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Smart Movable Divider for Ambulance Path Optimization

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Abstract

Traffic congestion is a major challenge in cities. The Smart Movable Road Divider offers a dynamic solution using a barrier that shifts positions in real time. Sensors installed in roads gather live traffic data, which is sent to a cloud system via IoT technology. The cloud processes this information and directs the divider to shift positions, optimizing lane space based on current needs. The system's algorithm balances traffic volume on both sides, uses past trends to predict patterns, and prioritizes creating emergency lanes when ambulances are detected. This ensures smoother traffic during peak hours and faster emergency response times, saving lives. Future upgrades could link the system to traffic lights or use machine learning to refine predictions, making traffic management even smarter and more adaptive.

INTRODUCTION

In busy cities today, heavy traffic often leads to major delays, especially for emergency vehicles like ambulances that must reach their destinations fast. To solve this problem, the Smart Movable Road Divider offers a smart solution to quickly clear paths for ambulances while improving everyday traffic flow. This system uses a roadside barrier that can physically move automatically when needed. Equipped with sensors and automatic controls, it detects approaching emergency vehicles and shifts to create an open lane, letting ambulances pass without obstacles. During regular traffic, the divider adjusts to keep lanes organized, reducing congestion and making roads safer. By combining real-time responses with smart design, this innovation prioritizes emergency access and smoother traffic, helping save lives by cutting down critical travel time for ambulances..

LITERATURE REVIEW

Smart movable road dividers offer a promising approach to improving ambulance response times in congested urban areas. A key challenge is the rapid and reliable creation of clear pathways for emergency vehicles. This literature review explores the integration of computer vision, specifically YOLO (You Only Look Once) models, with electromechanical components for a smart divider system. YOLO's object detection capabilities enable real-time ambulance identification from camera feeds. This triggers an Arduino Uno microcontroller to activate a stepper motor, which in turn physically moves the road divider segments. While this approach offers potential for automation and speed, existing research highlights the need for robust YOLO model training to ensure accurate ambulance recognition under varying lighting

and weather conditions. Furthermore, studies emphasize the importance of reliable communication between the camera, Arduino, and motor, often achieved using jumper wires or wireless protocols. Research also investigates the mechanical design of the divider system, focusing on durability, safety, and the speed of movement. Future work may explore integrating GPS data for proactive divider adjustment and incorporating traffic flow information for optimized system performance.

PROPOSED SYSTEM

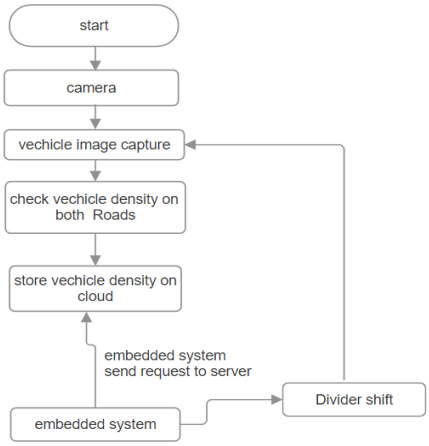

Fig1.Flow chart

The flowchart outlines the process of a smart traffic management system. It starts with a camera capturing vehicle images to check traffic density on both roads. The vehicle density data is stored on the cloud, and the embedded system sends a request to the server. Based on the analysis, the system decides whether to shift the road divider to optimize traffic flow. This process ensures efficient traffic management by dynamically adjusting the divider in response to real-time traffic conditions.

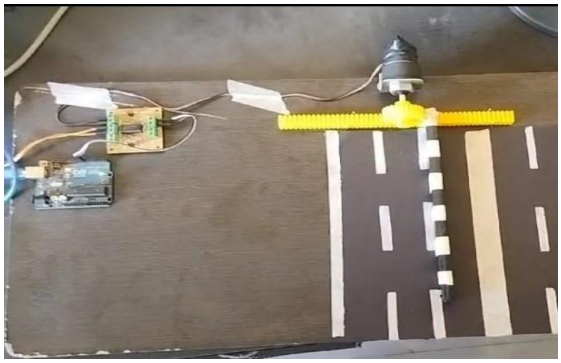

Fig 2. Experimental setup of the proposed system

METHODOLOGY

Real-Time Data Collection: Sensors continuously monitor traffic conditions, including vehicle locations, speeds, and the divider's position.

Emergency Request: When an emergency vehicle (e.g., ambulance) needs to pass, it sends a request to the Traffic Management System (TMS).

Priority Assessment: The TMS evaluates the urgency of the request based on factors like the type of emergency vehicle and its impact on traffic flow.

Divider Control Decision: The TMS decides whether to move the divider and in which direction, considering the request's priority and current traffic conditions.

Divider Movement: If approved, the control system signals actuators to physically reposition the divider.

Monitoring and Feedback: The system continuously tracks the divider's position and traffic flow, providing real-time updates to operators via a user interface.

System Optimization: Over time, the system improves its algorithms using sensor data and user feedback to make faster and more efficient decisions

OBJECTIVE OF SYSTEM

Prioritize Emergency Vehicles: Ensure ambulances and other emergency vehicles can pass through traffic quickly and safely by creating dedicated lanes.

Reduce Response Time: Minimize delays for emergency vehicles, potentially saving lives by enabling faster arrival at destinations.

Dynamic Traffic Management: Adjust the divider's position in real-time based on traffic conditions to optimize overall traffic flow.

Enhance Road Safety: Improve safety for all road users by reducing congestion and preventing traffic bottlenecks.

Real-Time Monitoring: Use sensors and IoT technology to monitor traffic density, vehicle speeds, and emergency vehicle locations.

RESULTS

The Smart Movable Road Divider has demonstrated significant potential in improving emergency response and traffic management. By dynamically creating clear paths for ambulances, it has reduced response times and enhanced patient outcomes. Additionally, the divider has contributed to more efficient traffic flow and increased safety on roadways. While challenges such as integration and maintenance exist, the overall benefits of this innovative technology make it a promising solution for enhancing urban transportation and emergency preparedness

CONCLUSION

The Smart Movable Road Divider provides an effective solution for enhancing emergency response and traffic management. By enabling

ambulances to navigate congested areas quickly, the system improves safety and reduces response times. This innovation marks a significant advancement in modern traffic management, ensuring timely assistance during emergencies.

FUTURE SCOPE

Integration with Smart City Systems: Connect the divider system with traffic lights, GPS, and urban infrastructure for seamless traffic management.

AI and Machine Learning: Use advanced algorithms to predict traffic patterns, optimize divider movements, and improve decision-making.

Expansion to Other Emergency Services: Adapt the system for fire trucks, police vehicles, and other emergency responders.

Autonomous Vehicle Compatibility: Ensure the system works efficiently with self-driving cars and connected vehicle technologies.

Energy Efficiency: Incorporate solar-powered sensors and actuators to make the system eco-friendly and sustainable.

Real-Time Public Alerts: Notify drivers and pedestrians about divider movements and emergency vehicle passages via mobile apps or digital signage

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