Traffic Density Based Signal Controlling System Using ML

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ABSTRACT- This project presents a novel traffic density-based signal controlling system that leverages deep learning techniques to optimize traffic signal timings dynamically. Traffic density sensors are deployed at intersections to collect real-time data, which is processed by a deep neural network model. The model predicts optimal signal timings based on the traffic density, and a central control unit communicates with traffic signal controllers to implement these adjustments. The system aims to reduce traffic congestion, enhance transportation efficiency, and minimize carbon emissions. Utilizing a supervised learning model, the system learns to predict optimal signal durations for different traffic scenarios, considering factors such as peak hours, road capacity, and historical congestion patterns. Through this adaptive approach, the system aims to minimize traffic congestion, reduce travel time, and improve overall traffic flow efficiency. Experimental results demonstrate the effectiveness of the proposed system in dynamically adjusting signal timings, leading to substantial improvements in traffic management and enhancing the overall urban commuting experience.

Key Words: traffic density, signal control, Convolutional, Neural Network (CNN), reinforcement learning, traffic sensors, urban traffic management, smart cities.

1.INTRODUCTION

The urbanization of cities has led to an exponential increase in vehicular traffic, resulting in traffic congestion and inefficiency at intersections. Traditional traffic signal systems rely on fixed schedules and lack adaptability to changing traffic conditions. This project introduces a traffic density-based signal controlling system that utilizes deep learning techniques to optimize traffic signal timings based on real-time traffic density data. By dynamically adjusting signal timings, the system aims to reduce congestion, improve traffic flow, and minimize the environmental impact of urban transportation.

2. BODY OF PAPER

A. Problems in the Current System

The existing traffic system suffers from inefficiencies caused by static signal timing, leading to congestion, increased travel time, and environmental pollution. It lacks real-time adaptability, resulting in imbalanced traffic flow and reduced road safety. Moreover, it fails to account for fluctuating traffic densities, causing unnecessary delays and fuel wastage. These issues demand an innovative solution in the form of a traffic density-based signal controlling system. By leveraging real-time data and advanced algorithms, this system aims to dynamically adjust signal timings, optimize traffic flow, reduce congestion and enhance overall transportation efficiency.

B. Present Work

1) The present traffic density-based signal controlling system empowered by machine learning, represents a significant advancement in optimizing urban transportation. By harnessing the potential of machine learning algorithms, this system can process large volumes of real-time traffic data from various sources, including cameras, sensors, and GPS devices. It employs advanced pattern recognition techniques to discern traffic patterns, anticipate congestion hotspots, and predict traffic flow fluctuations with greater accuracy.

2) Through continuous learning, the system can dynamically adjust signal timings based on the current traffic density, allowing for a more responsive and adaptive approach to traffic management. By analyzing historical data, it can identify recurring patterns during specific times of the day, days of the week, or seasons, enabling the optimization of signal plans accordingly. This ensures a more efficient allocation of green time at intersections, thereby reducing travel time, minimizing idling, and subsequently lowering carbon emissions.

3) Furthermore, the integration of machine learning in the traffic density-based signal controlling system facilitates the creation of predictive models that can anticipate potential traffic issues, enabling proactive measures to mitigate congestion and improve overall road safety. This technology-driven approach holds the promise of revolutionizing urban transportation management, enhancing commuter experiences, and fostering sustainable urban development.

3.LITERATURE REVIEW

Several kinds of research and techniques have been proposed to control the traffic signal in complex situation

Shibin Balu et al. [1] has proposed an image processing technique using MATLAB for a count of vehicles. Cameras are installed to capture videos and send them to MATLAB software for further process. The videos are taken every 10

seconds to find the traffic level. This system will take high time because of frequent video capture and processing.

Wahban Al okaishi et al. [2] has proposed a model to control traffic by applying the background updating and edge detection of image processing. The algorithm used is background updating, edge detection, traffic volume estimation. They separate the edge of the vehicles to find the density of vehicles from the edges of objects of the background.

Bilal Ghazal et al. [3] has discussed a model to deliver a system for traffic jam and congestion. These systems use hardware such as PIC microcontroller and valuate traffic density with the help of IR sensors and calculate the time slots at each level of the traffic.

Anna Merine George et al. [4] has developed a system uses IOT and Adaptive Neuro Fuzzy Inference System (ANFIS) for traffic management. A camera is used to capture the image and using Arduino UNO and Think Speak Platform the image is transferred to cloud. Then those images are analyzed using ANFIS controller. Several steps are taken to time interval hence it consumes more time.

4.PROPOSED METHODOLOGY AND DISCUSSION

A. Proposed Methodology: -

Traffic congestion is a pervasive issue in urban areas, leading to increased travel time, fuel consumption, and environmental pollution. A promising approach to alleviate this problem is the implementation of a traffic density-based signal controlling system using machine learning (ML). The proposed methodology involves the following steps:

1.Data Collection: The first step is to collect real-time traffic data, including vehicle counts, speeds, and density at various intersections using sensors and cameras. This data will serve as the foundation for training the ML model.

2.Data Preprocessing: The collected data will undergo preprocessing to remove outliers, handle missing values, and normalize the data to ensure uniformity and accuracy in the subsequent analysis.

3.Feature Engineering: Relevant features such as historical traffic patterns, time of day, and day of the week will be incorporated to provide the ML model with a comprehensive understanding of the underlying traffic dynamics.

4.Model Training: Various ML algorithms, such as support vector machines, neural networks, and decision trees, will be trained using the preprocessed data to predict traffic density and subsequently optimize signal timings based on predicted traffic conditions.

5.Signal Optimization: The trained model will be integrated into the existing traffic signal control system to dynamically adjust signal timings in response to real-time traffic density, aiming to minimize congestion and enhance traffic flow efficiency.

6.Evaluation and Validation: The proposed system's performance will be evaluated based on key metrics such as travel time, average speed, and congestion levels. Comparative analysis with traditional signal control systems will be conducted to demonstrate the superiority of the proposed ML-based approach.

B. Discussion

The utilization of ML in traffic management represents a significant advancement in the field, offering the potential to revolutionize the way traffic signals are controlled and optimized. By leveraging real-time traffic data and historical patterns, the proposed system can dynamically adapt signal timings, thereby reducing traffic congestion and improving overall traffic efficiency.

Furthermore, the integration of this system with smart city initiatives can lead to a holistic approach to urban planning, fostering sustainable transportation and reducing carbon emissions. The adaptive nature of the ML model allows for continuous learning and adjustment, ensuring that the system remains effective in handling changing traffic patterns and evolving urban landscapes.

However, challenges such as the need for a robust and reliable data collection infrastructure, potential privacy concerns related to data collection, and the requirement for continuous model retraining to account for dynamic urban changes must be addressed. Additionally, the integration of the proposed system with existing traffic management infrastructure should be seamless to ensure minimal disruption during the transition phase.

In conclusion, the proposed traffic density-based signal controlling system using machine learning has the potential to significantly enhance urban traffic management and pave the way for more sustainable and efficient transportation systems. Its successful implementation can lead to reduced travel times, improved air quality, and enhanced overall urban livability.

5. EXPERIMENTAL RESULTS

Experimental problem:

Here we try to understand our project implementation experimentally by following ways: -

Figure: Model 1

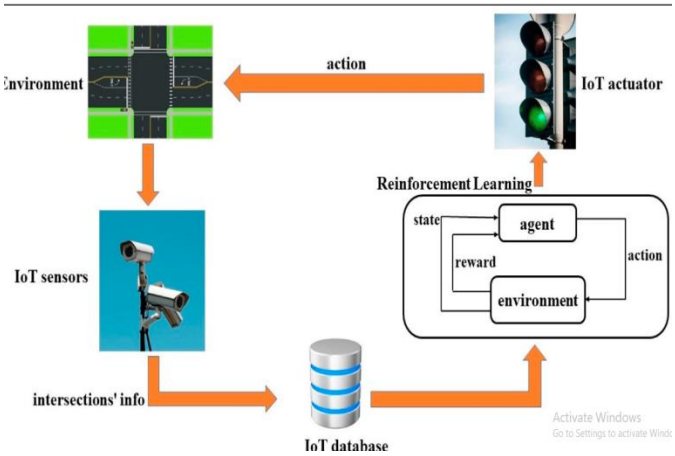
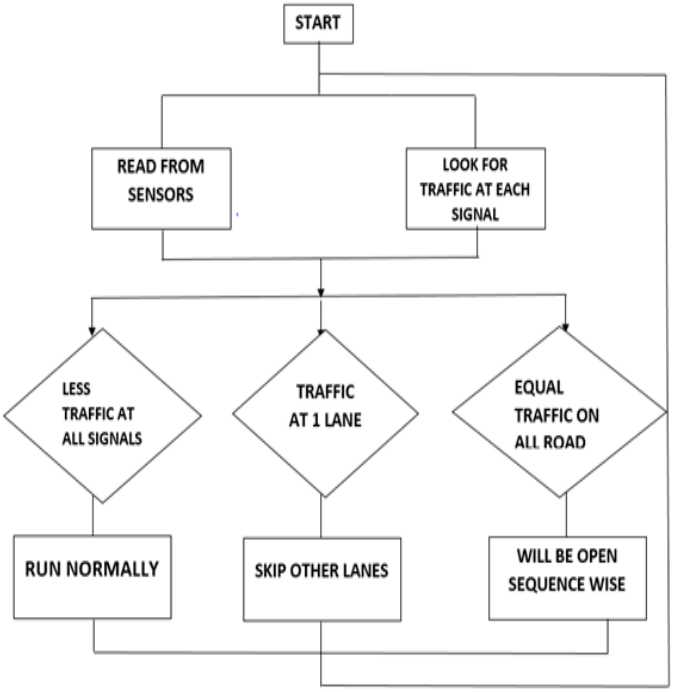


Figure: Model 2

Some steps for analyzing and implementing signal controlling system:

1. Problem identification
2. Data collection
3. Data preprocessing
4. Analyse problem & solutions
5. Apply ML algorithm
6. Traffic density sensors
7. Video cameras
8. Implementation

Following chart shows the how this traffic density-based signal controlling system will work:



4. CONCLUSIONS

The traffic density-based signal controlling system using machine learning offers a promising solution to the pressing issue of urban traffic congestion. By leveraging real-time traffic density data and advanced deep learning algorithms, the system can dynamically adjust signal timings, leading to reduced congestion, improved transportation efficiency, and a more sustainable urban environment. This project contributes to the vision of smarter, more efficient cities and paves the way for future innovations in traffic management. A real-time advanced traffic light control system is delivered in this paper. This advanced system will process both peak and non-peak hours which will work for all hours. By this advanced model, people have not to spend more time at traffic junction for the signal. The time interval for their vehicles will be allotted in a quick and fast manner in an efficient way.

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