



Traffic Signal For Emergency Vehicle Using Iot

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Abstract: In the domain of Internet of Things (IOT), a complete solution for optimizing traffic signals to priorities' emergency vehicles is provided by the combination of Raspberry Pi, NodeMCU, transmitter, receiver, LED, and jumper cables. This abstract delves into the technical intricacies. It utilizes IoT technologies for communication between emergency vehicles and traffic signal infrastructure.

Index Terms - IoT (Internet of Things), Traffic signal control, Emergency vehicle priority, Smart traffic management, Real-time traffic monitoring.

I. INTRODUCTION

EVP - Emergency Vehicle Priority GPIO - General Purpose Input Output GPS - Global Positioning System IOT - Internet of Things LI - Location Information LED - Light Emitting Diodes RFID - Radio Frequency Identifications SD CARD - Secure Digital Card V2I - Vehicle to Infrastructure V2V - Vehicle to vehicle

The integration of Internet of Things (IoT) technologies presents a novel approach to augment traffic signal operations specifically tailored to prioritize emergency vehicles. This project endeavors to harness the capabilities of Raspberry Pi, NodeMCU, transmitter, and receiver, LED, and jumper wires to create an IoT-based traffic signal system optimized for emergency vehicle passage. The project's primary objective is to design a dynamic traffic signal control mechanism capable of swiftly identifying and preemptively clearing paths for emergency vehicles, thereby minimizing response times and enhancing overall urban safety. By leveraging the computational power of Raspberry Pi as the central processing unit and the connectivity prowess of NodeMCU for wireless communication, the system establishes a robust infrastructure for real-time data exchange and signal management. The integration of transmitter-receiver pairs enables seamless communication between the control center and individual traffic signal units, facilitating dissemination of priority.

Reduced Response Times: Emergency vehicles can get where they're going faster by navigating through traffic more skillfully. **Enhanced Emergency Services:** Quicker reaction times enable emergency services to offer aid in a timely manner, which may even save lives. **Minimized Collisions:** The system lessens the chance of collisions and accidents by allowing emergency vehicles to pass through junctions. **Improved Intersection Safety:** By dynamically regulating traffic lights, collisions between emergency vehicles and other traffic streams are avoided, hence enhancing intersection safety. **Optimised Traffic Flow:** To minimise disruptions to regular traffic flow, traffic signal timings are modified in real-time to accommodate emergency vehicles. **Prevention of congestion:** By effectively managing intersections, congestion is avoided, guaranteeing efficient traffic flow. **Increased Road Safety:** The chance of traffic-related injuries and fatalities is decreased when emergency vehicles are allowed to clear intersections. **Enhanced Urban Mobility:** By guaranteeing that emergency vehicles may pass through crowded locations quickly, the system improves urban mobility. **Enhanced Public Safety:** Communities gain from enhanced emergency response capacities, which enhance public safety in general. **Real-time Communication:** Coordinating and exchanging information between emergency vehicles and traffic signal infrastructure is made possible by IoT integration.

LITERATURE REVIEW

An ideal control scheme utilising edge computing and Internet of Things sensors for emergency vehicle priority systems in smart cities:

By halting the incompatible motions, the current EVP system immediately delivers the green signal to the EVs. The existing EVP system gives green signal to the EVs immediately by stopping the conflicting movements. In the context of smart cities, this study suggests an ideal control approach for EVP that makes use of edge computing and IoT sensors. A GPS-based Internet of Things sensor that continuously transmits Location Information (LI) to the edge server was used to conduct the experiment. The edge server clears the emergency vehicles and calculates the best timings using the suggested control plan algorithm.

Smart Traffic Management System using IoT Enabled Technology:

In smart cities like Delhi, Bangalore, Mumbai, and Hyderabad, there is a lot of traffic congestion, which causes more accidents and makes it harder for emergency vehicles to get to their destinations on time. The system most likely consists of a collection of algorithms or decision-making procedures, such as those for communication protocols, traffic light control mechanisms, and RFID tag identification. This system makes use of RFID tags, which are able to connect with traffic lights, on emergency vehicles such as ambulances. The traffic lights turn green in response to the approaching ambulance thanks to the RFID reader, which allows the vehicle to continue travelling unhindered.

Arduino Based traffic congestion control with automatic signal clearance for emergency vehicles and Stolen Vehicle Detection:

An innovative approach utilizing IR sensor technology is put forth to address the crucial problems of traffic signal time consumption and vehicle congestion. Suggested a solution that uses an RF transmitter and receiver to solve this issue.

When the ambulance arrives, the specific path signal will become blue in addition to the green signal. RFID makes it simple to identify stolen vehicles as well.

Intelligent Traffic Management for Emergency Vehicles using Convolutional Neural Network:

The road network's structure and the city's explosive urbanization are getting more intricate. Assume that there is no guarantee of the privilege of preference for the emergency. In that scenario, there is a chance that the traffic jam at the scene could worsen, which would hardly be indicative of public transportation or any emergency vehicle prioritizing dependable, safe, and prompt output. For emergency vehicles, we have suggested using convolutional neural networks (CNNs) for traffic control. The Raspberry-Pi uses the CNN model. After receiving the video from the traffic road, the CNN model will decide quickly whether to admit the emergency cars.

Real-time Dynamic Traffic Light Control System with Emergency Vehicle Priority:

This research presents an intelligent system that assigns different priorities to different types of electric vehicles (EVs) and dynamically modifies the cycle duration for each of the lanes at an intersection based on the density of vehicles. The emergency radio-frequency identification (RFID) module, the internet module, and the traffic light control module make up the three modules that make up the system. Using ultrasonic sensors, the traffic light control module measures the density of vehicles and determines a dynamic set of cycle length based on the specific lane density condition. The internet module enables authorised workers to operate the dynamic traffic signal system in real time.

IoT based Intelligent Traffic Signal System for Emergency vehicles:

India's population is expanding, and with it, so is the country's car fleet. This complicates the scheduling and prioritisation of emergency vehicles, such as police, fire, and ambulance vehicles. The proposed model primarily focuses on effectively managing traffic and releasing vehicle congestion to allow emergency vehicles to go with less effort and time to their destination. This suggested model calls for the use of gadgets like the Raspberry PI, Node MCU, RFID tag, and reader to control traffic signals.

IoT based Traffic Signal control for reducing time delay of an Emergency Vehicle using GPS:

Traffic is one of the primary reasons for the delay in reaching the location. For emergency vehicles including fire departments and ambulances. This delay might be the difference between life and death. This paper proposes a way to control traffic signals so that emergency vehicles can be alerted when they are approaching a specific area. It is possible to track a vehicle's whereabouts using GPS. This location is received by the application. The application applies the algorithm using this data and the Google map. It controls the signals that are directed towards it. We also added a new blue light to avoid misunderstanding among people waiting at the traffic signal.

IoT based Emergency Vehicle Communication System:

It has created a system for this project that is based on V2V and V2I technologies. This system helps emergency vehicles, like fire trucks and ambulances, choose the least congested route by using data from the sensors to create communication architecture for automatic traffic management. The designed system will react and forward the required information regarding traffic congestion, giving the route status updates to the driver's vehicle display during any kind of difficulty, jam, or complexity.

Priority Based Traffic Pre-emption System for Medical Emergency Vehicles in Smart Cities:

Giving EVs priority could be one way to overcome this obstacle. This research proposes an Internet of Things-based priority pre-emption paradigm for electric vehicles in smart cities. It uses sensors to track the EV's position and speed dynamically and adaptively modifies the timing of each traffic light along its route. This guarantees that there will be little to no delay for the EV travelling to and from its destination.

Intelligent control system for the seamless transit of Emergency Vehicles:

The aim of this project is to design and develop an IOT-based analytical framework that will enable the creation of a green corridor for ambulances by alerting traffic personnel well in advance of their approach and preventing traffic jams while the ambulance is in the area. This study designates a 'pre-informing' centralized control system in contrast to previous attempts where traffic clearance is accomplished manually on-site by manipulating traffic lights.

SYSTEM ANALYSIS

EXISTING SYSTEM

The implementation of a traffic signal system for emergency vehicles utilizing IoT, edge computing, and GPS technology is a sophisticated endeavor aimed at enhancing emergency response efficiency. In this system, traditional traffic lights are equipped with IoT modules to facilitate communication with nearby emergency vehicles. These vehicles are fitted with GPS modules to continuously transmit their precise locations to nearby traffic lights via established communication protocols, such as MQTT or HTTP. Edge computing devices stationed at intersections process incoming GPS data in real-time, determining if an emergency vehicle is approaching and calculating optimal adjustments to traffic light timing to prioritize its passage. These adjustments might involve extending green light durations in the vehicle's direction while halting traffic from other directions safely. Additionally, the system must incorporate feedback mechanisms to restore normal traffic operations once the emergency vehicle has cleared the intersection. An optimal control strategy for EVP using edge computing and IoT sensor for smart cities. The experiment was conducted using a GPS based IoT sensor which keeps on sending the Location Information (LI) to the edge server. The edge server computes the optimum timings based on the proposed control strategy algorithm and clears the emergency vehicles. Redundancy measures and failover mechanisms are crucial for ensuring continuous operation, while rigorous testing and optimization are necessary to fine-tune algorithms and parameters for optimal traffic management. 8 Security measures, including encryption and authentication, are implemented to safeguard communication.

Hardware Setup:

- Traffic Lights: Traditional traffic lights equipped with IoT modules for communication.
- IoT Devices: Devices installed in emergency vehicles to communicate with traffic lights and provide their location data.
- Edge Computing Devices: These are small computing devices placed at intersections or nearby locations to process incoming data and make real-time decisions.
- GPS Modules: Installed in emergency vehicles to provide accurate location data.

Data Transmission:

- Emergency vehicles continuously transmit their GPS coordinates to nearby traffic lights through the established communication protocol.
- Traffic lights receive the data and forward it to the edge computing devices for processing.
- Edge Computing: Edge computing devices analyze the incoming GPS data from emergency vehicles in real-time.

Traffic Light Control:

- Traffic lights are dynamically changed to prioritise oncoming emergency vehicles based on the analysis from the edge computing devices.
- This can entail stopping traffic from other directions safely while extending the green signal duration in the direction of the emergency vehicle that is coming.

- **Feedback Mechanism:** The traffic lights resume normal operation after the emergency vehicle has driven through the intersection.
 - It is possible to use feedback mechanisms to guarantee a seamless return to normal traffic patterns.
- Evaluation and Enhancement:
- To guarantee the efficiency and dependability of the system, extensive testing and optimisation are essential.
 - It is necessary to carry out experiments and simulations in order to optimise the parameters and algorithms utilised in traffic light control.
 - This system may efficiently prioritise emergency vehicles' passage through traffic intersections by merging IoT, edge computing, and GPS technologies. This might potentially reduce response times and improve overall traffic flow.

PROPOSED SYSTEM

A proposed system design for a traffic signal prioritization system for emergency vehicles using IoT. It aims to prioritize emergency vehicles at intersections by dynamically controlling traffic signals. It utilizes IoT technologies for communication between emergency vehicles and traffic signal infrastructure. In our project the emergency vehicle will be detected and the signal will be automatically changed to green. The emergency vehicle will be detected before 500m . And we are using the buzzer to inform other drivers to avoid confusion. If suppose any problem occurs in communication of devices we are sending the notification to the traffic controller so that the signal will be changed manually.

PROPOSED METHODOLOGY

In this system, the transmitter module is activated when an emergency vehicle approaches an intersection. The receiver at the junction receives a signal from the transmitter showing the vehicle's presence and priority status. The signal is picked up by the receiver and sent to the Raspberry Pi via NodeMCU. After processing the incoming data, Raspberry Pi decides what action to take in light of the traffic situation and the emergency vehicle's presence. The Raspberry Pi dynamically modifies the timing of the traffic signals to give priority to the emergency vehicle's passage. Traffic signal LEDs are managed appropriately, with red lights indicating other directions and green lights for emergency vehicles. The Raspberry Pi resets the traffic signals to their regular settings when the emergency vehicle has passed through the intersection. When LEDs revert to their typical signalling patterns, traffic can resume.

EXPERIMENTAL DISCUSSIONS

Emergency Vehicle Detection

This module is responsible for detecting the presence of an emergency vehicle approaching the traffic signal. This could be achieved using sensors like cameras, LiDAR, or ultrasonic sensors installed on the vehicle or alongside the road. Once the detection is made, a signal is sent to the receiver module.

Receiver Module

The receiver module, typically based on a NodeMCU board (which is an ESP8266- based microcontroller), receives signals from the emergency vehicle detection system. It communicates wirelessly with the detection system and sends the information to the Raspberry Pi.

Communication between Receiver and Raspberry Pi

The communication between the receiver module and the Raspberry Pi can be established using protocols like MQTT (Message Queuing Telemetry Transport) over Wi-Fi or Bluetooth. MQTT is lightweight and suitable for IoT applications. The receiver module sends a message to the Raspberry Pi indicating the presence of an emergency vehicle.

Decision Module

The Raspberry Pi acts as the decision-making unit in the system. It receives signals from the receiver module indicating the approach of an emergency vehicle. Based on this information, it decides whether to change the traffic signal to give priority to the emergency vehicle or not. The decision-making algorithm can take into account factors like the distance of the vehicle from the signal, the traffic density, and the priority status of the vehicle.

Traffic Signal Control

LED lights connected to the Raspberry Pi through GPIO pins are used to control the traffic signal. When the decision module determines that an emergency vehicle is approaching, it triggers the LED lights to change the signal to green in the direction of the approaching vehicle, while holding the other signals at red or providing a flashing yellow signal for caution. By integrating these components, the system can efficiently

detect emergency vehicles, communicate their presence to the traffic signal control system, and make timely decisions to prioritize their passage through the intersection.

SYSTEM WORK FLOW

Emergency Vehicle Detection with Transmitter and Receiver:

A transmitter module would be installed in an emergency vehicle. Periodically or continuously, signals are released by this transmitter. A receiver is positioned at key locations close to the traffic light. The signals that the emergency vehicle's transmitter transmits are picked up by these receivers.

Signal Processing and Interpretation:

The data is sent to the Raspberry Pi for processing by the receiver after it has picked up the signal. To ascertain the location and presence of an emergency vehicle, the Raspberry Pi examines the strength of the received signal or any encoded data.

Raspberry Pi Decision-Making:

The Raspberry Pi decides whether an emergency vehicle is approaching the traffic signal and whether action is necessary based on the data it receives from the receivers.

Communication with NodeMCU:

The Raspberry Pi connects with the NodeMCU microcontroller to adjust the traffic lights in response to the detection of an emergency vehicle. It could transmit commands to alter the timing of the signal or initiate particular sequences in order to permit the emergency vehicle to pass.

Control of Traffic Lights via NodeMCU:

This method is comparable to the preceding one in that the NodeMCU gets instructions from the Raspberry Pi and regulates the traffic lights' operation in accordance with those instructions.

Setup of the Transmitter and Receiver:

The NodeMCU is linked to a transmitter module that controls the operation of the traffic lights by sending signals to receivers positioned close to them. Control LED Lights: Traffic signals continue to be operated by LED lights. The receivers control the traffic flow by turning on the relevant LEDs in accordance with the instructions they receive from the NodeMCU. Integration with Current Traffic Control System: Coordination and flawless operation with regular traffic signals are guaranteed by integration with the current traffic control system.

Emergency Vehicle Passage:

The technology instantly turns all of the traffic lights along the vehicle's route green when it detects an emergency vehicle approaching. This permits the car to pass through without any delays.

Resetting Normal Operation:

The system returns the traffic signals to their usual operation, depending on the regular traffic patterns, after the emergency vehicle has passed. Constant Monitoring: To ensure prompt travel without sacrificing safety, the system constantly scans the area for the presence of emergency vehicles and modifies the traffic lights accordingly.

CONCLUSION

The project aiming to prioritize the passage of emergency vehicles through traffic signals by utilizing a system based on Raspberry Pi, NodeMCU, transmitters, receivers, LED lights, and jumper wires offers a robust solution to enhance emergency response efficiency and road safety. By detecting the presence of emergency vehicles through strategically placed transmitters and receivers, the system effectively communicates with the central Raspberry Pi unit, which processes the data and makes informed decisions regarding traffic signal control. Through seamless integration with existing traffic infrastructure, the system ensures minimal disruption to regular traffic flow while prioritizing emergency vehicles' safe and swift passage. LED lights, controlled by the NodeMCU microcontroller, facilitate clear and intuitive signaling for all road users. Continuous monitoring and real-time adjustments enable dynamic responsiveness to changing traffic conditions, ensuring optimal traffic management. Overall, this project represents a significant advancement in traffic signal technology, demonstrating the potential for smart systems to improve emergency response capabilities and enhance overall road safety.

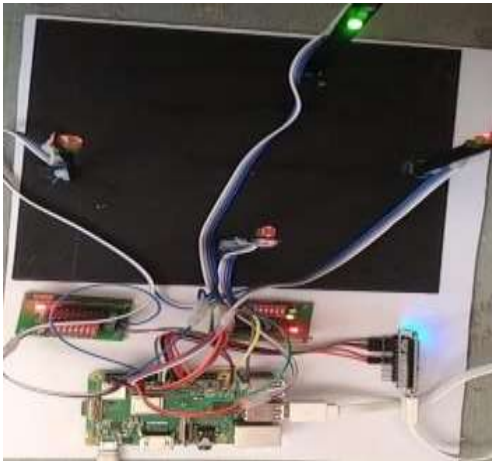
FUTURE WORK

To increase the precision and dependability of emergency vehicle identification, investigate the application of advanced vehicle detection technologies such as computer vision systems or machine learning algorithms. To further maximise traffic flow and reduce congestion, use dynamic traffic signal

control algorithms that can adjust in real-time to changing traffic conditions, including the presence of emergency vehicles. To build a more extensive and linked urban mobility ecosystem, integrate the system with other smart city infrastructure elements including traffic control systems, public transport networks, and emergency services.

Investigate if vehicle-to-infrastructure (V2I) communication technologies can facilitate direct connection between emergency vehicles and traffic signal systems, thereby facilitating even more accurate and effective coordination. To further increase road safety for all users, not just emergency vehicles, include extra safety measures like pedestrian recognition and crosswalk prioritization. Create plans for expanding the system's deployment to more expansive urban regions while considering aspects like affordability, scalability, and compatibility with current infrastructure. To find areas for development and make sure the system satisfies the needs and expectations of all stakeholders, conduct in-depth user feedback sessions and performance evaluations in real-world scenarios.

SAMPE OUTPUT



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