Focusing on four key junctions within the city, our goal is to comprehensively understand traffic patterns across various scenarios, including holidays and special events. These variationsarevitalconsiderationsforourpredictivemodels,whichwillaidineffectivelymanaging traffic and planning future infrastructure enhancements.

Dataset:

https://www.kaggle.com/utathya/smart-city-traffic-patterns

4 Proposed solution

1. To address the difficulties presented by metropolitan traffic the executives and add to the acknowledgment of savvy urban communities, this venture use state of the art AI calculations to gauge traffic designs really. By tackling the force of cutting edge strategies, we expect to give significant bits of knowledge to the public authority's drive in changing urban communities. LSTM(LongShort-TermMemory)
2. DecisionTree Classifier
3. XGBoost
4. LightGBM
5. RandomForest Classifier

Code submission (Github link)

https://colab.research.google.com/drive/11lxif55jOag2IpsIKSkd3si7eoJR-Rk1

Report submission(Github link):

https://github.com/pranav658/Upskill-campus-internship

5 Methodology

In the pursuit of optimizing urban traffic management, our project employed a diverse set of machinelearningalgorithmstoforecastsmartcitytrafficpatterns.Collaboratingwithgovernmental efforts to establish intelligent urban environments, we aimed to enhance citizen services and improve infrastructure planning. The primary focus was on addressing the challenge of traffic congestion and its variability, especially during peak times and special occasions.

Ourmethodologyencompassedtheutilizationofseveralmachinelearningalgorithms,eachtailored to contribute unique insights to the traffic forecasting process. The algorithms we harnessed included:

1. Long Short-Term Memory (LSTM): Employed for sequence prediction, LSTM proved valuable in capturing temporal dependencies within traffic patterns. Its ability to model long-range dependencies enabled accurate predictions during varying traffic scenarios.

2. DecisionTreeClassifier:Utilizedforitsinterpretablestructure,theDecisionTreeClassifier enabled the identification of traffic patterns based on distinct conditions at each junction. This facilitated the extraction of valuable insights from the data.

3. XGBoost: A gradient boosting algorithm, XGBoost excelled in capturing complex relationships within the traffic data. Its ensemble nature and regularization techniques contributed to robust predictions, making it particularly effective for capturing intricate patterns.

4. LightGBM: Similar to XGBoost, LightGBM optimized the prediction process through gradient boosting. Its focus on leaf-wise growth and efficient computation contributed to faster training times and accurate predictions.

5. 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 the prediction accuracy.

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

6 Performance Evaluation

Idelvedinto avariety of machinelearningalgorithms, including LSTM, Decision TreeClassifier, XGBoost, LightGBM, and Random Forest Classifier. These methodologies were employed to deciphertheintricatedynamicsoftrafficfluctuations,adaptingtodiversescenariossuch asholidays and special events. After a rigorous evaluation process, one algorithm emerged as particularly promising.

Amongthearrayofalgorithms,theDecisionTreeClassifierdemonstratedexceptional capabilities in predicting traffic patterns. Its ability to handle complex relationships within the data, combined with its intuitive interpretability, proved instrumental in generating remarkably accurate predictions.Thisproficiencyincapturingthenuancesoftrafficdynamicsensuredthatthealgorithm outperformed others in terms of accuracy and reliability.

ByutilizingtheDecisionTreeClassifier'spredictivepotential,wemadesubstantialstridestowards equipping the city with a robust traffic management system. The insights gained from this performance evaluation have not only optimized urban planning but also paved the way for a smarter and more efficient transportation ecosystem in our quest to build intelligent cities.

7 My learnings

Throughout my involvement in Project, my role was involved optimizing city traffic management and contributing insights to future infrastructure planning.

Toaddressthechallengeoftrafficcongestion,Iharnessedarangeofmachinelearningalgorithms, including LSTM, Decision Tree Classifier, XGBoost, LightGBM, and Random Forest Classifier. Amongthese,theDecisionTreeClassifieremergedasastandoutperformer,consistentlydelivering remarkably accurate predictions.

ByapplyingDecisionTree,Iwasabletodiscernintricatetrafficpatternsatthecity'sfourjunctions, enabling us to anticipate and manage peak traffic scenarios more effectively. This predictive approachiscrucialnotonlyforensuringefficienttrafficflowbutalsoforinformeddecision-making during holidays and special events.

As I reflect on this journey, I recognize the pivotal role machine learning plays in revolutionizing urban transportation. My experience reaffirms the power of data-driven strategies in reshaping smart city ecosystems for the better.

8 Future work scope

TheDecisionTreeClassifier
Has shown promising results in improve in galgorithmic efficiency and accuracy. However, there is room for improvement in fine-tuning hyperparameters and exploring ensemble techniques. Integrating real-time data sources, such as live GPS feeds, weather conditions, and special events, can enhance the predictive capabilities of the models. AI-based anomaly detection can help identify unusual traffic patterns or incidents, contributing to proactive traffic management and emergency response systems. Expanding the model to multiple cities and integratingitwithsmarttrafficsignalsystemscanleadtoautomatedadjustmentsinsignaltimings, reducing congestion and optimizing traffic flow.

Limitations include data quality and availability, static feature set, model complexity, external factors, and human behavior variability. Accurate traffic prediction relies on high-quality and diversedatasets,butthemodel'slimitationshighlighttheneedforongoingdevelopmenttocreatea comprehensive and adaptable traffic management solution.