

Intelligent Traffic Routing System (ITRS)

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Abstract: The concept presents a system designed to manage traffic in cities by automatically adjusting signal timings based on actual traffic conditions on roads. The system uses sensors and cameras to count vehicles at different intersections and changes the signal duration according to the traffic flow. Roads with higher vehicle load are given longer green signals to reduce waiting time and avoid traffic jams. This system is designed to achieve smoother traffic movement and minimize average waiting time as compared to manually fixed-timer signals. Such an approach can help to improve road efficiency and reduce overall traffic problems in urban areas.

Keywords: Intelligent Traffic Routing System, Traffic Management, Vehicle Detection, Signal Timing, Traffic Flow, Route Optimization, Smart City

I. INTRODUCTION

Traffic congestion is a major problem in many cities today. It causes long delays, wastes fuel, and increases pollution. Traditional traffic lights with fixed timers often do not match the actual traffic on the roads, which leads to unnecessary waiting even when roads are empty. The **Intelligent Traffic Routing System (ITRS)** is designed to improve this situation. It uses sensors and cameras to detect the number of vehicles on different roads and changes traffic signal timings based on real traffic conditions. Roads with more vehicles get longer green signals. Overall, ITRS aims to make city traffic flow more smoothly and reduce waiting times.

The ITRS is easy to use because it works automatically without needing constant human control. Unlike traditional traffic signals, it monitors traffic in real time and adjusts signals based on the number of vehicles. In short, the system uses simple sensors and cameras to improve traffic flow, reduce waiting time of vehicles, and make city roads safer and more efficient for everyone.

II. LITERATURE SURVEY

The Intelligent Traffic Routing System (ITRS) has gained attention in recent years due to the need for better traffic management in cities. Traffic systems use fixed-timer signals, which often cause delays because they do not respond to real traffic conditions. Automatic systems with sensors and cameras are introduced to detect vehicles and adjust signal timings. These systems improve traffic flow but face challenges such as inaccurate detection in bad weather and high maintenance costs.

Recent approaches combine real-time data from sensors, cameras, and GPS to make traffic routing more responsive. They prioritize busy roads. While effective, these systems require careful setup and testing to work reliably in real cities.

Overall, research on ITRS shows a shift from fixed schedules to intelligent, data-driven traffic management to reduce delays and improve urban mobility.

In today's cities, traffic congestion has become a major problem because of the growing number of vehicles and limited road space. Most of the existing traffic systems still work with manually controlled or fixed-timer signals. These systems do not respond to real-time traffic conditions, which often leads to unnecessary waiting, fuel wastage, and longer travel times.

Even though some progress has been made through Intelligent Transportation Systems (ITS), most of them still use fixed timing methods instead of adjusting according to actual traffic flow. The use of modern technologies like Artificial



Intelligence (AI), Internet of Things (IoT), Machine Learning (ML), and Computer Vision for traffic control is still not widely implemented in real-world systems.

Our project, the Intelligent Traffic Routing System (ITRS), is designed to overcome these problems by creating an automatic and smart traffic control system. In this system, IoT-based sensors and cameras are used to collect live data about vehicle movement. With the help of Computer Vision using OpenCV, the system can detect and count vehicles on the road. The data collected is then processed using Machine Learning algorithm to analyze traffic flow and predict congestion. According to these predictions, the system changes the signal timings automatically to manage traffic more efficiently.

Unlike traditional systems, ITRS aims to make traffic control real-time, adaptive, and fully automated. Since the combination of AI, IoT, and ML in live traffic systems is still new and less explored, our project makes a step forward in developing a smart and efficient solution for urban traffic management.

Advantages of ITRS:

- **Reduced Traffic Congestion:** Dynamically controls signal timings to balance traffic flow.
- **Time Efficiency:** Minimizes unnecessary waiting time at red lights.
- **Environment Friendly:** Reduces fuel consumption and air pollution by minimizing idling time.
- **Scalable System:** Can be implemented at multiple junctions and integrated with existing city infrastructure.
- **Improves Road Efficiency:** Makes better use of existing road infrastructure by balancing traffic flow.
- **Adapts to Real Conditions:** Works in real time, responding to changes in traffic patterns instantly.
- **Easy to Monitor and Control:** Traffic authorities can track road conditions and make adjustments when needed.

III. METHODOLOGY

The proposed **Intelligent Traffic Routing System (ITRS)** is designed to automatically control traffic lights based on real-time vehicle density at road intersections. The following steps describe the working process and methodology of the project:

Data Collection through Cameras

Cameras are placed at each traffic signal to capture live video of vehicles on the road. These cameras are arranged in such a way that they can clearly view all directions of the intersection.

Vehicle Detection and Counting

The video captured by the cameras is processed using OpenCV. The system detects and counts the number of vehicles present on each side of the road. This helps in finding which direction has more traffic.

Data Processing

The collected data is processed using a **Python-based system**, which calculates the number of vehicles in each direction. This information is used to understand traffic density levels at that intersection.

Machine Learning Module

The processed data is analyzed using a **Machine Learning algorithm** that helps in predicting possible congestion and deciding the required green light duration for each lane. The algorithm is trained to optimize signal timing based on traffic flow patterns.

Signal Timing Calculation

Based on the detected vehicle count and predicted traffic flow, the system calculates the optimal signal timing. The lane with higher traffic density is given a longer green signal, while lanes with less traffic receive shorter durations.

Communication with Microcontroller

The calculated signal durations are sent to the **microcontroller** through serial communication. The controller operates the traffic lights according to the instructions received from the processing unit.

Automatic Signal Control

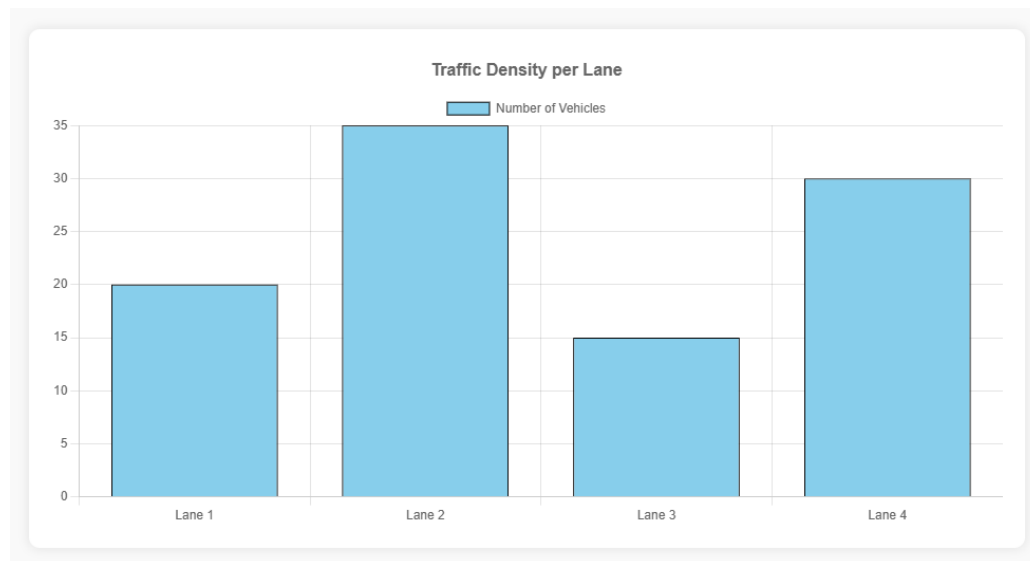
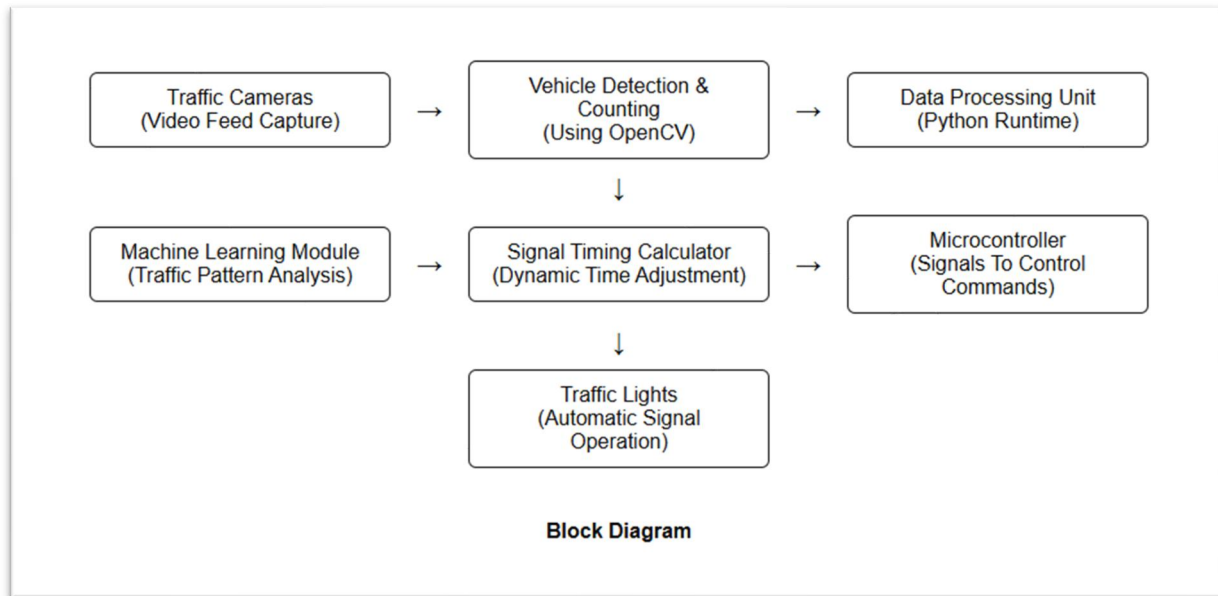
The microcontroller controls the **signal lights (Red, Yellow, Green)** at the intersection. The lights change automatically based on the timing data, ensuring smooth and adaptive traffic flow.

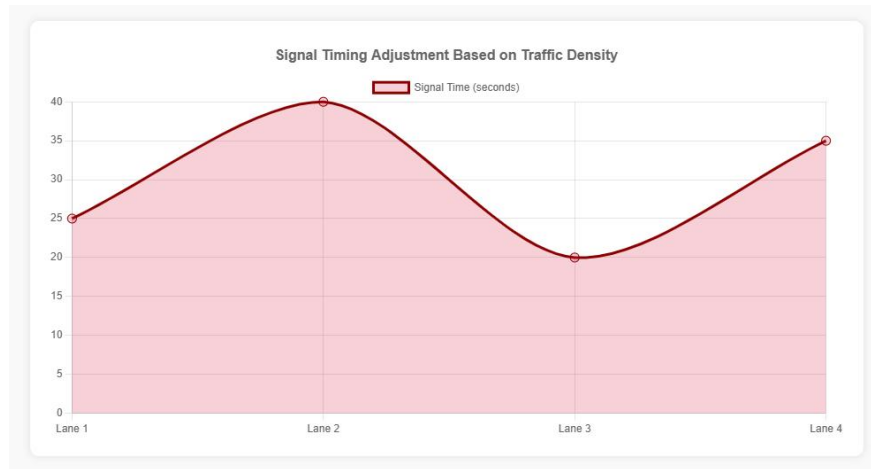


Real-Time Feedback and Updating

The system continuously monitors live video, updates vehicle counts, and adjusts signal timings in real time. This feedback loop helps in maintaining efficient traffic movement during varying conditions.

Work flow of the system is as follows:-





IV. CONCLUSION

Intelligent Traffic Routing System (ITRS) is an innovative approach to improving urban traffic management. It works by using sensors, cameras, and real-time data to analyze traffic conditions and automatically adjust signal timings based on vehicle density. This helps reduce road congestion, unnecessary waiting time, and fuel wastage while ensuring smoother movement of vehicles. By reducing delays and improving the overall flow of traffic, IRTS also contributes to lowering pollution levels and saving energy, which supports a cleaner and more sustainable environment. Overall, the Intelligent Traffic Routing System is a practical step towards developing smart cities. It improves efficiency, road safety, and travel experience for daily commuters. With continued development and large scale implementation, IRTS has the potential to transform urban transportation systems and make them more reliable, intelligent, and eco-friendly for the future.

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