AI POWERED TRAFFIC MANAGEMENT

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College : Rajarajeswari College of Engineering, Bengaluru
Branch : Department of Electronics and Communication
Guide(s) : Dr. Haritha K S
Dr. Deepika J
Student(s) : Mr. Anoop B Patel
Mr. Kushal B
Mr.Aman Maharathi
Ms.Chandana V S

Keywords:

Intelligent Traffic Systems, Computer Vision, Real-time Edge Analytics, Dynamic Signal Control, and Autonomous Incident Detection.

Introduction:

Rapid urbanization has led to significant traffic congestion, environmental degradation, and reduced quality of life, largely due to traditional fixed-timer signal systems that cannot adapt to real-time vehicle density. To combat these inefficiencies, AI-powered adaptive traffic management offers a sophisticated solution by utilizing computer vision and deep learning to process live camera feeds, allowing intersections to dynamically adjust signal timings based on actual road conditions. These intelligent systems not only optimize traffic flow and reduce fuel consumption but also enhance urban safety by prioritizing emergency vehicles through RFID or acoustic detection and protecting pedestrians via automated monitoring. Ultimately, transitioning to AI-driven infrastructure transforms intersections from static choke points into responsive nodes, fostering a more sustainable, efficient, and safer urban environment.

Objectives:

1. Develop an AI-Driven Traffic Control System
2. Enhance Object Detection and Classification
3. Prioritize Emergency Vehicle Movement
4. Enable Cloud-Based Data Monitoring and Analytics
5. Optimize Energy Efficiency and Reduce Congestion

Methodology:

The AI-powered Smart Traffic Management System is a fully automated ecosystem that integrates deep learning and IoT to optimize urban mobility. The process begins with a camera module that captures live footage, serving as the primary input for all subsequent decision-making and analysis. This visual feed is processed to classify traffic into normal, medium, or heavy congestion states, replacing inefficient fixed-cycle signals with adaptive control. Simultaneously, a dedicated detection module identifies emergency vehicles to trigger a priority "green corridor" mode for uninterrupted passage.

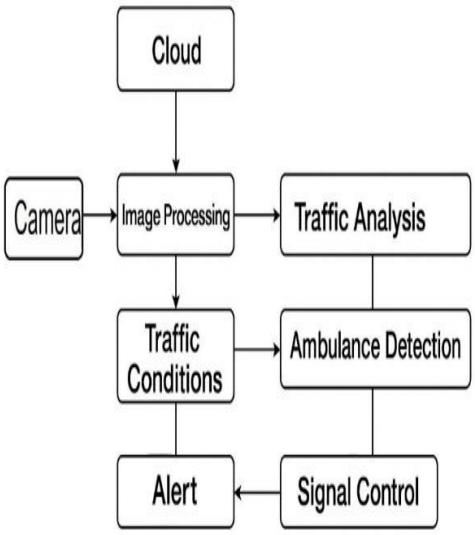

Figure: Block Diagram

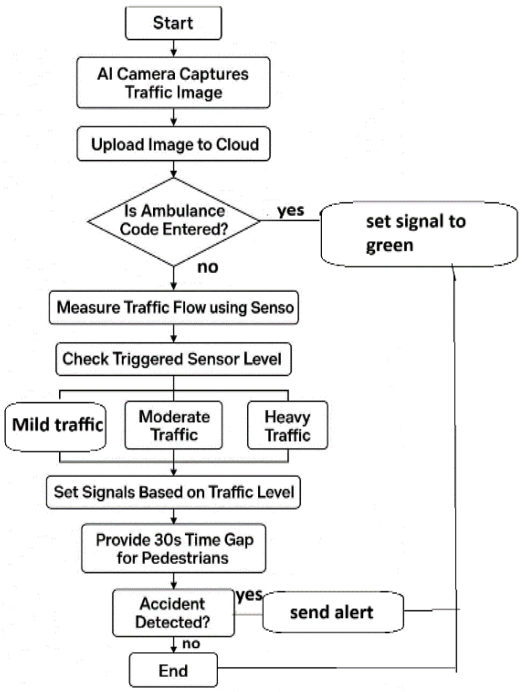

Figure : Flow Chart

The system's control logic evaluates these conditions to switch between normal, adaptive, or emergency override modes based on real-time demand. Physical signal outputs are then adjusted, including light switching and dynamic timer updates, to manage vehicle flow efficiently. An integrated alert module communicates live system responses to operators via Blynk Cloud and local LCD outputs for instant situational awareness. Furthermore, all data is uploaded to the cloud to facilitate remote monitoring, long-term logging, and intelligent future analysis. Ultimately, this seamless integration of sensing and cloud-based analytics ensures a safe, responsive, and data-driven traffic environment.

Result and Conclusion:

AI-powered traffic management system represents a transformative approach to urban infrastructure by replacing outdated, fixed-timer signals with intelligent, adaptive control. By leveraging computer vision and deep learning algorithms, the system analyzes live camera feeds to perform real-time object detection and vehicle density estimation. This allows for dynamic signal optimization that significantly improves traffic flow, reduces idle times, and lowers fuel consumption, directly addressing the core issues of congestion and environmental pollution. Furthermore, the system's ability to integrate emergency vehicle prioritization and pedestrian detection ensures that critical services can navigate intersections safely and swiftly, enhancing overall public safety and emergency response times.

Beyond immediate operational benefits, this AI-driven solution provides a scalable and cost-effective foundation for long-term smart city sustainability. By optimizing vehicle movement, the system contributes to a measurable reduction in carbon emissions and improved urban air quality, aligning with global environmental goals. The successful

implementation of core vehicle detection logic and emergency algorithms demonstrates that AI-based transportation is not just a theoretical concept but a practical, essential infrastructure for modernizing growing cities. As urban populations continue to rise, these responsive networks will be vital in transforming intersections from static choke points into efficient, data-driven nodes that create more livable and sustainable environments.

References:

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Future Scope:

The future scope of this project includes:

1. V2X Integration
2. Edge Computing & 5G
3. Predictive Analytics
4. Holistic Smart City Ecosystems
5. Advanced Sensing Technologies