Cloud Based Adaptive Traffic Signal System using Amazon AWS

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ABSTRACT

Traffic congestion is a growing problem in cities due to the increasing number of vehicles. Most traditional traffic signal systems work with fixed time settings and do not change based on actual traffic conditions. This often results in unnecessary delays and traffic jams. To address this issue, this project presents a Cloud-Based Adaptive Traffic Signal System using Amazon Web Services (AWS). The proposed system collects real-time traffic data from sensors placed at road intersections. This data is processed using AWS services such as Amazon EC2, AWS IoT Core, AWS Lambda, and Amazon DynamoDB to control traffic signal timings according to traffic density. AWS CloudWatch is used to monitor system performance, and AWS IAM helps maintain secure access to the system. By adjusting traffic signals based on real-time traffic conditions, the system helps reduce waiting time and improve traffic flow. The cloud-based design makes the system scalable, reliable, and suitable for use in smart city applications.

KEY WORDS

Cloud Computing, Adaptive Traffic Signal System, Amazon Web Services (AWS), Real-Time Traffic Monitoring, Smart City, Traffic Management, IoT.

INTRODUCTION

Traffic congestion is a common problem in urban areas due to the increasing number of vehicles. Traditional traffic signal systems work on fixed timings and cannot adjust based on real-time traffic conditions. This often leads to long waiting times and traffic jams at road intersections. To overcome this issue, an adaptive traffic signal system is required. The Cloud-Based Adaptive Traffic Signal System using Amazon Web Services (AWS) uses real-time traffic data to control signal timings efficiently. Traffic data collected from sensors and cameras is processed using AWS cloud services. Based on traffic density, the system adjusts signal timings automatically. This helps reduce congestion and improve traffic flow. The cloud-based approach also makes the system scalable, reliable, and suitable for smart city applications.

LITERATURE REVEY

Several researchers have worked on improving traffic signal systems using adaptive and cloud-based technologies. Zhao et al. proposed an adaptive traffic signal control system using machine learning techniques, showing that real-time traffic data can significantly reduce congestion and waiting time at intersections**.** Nguyen et al**.** studied an IoT-based intelligent traffic management system integrated with cloud computing, where real-time traffic data collected from sensors is processed in the cloud to dynamically adjust traffic signals, improving scalability and system efficiency. Miller et al. presented a cloud-based traffic signal control system using AWS services, highlighting the benefits of scalability, secure data storage, and real-time monitoring for smart city applications. These studies demonstrate that integrating IoT, cloud computing, and intelligent algorithms can greatly enhance traffic management, which forms the foundation for the proposed Cloud-Based Adaptive Traffic Signal System using AWS.

RELATED WORK

Several researchers have worked on improving traffic signal systems using adaptive and intelligent approaches. Zhao et al. studied the use of machine learning for adaptive traffic signal control and showed that adjusting signal timings based on real-time traffic data can reduce congestion and waiting time. Nguyen et al. proposed an IoT-based traffic management system integrated with cloud computing, where traffic data collected from sensors is processed in the cloud to dynamically control traffic signals. Miller et al. presented a cloud-based traffic signal system using AWS services and highlighted the advantages of scalability, secure data storage, and real-time monitoring for smart city traffic applications. These studies show that combining IoT, cloud computing, and intelligent algorithms improves traffic management, and they form the foundation for the proposed Cloud-Based Adaptive Traffic Signal System using AWS.

EXISTING METHOD

Current traffic signal systems operate on fixed schedules that do not adjust to real-time traffic conditions. Each direction receives a green signal for a set duration, regardless of the number of vehicles waiting. Some intersections use basic sensors, but decision-making remains limited and not fully adaptive. Local controllers handle traffic at intersections with minimal data processing and little integration with central systems. Real-time monitoring and analysis are often lacking, reducing overall efficiency. During peak hours or unexpected traffic events, these systems struggle to manage flow effectively. This can lead to congestion, longer waiting times, and underutilized road infrastructure. The static nature of these systems prevents optimal traffic management. These limitations highlight the need for smarter solutions. A cloud-based adaptive traffic signal system can respond dynamically to real-time traffic and improve overall flow.

PROPOSED METHOD

The proposed method focuses on a cloud-based adaptive traffic signal system that adjusts traffic light timings in real time based on current traffic conditions. Traffic data is collected using IoT sensors, cameras, or vehicle detection devices installed at intersections. This data is sent to a centralized cloud platform for processing and analysis. Advanced algorithms, such as machine learning or real-time optimization, calculate the optimal signal duration for each direction. The system can dynamically update traffic signals to reduce congestion, waiting times, and improve overall traffic flow. Additionally, it supports real-time monitoring and centralized control, enabling better management during peak hours, emergencies, or unexpected traffic situations. The approach also allows scalability, integrating multiple intersections for coordinated traffic control across a city. Overall, this method aims to create a smart, responsive, and efficient traffic management system.

ARCHITECTURE

The below block diagram shows how the system works in a detailed way.

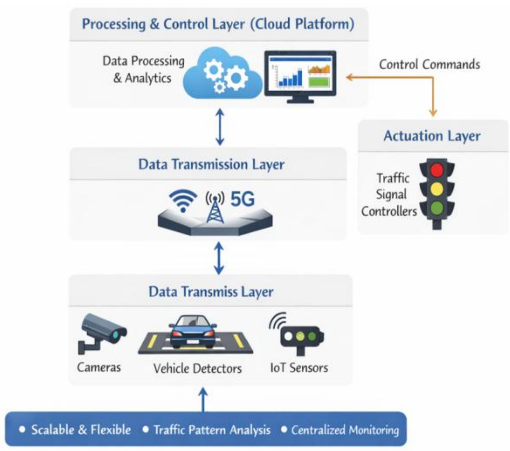

Figure 1: Architecture

METHODOLOGY DESCRIPTION

The proposed system uses a cloud-based adaptive traffic signal control approach to improve traffic flow and reduce congestion. The methodology can be divided into the following steps: Traffic Data Collection: IoT sensors, cameras, and vehicle detectors are installed at intersections. These devices capture real-time traffic data, including vehicle count, speed, waiting time, and congestion levels. Data Transmission: Collected data is sent to a cloud server through wireless networks such as Wi-Fi, LTE, or 5G. Data Processing and Analysis: The cloud platform stores and processes the incoming traffic data. Traffic Signal Control: The cloud sends real-time commands to traffic signal controllers at intersections. Monitoring and Feedback: A centralized dashboard provides real-time monitoring and analytics. Scalability and Integration: The system is designed to integrate multiple intersections and scale across the city. Ensures coordinated traffic control and smooth flow over larger areas.

RESULTS:

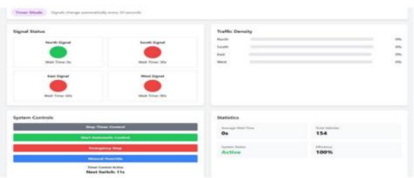

Fig2: Real-Time Traffic Signal

The image displays a traffic signal control dashboard for a cloud-based adaptive traffic management system.

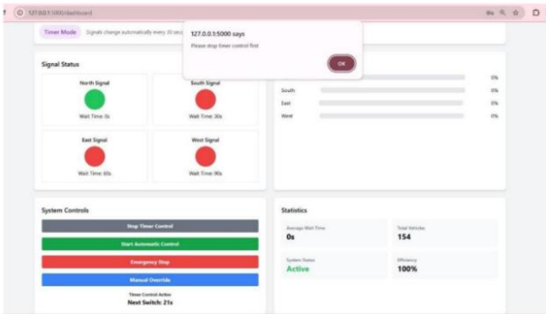

Fig3: Traffic Signal System Dashboard

The image shows similar to the previous interface, with an additional alert message displayed.

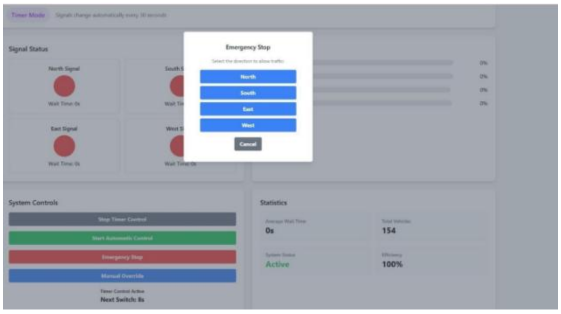

Fig4: Emergency Stop Control Interface

Indicates that the signals automatically change every 30 seconds. This is a preset automated control mode.

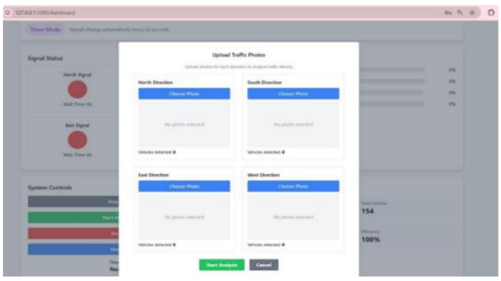

Fig5: Traffic Signal Profile Interface

A modal window titled Upload Traffic Photos is displayed in the center. It allows the user to upload images for four directions: North, South, East, and West.

CONCLUSION

The Cloud-Based Adaptive Traffic Signal System using AWS successfully demonstrates an intelligent traffic management solution that adapts in real-time to traffic conditions. By leveraging cloud computing, IoT sensors, and real-time data processing, the system optimizes signal timings, reduces congestion, and enhances road safety. This scalable and efficient approach offers a promising solution for modern urban traffic challenges.

FUTURE ENHANCEMENT

The experiment can be improved by using more precise measuring instruments to reduce errors. Additional variables could be tested to explore their effect on the outcome.Repeating the experiment under different environmental conditions could validate and strengthen the results.

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