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Smart Traffic Management Web System Using AI and Real-Time Analytics

Varsha Santosh Ekhande

Department of Computer Science Engineering, International Center of Excellence In Engineering and Management (ICEEM), Maharashtra, India

Abstract: Urban traffic congestion has become a major challenge in rapidly growing cities, leading to increased travel time, fuel consumption, and environmental pollution. Traditional traffic control systems are mostly static and do not adapt to real-time conditions, which results in inefficient traffic flow. This paper presents a Smart Traffic Management Web System that integrates real-time monitoring, artificial intelligence, and adaptive signal control to improve overall traffic efficiency.

The proposed system uses computer vision techniques based on YOLO and OpenCV to detect vehicles from video input and estimate traffic density. A dynamic signal control mechanism adjusts traffic light timing based on congestion levels. The system also provides a web-based dashboard for monitoring traffic conditions, analytics visualization, and emergency vehicle prioritization. Firebase is used as the backend for real-time data storage and synchronization.

I. Introduction

Traffic congestion is one of the most common problems faced in urban areas today. With the rapid increase in the number of vehicles, existing traffic control systems are unable to handle dynamic traffic conditions efficiently. Most signals operate on fixed timing cycles, regardless of the actual number of vehicles waiting at an intersection. This leads to unnecessary delays and inefficient road utilization.

In recent years, smart city initiatives have focused on improving transportation systems using technology. Intelligent Traffic Management Systems (ITMS) aim to use real-time data, automation, and analytics to optimize traffic flow. However, many existing systems are either expensive or lack proper integration of modern technologies such as artificial intelligence and cloud computing.

The objective of this project is to design and develop a Smart Traffic Management Web System that can monitor traffic in real time, analyze vehicle density using AI, and dynamically control traffic signals. The system also provides additional features such as emergency vehicle prioritization, analytics dashboards, and an admin control panel.

II. Related Work

Several studies have been conducted in the field of intelligent traffic systems. Traditional approaches mainly rely on sensors such as inductive loops and infrared detectors to measure traffic density. While these methods provide basic data, they are costly to install and maintain.

Recent research has explored the use of computer vision for traffic monitoring. Techniques using deep learning models such as YOLO (You Only Look Once) have shown high accuracy in detecting vehicles in real time. These systems can process video feeds and provide detailed information such as vehicle count and classification.

Some systems also implement adaptive traffic signal control, where signal timing is adjusted based on traffic conditions. However, many of these solutions are limited to simulations and lack integration with user-friendly interfaces or cloud platforms.

III. Literature Survey

Various researchers have proposed different methods for improving traffic management systems:

- Studies on intelligent traffic systems highlight the importance of real-time data collection and dynamic decision-making.
- Research on deep learning models, especially YOLO, shows that object detection in traffic environments can be performed with high speed and accuracy.
- OpenCV-based systems have been widely used for image processing and vehicle detection due to their flexibility and ease of integration.
- Cloud platforms such as Firebase enable real-time data synchronization and scalable backend solutions for web applications.

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- Web-based dashboards using libraries like Chart.js and React.js provide effective visualization of traffic data and trends.

IV. PROPOSED SYSTEM

The proposed Smart Traffic Management Web System is designed as a complete solution that includes traffic monitoring, analysis, and control.

A. System Architecture

The system follows a modular architecture:

- Input data is captured through cameras or uploaded video feeds
- The AI module processes the data using YOLO and OpenCV
- The backend (Firebase/Flask API) stores and manages data
- The web interface displays traffic information and controls signals

B. Key Features

1) Live Traffic Dashboard: The system provides a real-time dashboard that displays traffic conditions using color indicators:

- Green for low traffic
- Yellow for moderate traffic
- Red for heavy congestion

2) AI-Based Vehicle Detection: The system uses YOLO for detecting vehicles from video input. It calculates:

- Number of vehicles
- Traffic density level

3) Smart Signal Control: Traffic signals are dynamically adjusted:

- Higher traffic density → longer green signal
- Lower traffic density → shorter signal

This ensures better traffic flow and reduces waiting time.

4) Analytics Dashboard: The system provides graphical insights such as:

- Traffic trends
- Peak traffic hours
- Daily and weekly reports

5) Emergency Mode: An emergency feature allows prioritization for ambulances and fire vehicles. The system automatically adjusts signals to provide a clear path. It also includes options to contact emergency services.

6) Admin Panel: The admin panel allows:

- Manual control of signals
- Monitoring live data
- Managing roads and system settings

C. Technology Stack

- Frontend: React.js, HTML, CSS, JavaScript
- Backend: Firebase (Firestore, Authentication, Hosting), Node Js , SQL
- AI Module: Python, Flask, OpenCV, YOLO

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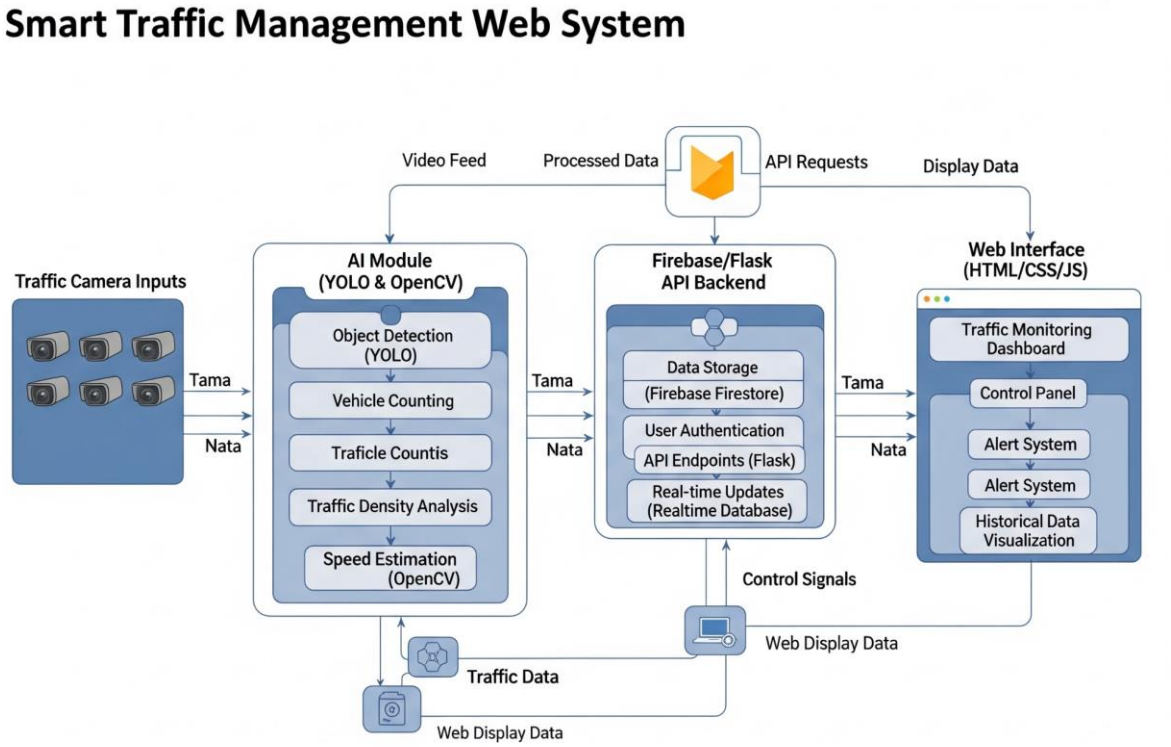

Figure 1. Proposed System Architecture.

V. RESULTS

The system was tested using simulated traffic data and sample video inputs. The AI model successfully detected vehicles and calculated traffic density with good accuracy.

The smart signal control mechanism showed improved traffic flow compared to fixed-time signals. Intersections with higher traffic were given longer green signals, reducing congestion.

The web dashboard provided clear and real-time visualization of traffic conditions. The analytics section helped in identifying peak hours and traffic patterns.

Emergency mode was also tested, and the system successfully prioritized routes, demonstrating its usefulness in real-world scenarios.

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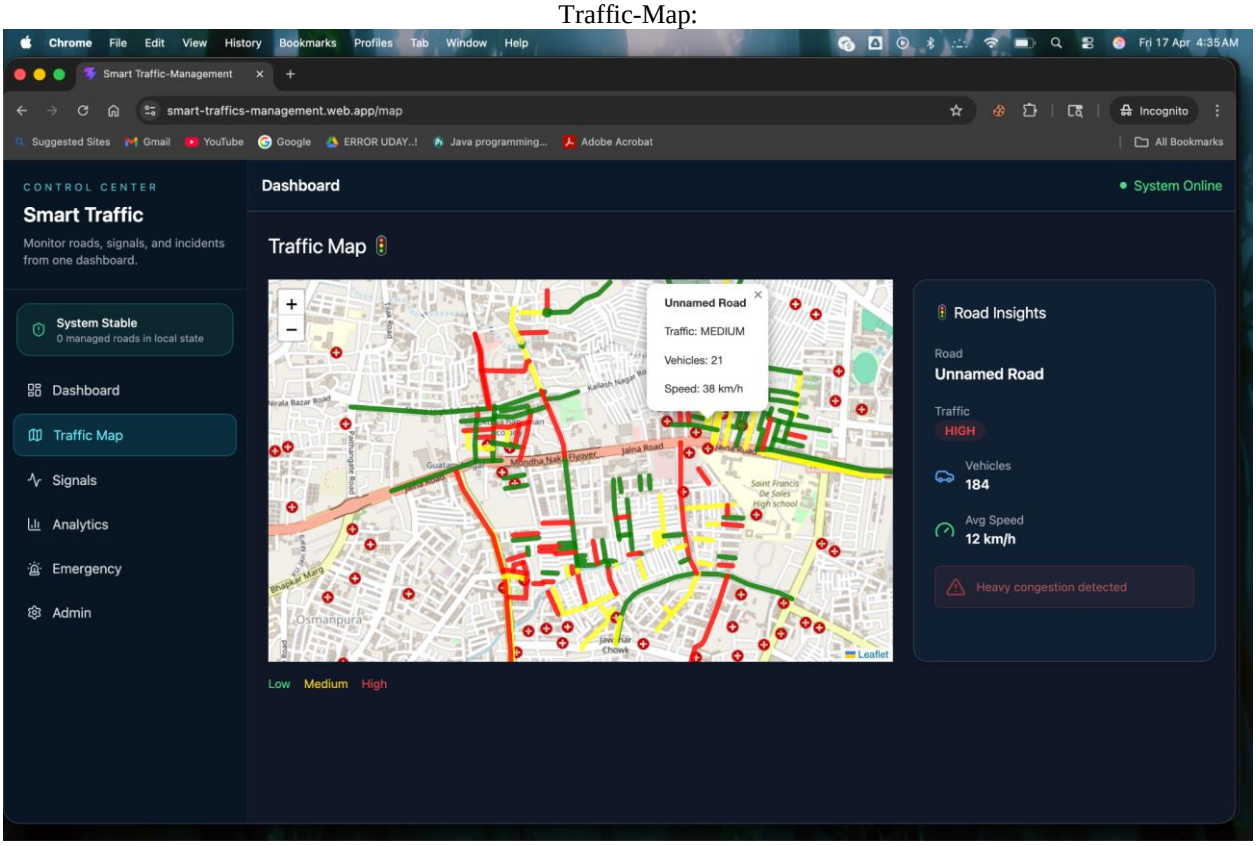
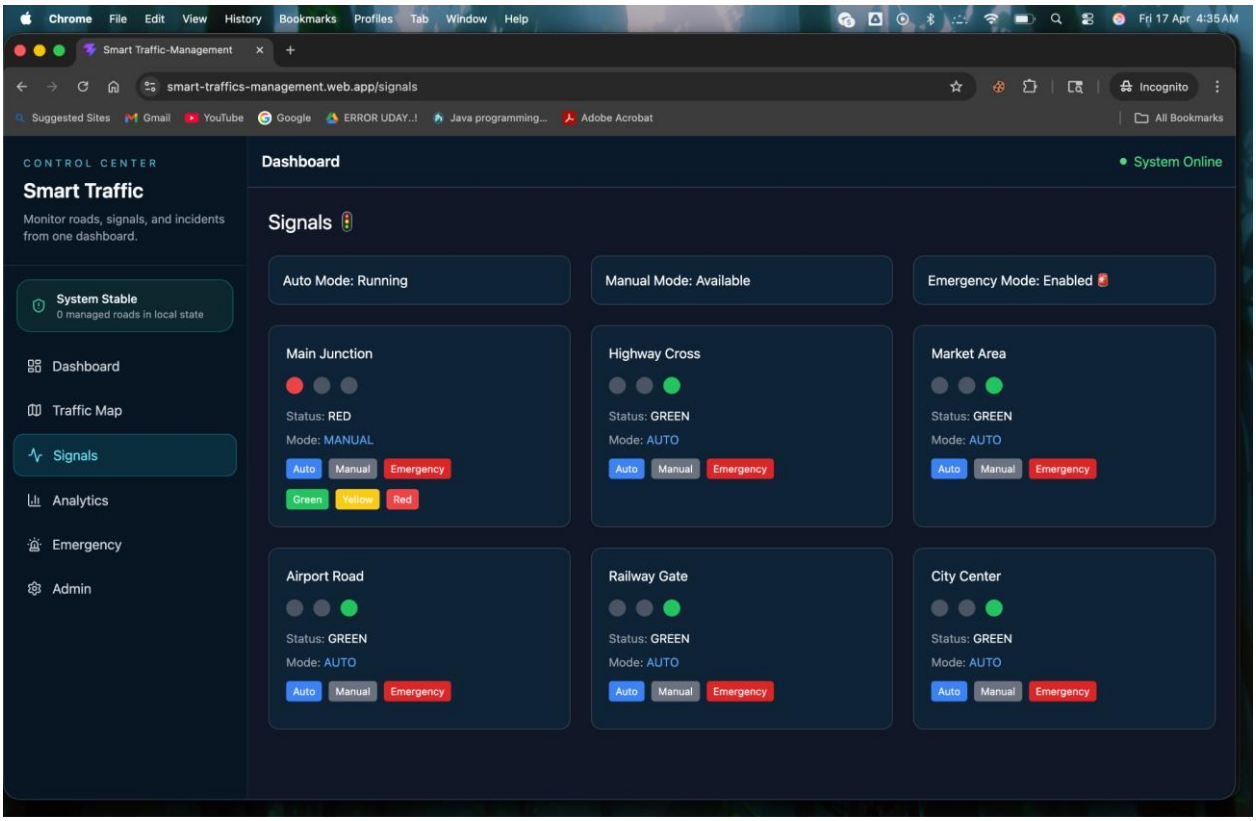
Traffic-Map:





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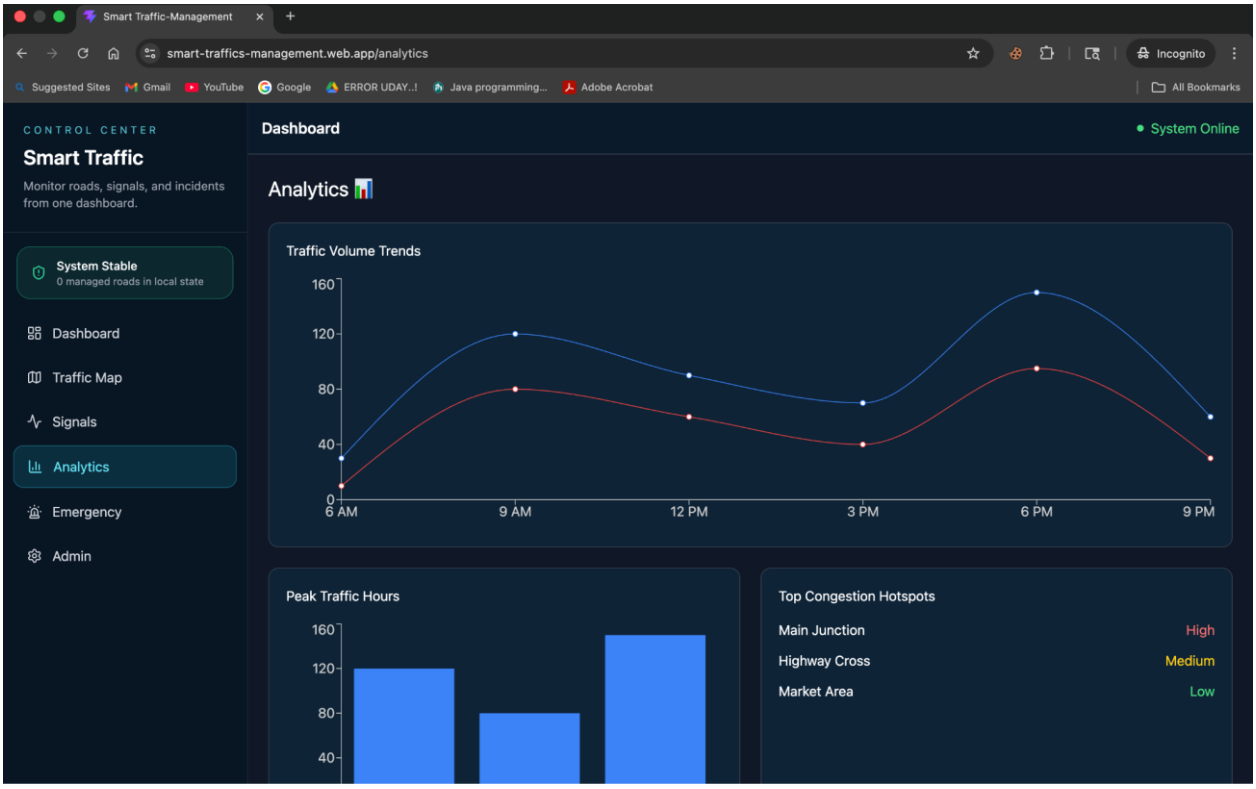

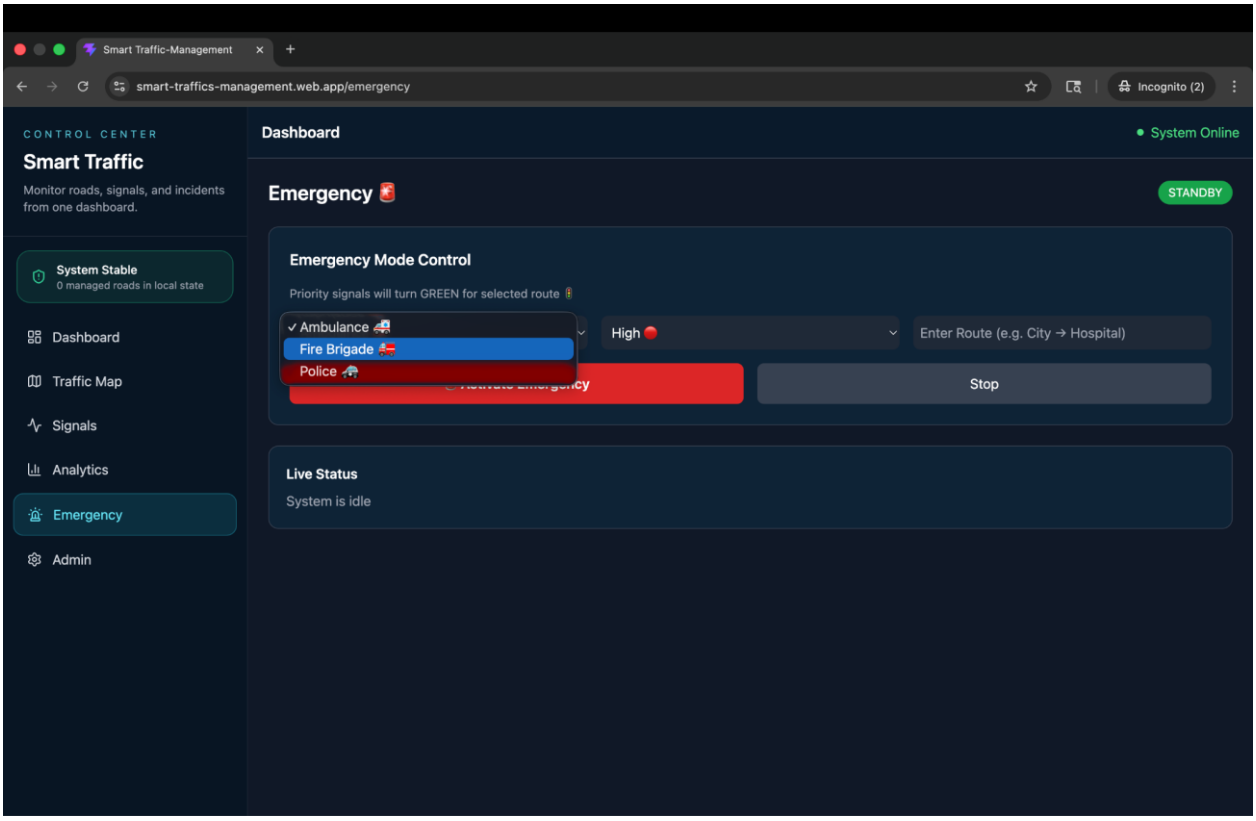

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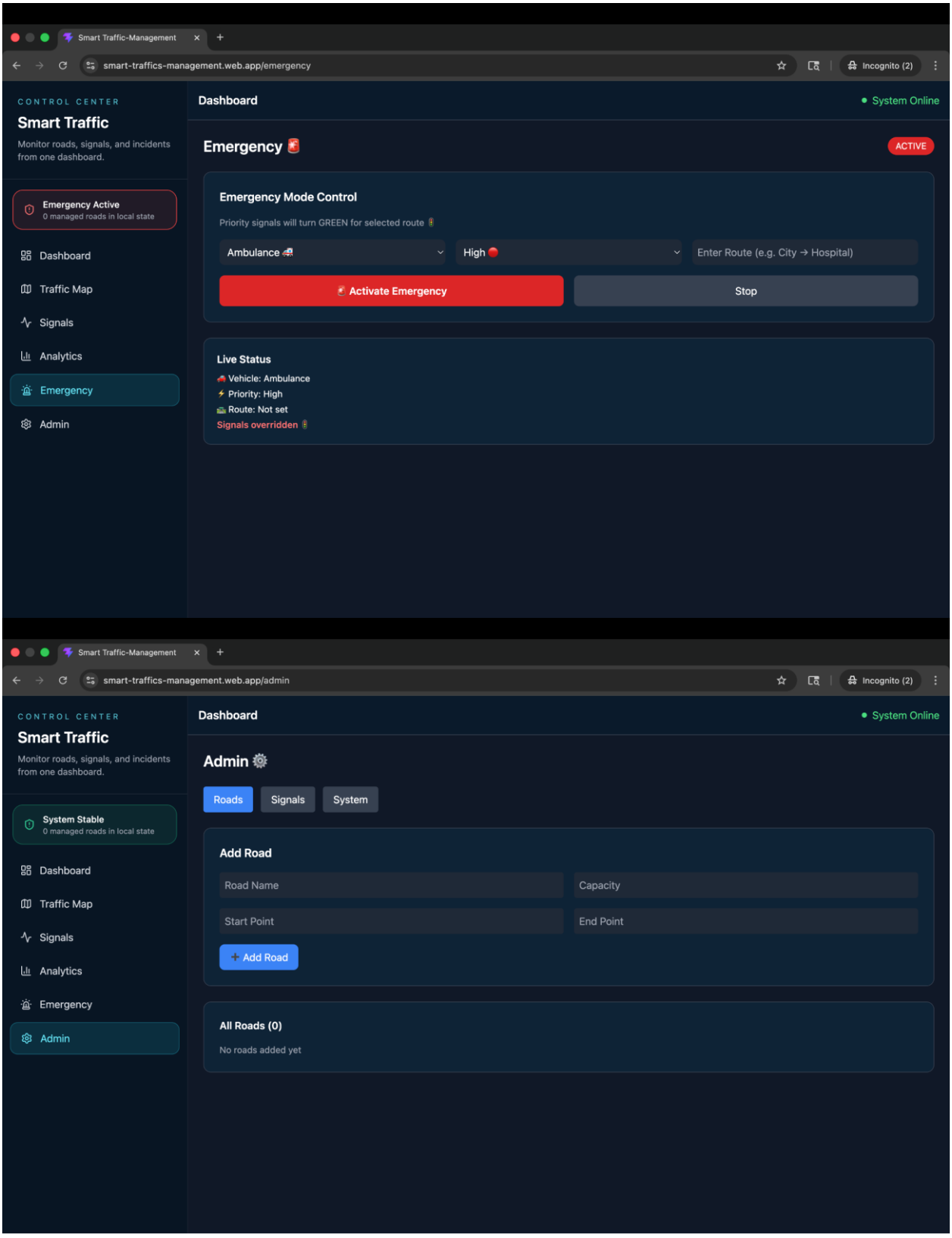

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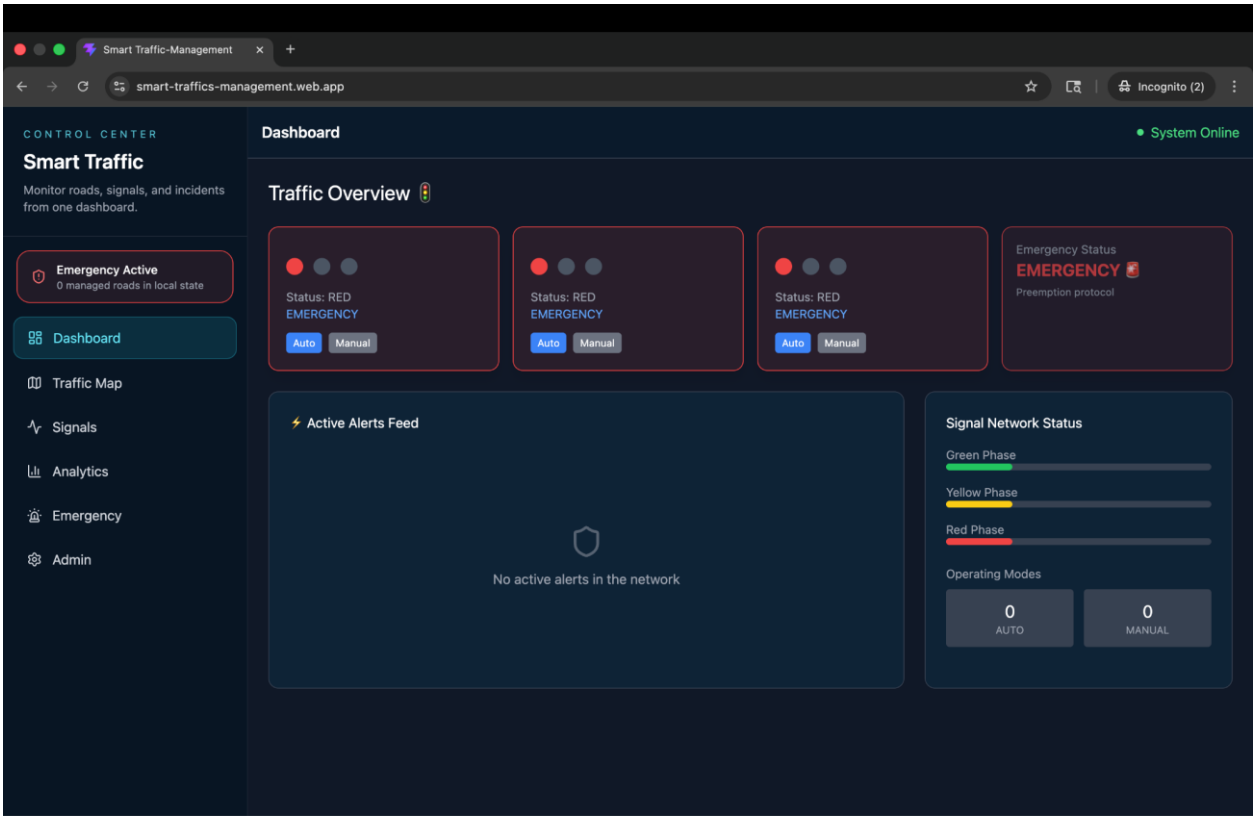

VI. Conclusion and Future Scope

This paper presents a Smart Traffic Management Web System that integrates artificial intelligence, real-time data processing, and web technologies to address traffic congestion problems. The system provides an efficient and scalable solution for monitoring and controlling traffic dynamically.

The use of AI for vehicle detection and adaptive signal control improves traffic flow and reduces delays. The addition of analytics and emergency features makes the system more practical and user-friendly.

In the future, the system can be enhanced by:

- Integrating real-time GPS data
- Implementing traffic prediction using machine learning
- Connecting with mobile applications
- Incorporating weather-based traffic analysis
- Deploying the system in real-world environments with IoT devices

This work demonstrates how modern technology can be used to build smarter and more efficient transportation systems.

References

[1]. Redmon, J., et al. "You Only Look Once: Unified, Real-Time Object Detection."
[2]. OpenCV Documentation – https://opencv.org
[3]. Firebase Documentation – https://firebase.google.com
[4]. World Health Organization – Traffic Management Reports
[5]. Research papers on Intelligent Traffic Systems and Smart Cities
[6]. Chart.js Documentation – https://www.chartjs.org