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Automatic Traffic Signal controlling for Emergency Vehicles using Internet of Things

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Abstract: Road traffic congestion becomes a major issue for highly developed metropolitan cities. We are facing terrible road congestion especially in the cities. According to Times of India about 30 percent of deaths are caused due to delayed ambulance to reach at hospital. In proposed system, we are trying to reduce the delay for the ambulance. To smoothen the ambulance movement we come up with the solution referred as automatic traffic signal controlling for emergency Vehicles using IoT. Here the generated data will send to the hospital before the ambulance reaching to the hospital over there. As this system is fully automated and controlled by RFID , it recognizes the ambulance and control traffic signals. This system controls traffic light and the ambulance reach to the hospital on time. It saves the time in emergency period and the life of the patient. Thus it act as a life saver project

Keywords: RFID readers, Arduino NANO, ZIGBEE, Traffic Lights, USB-TTL Converter.

1. Introduction

Intellectual solutions that are capable in calculating automobile movement in addition to mechanized supervisory practices are profoundly required to overcome urban automobile traffic hindrances. Orthodox ITS policies do not show flexibility and intellect that can manage present traffic flow magnitudes as well as self-reliant vehicle adaptation. DL as well as RL along with AI provide an opportunity in redesigning ITS for the future. When integrated with cloud computing, these technologies can be deployed at scale, enabling smart cities to optimize traffic flows and reduce environmental impacts. Concurrent data from an assembly of IoT and vehicular radars is composed and pre-processed to practice the "acknowledged" evidence for the RL administrator. The DNNs will estimate the significant functions or strategies in RL, aiding the control of high dimensional and accomplishments that are impracticable for out dated RL approaches. The output of the DRL model interprets into actual actions, such as vigorously regulating traffic signal judgments or providing finest route recommendations to related vehicles.

DRL systems can study and implement ideal traffic light regulator strategies that generate "green wave" outlines, profoundly dropping typical waiting periods and cultivating complete traffic movement associated to stagnant, pre mediated systems. Deep learning prototypes, primarily CNNs and RNNs, can attain compound outlines to precisely forecast temporary traffic situations and jamming points. In a cloud/edge computing setting, RL can improve the distribution of computational and assertion capitals for numerous facilities such as safety alerts to safeguard quality of service and energy effectiveness. Annoying calamities can be avoided effectively by establishing plan that is capable in taking immediate disaster management actions as well as implement spontaneous traffic flow guideline. This is possible only when gigantic statistical information and also multidimensional summaries collected are assessed accurately. Robust tailored combination of utilities that are proved remarkable result in well-organized independent urban transportation formats.

Traffic Signals: This project used Arduino Nano controller to program a priority-based traffic light controller for emergency vehicle. During emergency cases, emergency vehicle like ambulance can trigger the traffic light signals to change from red to green in order to make clearance for its path automatically using RFID technology. At traffic signals when the emergency vehicle comes near to the RFID reader, it will read that vehicle tag and identify whether it is normal vehicle or emergency. If the system detects emergency vehicle it will turn on the GREEN LIGHT to clear the path. After passing the emergency vehicle, traffic lights work in normal mode

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to clear the traffic conjunction. RFID tag consist of ambulance number and patient health parameters.

Ambulance Section: Pulse sensor, temperature sensor, ZIGBEE transceiver and LCD display which is interfaced to the Arduino Nano. Arduino Nano will continuously reads the data from sensors will be displays on LCD module and upload this data into the near hospital wirelessly through Zigbee.

Hospital Section: Hospital section consist of ZIGBEE transceiver along with PC. HyperTerminal application is uses to monitor the ambulance number, driver phone number and patient health parameters. After checking this data doctor will accept and reject the patient from application.

The traffic lights system follows a fixed timing pattern for traffic management. Due to this fixed time ,in case heavy traffic congestions the emergency ambulance cannot pass at the traffic signal. So it is difficult to the ambulance to reach the hospital in time. There are high chances of causing deaths. To avoid these conditions, we come up with new system for providing patient information to the hospital to speed up the treatment and for controlling traffic signals.This system introduces an automatic traffic light controller to minimizes the traffic issues using RFID readers. It is designed to send the patient condition using sensors to the nearby hospital using ZIGBEE. The location will be tracked using RFID readers to both ambulance and traffic signals.

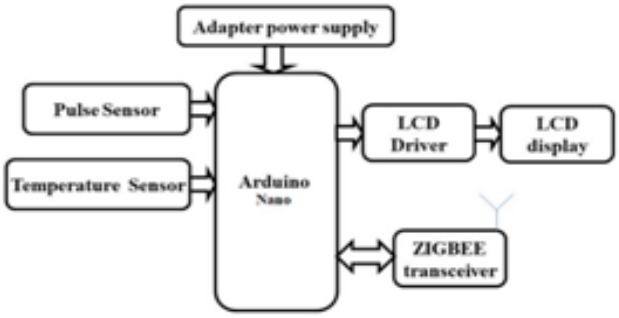

Figure. 1 Traffic Signal Controlling Section

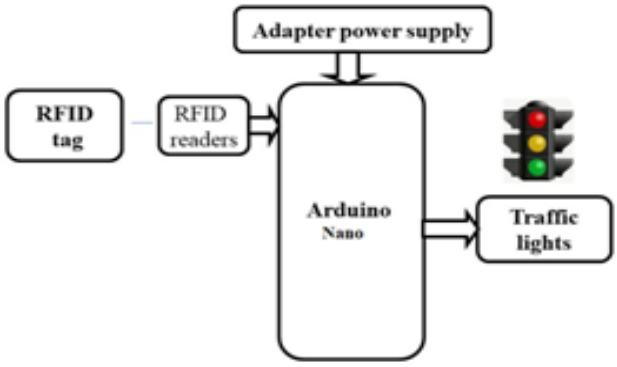

Figure. 2 Ambulance Monitoring Section

2. Literature Survey

The concept you're working on combines traffic management, emergency response systems, and wireless health monitoring. A review of related research shows various applications of RFID, Zigbee, and health-monitoring systems in traffic management and emergency medical services. Here's an overview of the existing literature relevant to your project:

Traffic Signal Management Systems

RFID-based Traffic Signal Control: Several studies have focused on the integration of RFID technology for priority-based traffic signal control, particularly for emergency vehicles. For example, RFID has been used to detect approaching emergency vehicles and automatically change the traffic light to prioritize them. This is particularly beneficial in reducing response times and improving emergency services efficiency (Shao, et al., 2011).

Intelligent Traffic Management: Other studies discuss the use of intelligent traffic management systems (ITS) with sensor networks, such as RFID and wireless communication, to dynamically adjust traffic signals based on real-time vehicle conditions (Dey, et al., 2013).

Emergency Vehicle Priority Systems:

Ambulance Prioritization: Systems like the one you're proposing are being researched to provide priority for ambulances or other emergency vehicles in traffic. Studies indicate that RFID technology has been used effectively for this purpose by automatically triggering traffic signal changes when emergency vehicles are detected (Shankar, et al., 2016).

Vehicle-to-Infrastructure Communication: Research highlights the potential vehicle-to-infrastructure communication systems (like Zigbee) for sharing real-time information, enabling emergency vehicles to get green lights during their travel route (Wu, et al., 2014).

Health Monitoring in Ambulances:

Wireless Health Monitoring Systems: The integration of wireless health monitoring systems in ambulances has been a significant area of research. Several studies have demonstrated the use of Zigbee and other wireless communication protocols for transmitting patient health data from the ambulance to the hospital in real time. For example, Zigbee modules have been used. Zigbee modules have been used to send real-time patient data such as heart rate, body temperature, and other vital signs to doctors at the hospital (Nayak, et al., 2013).

Ambulance Monitoring: Researchers have developed systems where various sensors are

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connected to an Arduino or similar microcontroller to monitor patient health parameters, and the data is transmitted wirelessly to hospitals for immediate medical attention (Verma, et al., 2018)

Wireless Communication for Healthcare:

Zigbee-based Communication: Zigbee has been widely used for wireless communication in healthcare applications due to its low power consumption and reliable data transfer. In the context of ambulances, Zigbee has been used for monitoring and transmitting vital patient data in a secure manner (Moustafa, et al., 2016).

Integration with Hospital Systems: Several studies have explored integrating these wireless systems with hospital management software to enable doctors to access real-time patient data remotely and make decisions faster (Patel, et al., 2017).

Traffic Control and Emergency Systems in Smart Cities:

Smart City Traffic Management: With the advent of smart cities, there has been increasing focus on integrating IoT, RFID, and wireless communication technologies for real-time traffic management. These studies indicate that emergency vehicle prioritization using RFID and smart traffic signals is a critical component of modern smart city infrastructure (Kumar, et al., 2021

3. Methodology

The system you are designing involves multiple components and involves both hardware and software implementation. Here's a detailed methodology for the **Priority-based Traffic Signal Control System** for emergency vehicles (ambulance), integrated with health monitoring and wireless communication with the hospital.

3.1 Hardware Design:

Ambulance Section:

Arduino Nano: Acts as the central controller, interfacing with the sensors, the RFID reader, and the Zigbee module.

RFID System: The RFID reader is used to detect the unique RFID tag on the emergency vehicle (ambulance) and identify whether it is an emergency vehicle or a normal vehicle.

Pulse and Temperature Sensors: These sensors continuously monitor the health of the patient in the ambulance. The data (pulse rate, body temperature, etc.) will be displayed on an LCD screen in the ambulance.

Zigbee Transceiver: This module will wirelessly transmit patient data (e.g., pulse rate, temperature, etc.) to the hospital system.

LCD Display: Displays the health data of the patient in real time.

Hospital Section:

Zigbee Transceiver: Receives the data from the ambulance, which includes the ambulance number, patient's health parameters (pulse rate, temperature, etc.), and other information.

PC with HyperTerminal Application: Used by the hospital staff or doctor to monitor the received data. The system displays the ambulance number, the health status of the patient, and allows the doctor to accept or reject the case based on the health parameters.

Traffic Signal Control:

Arduino Nano: Controls the traffic lights based on RFID signals. When an RFID tag associated with an ambulance is detected, the Arduino triggers a change in the traffic light to give priority to the emergency vehicle.

Traffic Lights: LEDs are used to simulate traffic lights (Red, Yellow, Green), which will be triggered by the Arduino based on the RFID signal detection.

3.2 Flow of Data and Control:

Detection of Emergency Vehicle: The RFID reader at the traffic signal scans the RFID tag of the approaching ambulance. If the system detects that it is an emergency vehicle (based on the RFID data), it will immediately change the traffic light to green to allow the ambulance to pass.

Health Data Collection: The sensors (pulse and temperature sensors) in the ambulance continuously monitor the patient's vital signs. These health parameters are sent wirelessly through Zigbee to the hospital section.

Data Reception and Monitoring: The Zigbee transceiver at the hospital receives the data and sends it to a PC running a HyperTerminal application. The hospital staff can then assess the patient's condition and decide whether to accept or reject the case based on the received health data.

Traffic Signal Reversion: After the ambulance has passed, the traffic light system returns to its normal mode, managing traffic congestion as usual

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4. Result And Analysis

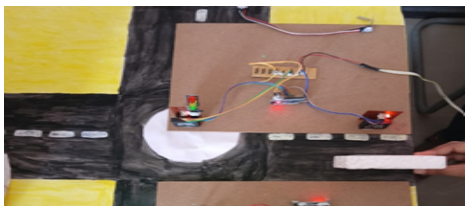

Figure. 3 Ambulance Detection

The system detects an approaching ambulance via RFID or GPS-based communication. It changes the traffic light to green at the necessary junction, ensuring an uninterrupted passage. Other roads are temporarily given a red signal to halt regular traffic. Once the ambulance crosses, normal traffic light operation resumes.

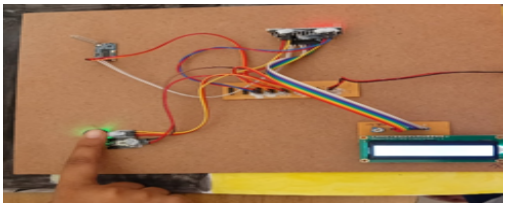

Figure. 4 Collecting Patient Information

When an ambulance is detected, the system sends a signal to change the traffic light to green. Once the ambulance crosses, the traffic lights return to their normal sequence, and it will display the patient heartbeat and temperature of the patient body.

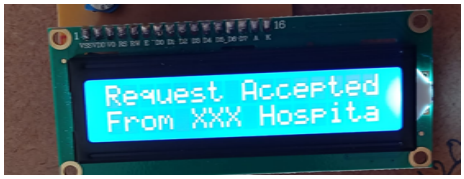

Figure. 5 Response Accepted Message

When an ambulance sends an emergency request via IoT, the system detects and verifies it.The LCD displays a “Request Accepted”, acknowledging the request from the hospital.The system then triggers the automatic change of the traffic signal to green for the ambulance.

Figure. 6 Response Rejected Message

The system receives an emergency request from an ambulance via IoT.If the request is invalid or unauthorized, the system displays "Request Rejected" on the screen.The traffic signal remains unchanged, preventing unauthorized access to the priority system.

5. Conclusion

The proposed system provides an effective solution to reduce emergency response time by automatically controlling traffic signals for ambulances using IoT technology. By integrating RFID and GPS for real-time location tracking, along with sensors to monitor patient condition, the system ensures smooth ambulance movement and timely hospital notifications. This not only improves traffic management during emergencies but also plays a crucial role in saving lives. This not only improves traffic management during emergencies but also plays a crucial role in saving lives. Furthermore, the system's ability to automate and coordinate various components—such as traffic lights, ambulance tracking, and hospital alerts—creates a responsive and intelligent emergency network. As a result, it reduces human error, enhances operational efficiency, and ensures that critical care reaches patients at the earliest possible time. Overall, the proposed solution demonstrates the potential of smart technologies in transforming emergency services and building safer, more connected cities.

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