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2024/IT/SEMVI/Mini Project

Smart Traffic Controller

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Current Scenario

Traffic congestion has increased drastically over the years and has had negative impacts that include road rage, accidents, air pollution, wastage of fuel and most importantly unnecessary delays. One of the many causes of traffic congestion is improper traffic management systems.

Need for Proposed System

- Fix for current improper traffic management systems.
- Reducing idle traffic will result in reduced AQI(Air Quality Index) and save fuel.
- Storage capabilities for historical traffic data that can be used by analytical tools to identify patterns, trends, and areas for improvement.
- Less time spent in traffic leads to improved productivity, lower stress levels, and a more enjoyable commute.

Problem Statement

Design an adaptive Traffic Signal Control System that utilizes real-time traffic density classification (low, medium, high and heavy) on individual lanes to dynamically allocate signal timings. The system aims to optimize traffic flow by adjusting signal cycles based on the current density, reducing congestion and enhancing overall transportation efficiency in urban areas.

Scope of the problem

The project aims to enhance the traffic management system by classifying the traffic density on each lane into 4 categories(low, medium, high and heavy) and deciding the time for each lane based on this.

The future scope of this project is to integrate real time data collection using cameras at traffic signal along with YOLO v8. Stored data can be then also be used for historical analysis of traffic.

Literature Summary

Core	Finding/Result	Gap
RFID Technology Adoption: The system focuses on implementing magnetic inductive loop technology to address traffic congestion. **Reducing Congestion :** The primary objectives of the system include reducing congestion, detecting bottlenecks early, and ultimately saving time and money for drivers. [1]	**Efficient flow of traffic Congestion:** The successful implementation of the inductive loop is expected to lead to a measurable reduction in traffic congestion in cities like India. **Time and Cost Savings for Drivers:** Demonstration of tangible time and cost savings for drivers. By efficiently managing traffic in real-time and detecting bottlenecks early, the system aims to contribute to a smoother flow of traffic, resulting in reduced travel time and associated costs for commuters.	The evaluation of inductive loop demonstrates effectiveness, with results aligning within a set threshold. However, there are gaps in explaining the threshold determination and providing a detailed comparison with an existing solution. Implementing a system like this may prove to be expensive.

Literature Summary

Core	Finding/Result	Gap
Revolutionizing Urban Mobility: A Cost-Effective RFID-Based Smart Traffic Management System for Congestion Mitigation [2]	Detrimental impact of traffic congestion in Indian cities, proposes Radio Frequency Identification (RFID) technology as a cost-effective solution to overcome the limitations of existing traffic management methods, detailing its components and applications, and concludes by emphasizing the system's potential to efficiently manage traffic while suggesting avenues for future improvements.	It lacks a comprehensive discussion on the potential challenges and ethical considerations associated with the implementation using RFID

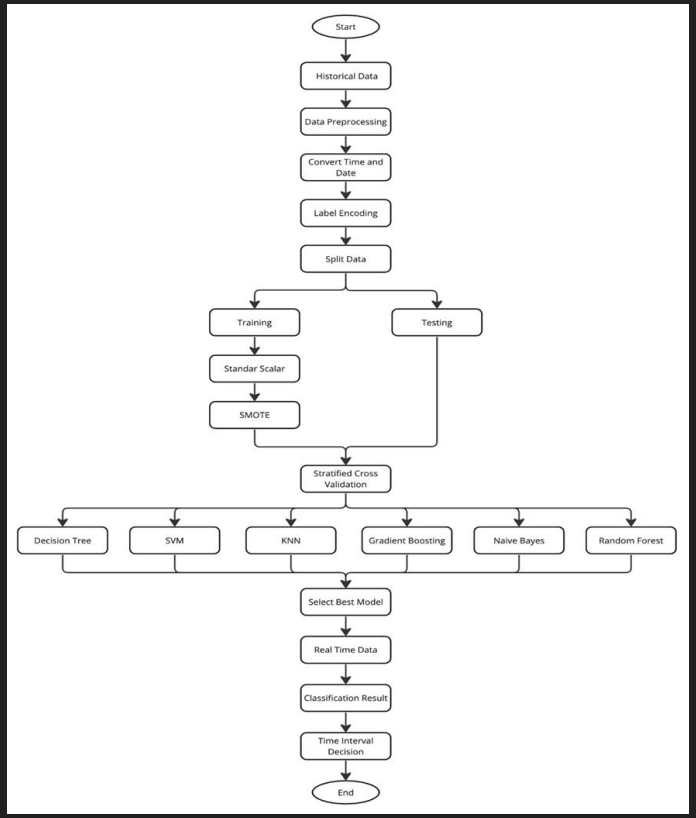
Literature Summary

Core	Finding/Result	Gap
CISCO SYSTEMS INC [3]	This solution supports Transit Signal Prioritization (TSP), Computer Aided Dispatch and Automated Vehicle Location (CAD/AVL), Dedicated Short Range Communications (DSRC), network management, data analytics, and Wireless Bulk Data Transfer (WBDT) for transforming urban roadway systems.	Dedicated Short Range Communications (DSRC) may pose a limitation as it may not be universally adopted or compatible with emerging technologies, potentially restricting interoperability.

Literature Summary

Core	Finding/Result	Gap
UTOPIA by SWARCO AG [4]	UTOPIA is an adaptive control system that enables traffic management authorities to optimize road traffic flow. Under the interurban traffic management segment, the company offers highway and tunnel systems, variable speed control systems, vehicle classification and detection systems, and dynamic and static signage.	Uncertainties about adaptability to diverse infrastructures and regions, and the integration challenges with existing traffic management systems are not addressed.

Flowchart


Start
Historical Data
Data Preprocessing
Convert Time and Date
Label Encoding
Split Data
Training
Testing
Standar Scalar
SMOTE
Stratified Cross Validation
Decision Tree
SVM
KNN
Gradient Boosting
Naive Bayes
Random Forest
Select Best Model
Real Time Data
Classification Result
Time Interval Decision
End

Hardware & Software requirements

Hardware requirements	Software Requirements
• Computer with 8GB RAM • Adequate storage space (512GB)	• Google colab • Python 3.10

Work Plan

Activity	Start Date	Duration
Literature review	25-01-2024	6
Refinement of problem formulation	27-01-2024	1
Identifying or creating data	18-01-2024	11
Acquaintance with the tool to implement	18-01-2024	7
Implementation and Presentation 1	01-02-2024	5
Coding/Discovering the properties of table	08-02-2024	2
Generating / reporting visual trion (identifying pattern) of the data	10-02-2024	5
Importing necessary lib/ apis for implementation	15-02-2024	1
Code ML algorithm	16-02-2024	30
Performance evaluation of ML algorithm	17-03-2024	5
Refine algorithm again and Presentation 2	22-03-2024	10
Documentation	01-04-2024	10

References

[1] J. E. Naranjo, M. Humayun, et al, "Smart Traffic Management System for Metropolitan Cities of Kingdom Using Cutting Edge Technologies," Journal of Advanced Transportation, vol. 2022, pp. 4687319, Sep. 29, 2022. DOI: 10.1155/2022/4687319.

[2] N. Lanke and S. Koul, "Smart Traffic Management System," International Journal of Computer Applications, vol. 75, pp. 19-22, 2013. DOI: 10.5120/13123-0473.

References

[3] Cisco. "Internet of Things for Roadways and Intersections," Cisco. Available: https://www.cisco.com/c/en/us/solutions/internet-of-things/roadways-intersections.html. Accessed: Feb. 1, 2024.

[4] SWARCO. "Urban Traffic Management - UTOPIA," SWARCO. Available: https://www.swarco.com/products/software/urban-traffic-management/utopia. Accessed: Feb. 1, 2024.

References

[5] Aimsun. "Aimsun - Mobility Intelligence," Aimsun. Available: https://www.aimsun.com/. Accessed: Feb. 1, 2024.

[6] S. Jacob, A. Rekh, G. Manoj, and J. Paul, "Smart Traffic Management System with Real-Time Analysis," International Journal of Engineering and Technology (UAE), vol. 7, pp. 348-351, 2018.

Demonstration

https://colab.research.google.com/drive/18kyPc6n41F_ACfGL0Sy0oE5eE6_Y7H95?usp=sharing

Thank you!