

# RFID based intelligent Ambulance monitoring and Traffic control system with pulse and temperature observation

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**Abstract:** Traffic congestion in urban areas often delays ambulances during medical emergencies, which can lead to serious consequences for patients. To overcome this problem, an intelligent traffic control system is required to provide priority to emergency vehicles. This paper proposes an RFID-based ambulance monitoring and traffic control system that helps ambulances pass through traffic signals without delay. In this system, ambulances are equipped with RFID tags, and RFID readers are installed at traffic intersections. When an ambulance approaches the signal, the RFID reader detects the tag and sends the information to the Arduino microcontroller, which automatically changes the signal to green for that route. This allows the ambulance to move quickly through the intersection. The system also includes patient health monitoring using pulse and temperature sensors inside the ambulance. These health parameters are transmitted wirelessly to the hospital using Zigbee communication, enabling doctors to prepare for treatment before the ambulance arrives. This system helps reduce ambulance delay, improve emergency response time, and enhance patient care through smart traffic management.

**Keywords:** RFID reader, RFID tag, Zigbee transmitter module, Zigbee receiver module ,wireless serial port communication module, temperature sensor, pulse sensor, Traffic control , Ambulance monitoring.

## 1.INTRODUCTION

Rapid urbanization and the increasing number of vehicles on roads have led to severe traffic congestion in many cities. During medical emergencies, ambulances often face difficulties in reaching hospitals on time because they must wait at traffic signals along with other vehicles. These delays can critically affect the chances of saving a patient's life. Therefore, it is essential to develop a system that can give priority to emergency vehicles in traffic.

The RFID Based Intelligent Ambulance Monitoring and Traffic Control System is designed to address this issue by using modern communication and identification technologies. In this system, ambulances are equipped with RFID tags, and RFID readers are placed at traffic intersections to detect the approaching ambulance. The collected patient data is transmitted to the hospital using Zigbee wireless communication, enabling doctors to assess the patient's condition before arrival. Additionally, the hospital can send acceptance information back to the ambulance, helping the driver choose the appropriate destination. By combining traffic automation with healthcare monitoring, the system aims to improve emergency response, reduce delays, and enhance the overall efficiency of medical services. Another important aspect of this paper is the use of wireless communication through Zigbee modules, which enables seamless data transfer between the ambulance and hospital. Unlike traditional methods, this system provides continuous updates of the patient's condition, allowing medical staff to make quick decisions and prepare necessary treatment facilities in advance. This not only saves time but also improves the quality of emergency healthcare services.

## 2. SYSTEM IMPLEMENTATION

The implementation of the RFID based intelligent ambulance monitoring and traffic control system begins with the overall design of three main units: the ambulance unit, the traffic signal control unit, and the hospital monitoring unit. These units are interconnected to ensure smooth communication and coordination during emergency situations. The system uses RFID technology for ambulance identification, Arduino as the main controller for processing and decision-making, and Zigbee modules for wireless communication between the ambulance and the hospital. The goal of the implementation is to reduce ambulance delay at traffic signals while also enabling real-time patient monitoring.

In the ambulance unit, various hardware components such as an Arduino UNO, pulse sensor, temperature sensor, Zigbee transmitter, and LCD display are assembled. The sensors continuously monitor the patient's vital parameters, including pulse rate and body temperature. These values are read and processed by the Arduino, which then displays them on the

LCD screen inside the ambulance. At the same time, the processed data is sent to the Zigbee transmitter, which wirelessly transmits the patient's condition to the hospital unit. An RFID tag is also placed in the ambulance, which uniquely identifies it as an emergency vehicle when it approaches a traffic signal.

At the traffic signal control unit, an RFID reader is installed near the junction and connected to an Arduino controller along with traffic lights. The reader continuously scans for nearby RFID tags. When the ambulance approaches the signal, the RFID reader detects the tag and sends the unique identification number to the Arduino. The controller verifies that the detected tag belongs to an ambulance and immediately changes the traffic signal to green for the ambulance's direction, while keeping other lanes on red. This ensures that the ambulance can pass through the intersection without any delay. Once the ambulance crosses the signal and moves out of range, the system automatically restores normal traffic operation.

The Zigbee communication system plays a crucial role in enabling real-time data exchange between the ambulance and the hospital. The Zigbee transmitter in the ambulance sends the patient's health data to the Zigbee receiver installed at the hospital. This receiver is connected to a computer system where the data is displayed using serial communication software. Doctors at the hospital can monitor the patient's condition in real time and make quick decisions regarding treatment readiness. If the hospital is prepared to accept the patient, the doctor can send an acceptance signal back to the ambulance using the same Zigbee communication system.

Once the acceptance signal is received in the ambulance, the Arduino processes this information and displays the hospital name along with the acceptance status on the LCD screen. This helps the driver to directly proceed to the appropriate hospital without confusion or delay. The entire system is programmed using Embedded C in the Arduino IDE, where the code handles RFID detection, sensor data processing, traffic light control, and Zigbee communication. During testing, each module is verified individually, including RFID detection, sensor accuracy, wireless communication, and signal switching, before integrating the complete system.

The final implementation demonstrates that the system successfully provides automatic traffic clearance for ambulances, enables continuous patient monitoring, and establishes effective communication between the ambulance and hospital. By integrating these technologies, the system improves emergency response time, reduces traffic-related delays, and enhances the overall efficiency of healthcare services during critical situations. In addition to its core functionality, the system is designed with scalability and real-time reliability in mind, making it suitable for integration into larger smart city infrastructures. The use of low-power and cost-effective components like Arduino and Zigbee ensures that the system remains economical while maintaining efficient performance. During operation, the synchronization between traffic control and patient monitoring creates a coordinated emergency response mechanism, reducing human intervention and decision delays.

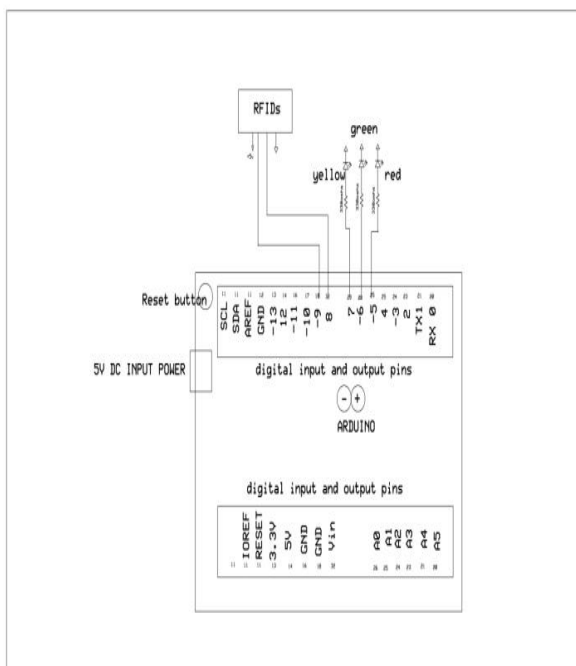


Fig1:interfacing of Arduino with traffic lights

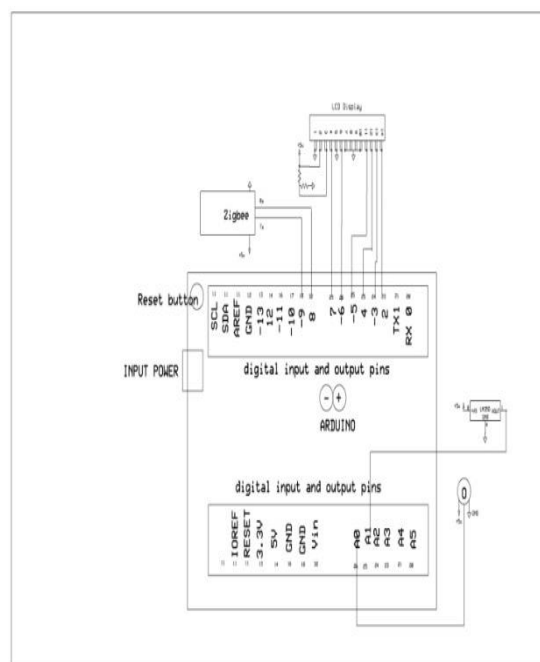


Fig2:interfacing of Arduino with Ambulance section

### 3. HARDWARE DESCRIPTION

1) Arduino UNO:

Acts as the main controller to process data and control all operations in the system.



Fig3:Arduino UNO

2) RFID Tag

Attached to the ambulance to provide a unique identification number.

RFID Reader

Detects the RFID tag when the ambulance approaches the traffic signal



Fig4:RFID Tag and RFID Reader

3) Zigbee Transmitter Module:

Sends patient health data from the ambulance to the hospital wirelessly.

Zigbee Receiver Module:

Receives the transmitted data at the hospital side.

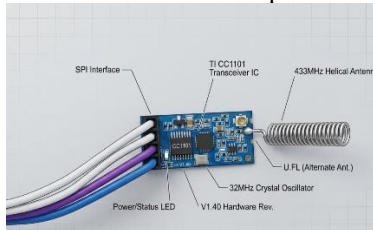


Fig5:Transmitter module

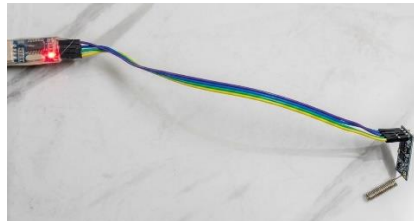


Fig6:Receiver module

4) Pulse Sensor:

Measures the patient's heart rate inside the ambulance.

Temperature Sensor (LM35):

Measures the body temperature of the patient.



Fig7:Pulse and temperature sensor

5) 16x2 LCD Display:

Displays patient data and hospital acceptance status in the ambulance and also for traffic control section

Traffic LEDs (Red, Yellow, Green ): Represent traffic signals and are controlled by Arduino.



Fig8:LCD Display



Fig9:Traffic LED lights

6) Serial Communication Software (HyperTerminal):

Used to monitor and display incoming data from Zigbee on the computer.

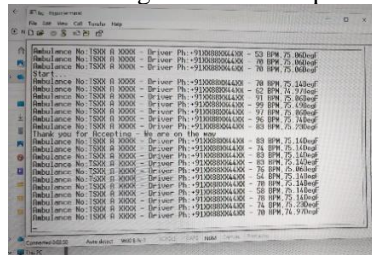
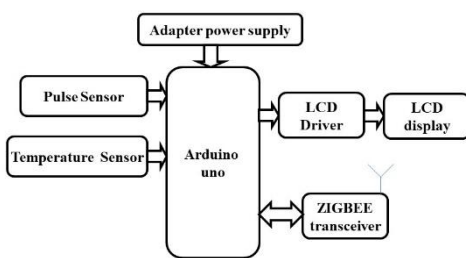


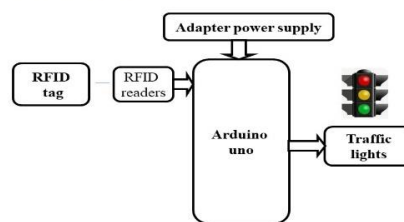
Fig10: Serial communication software

**4. BLOCK DIAGRAMS**

Block diagram: Ambulance section



Block diagram: Traffic signals



Block diagram: PC section



**5. MERITS**

- 1)Automatic Emergency Vehicle Detection  
Uses RFID technology to accurately identify ambulances without human intervention.
- 2)Real-Time Traffic Signal Control  
Dynamically changes traffic signals based on ambulance presence, reducing idle waiting
- 3)Reduced Emergency Response Time

Ensures faster movement of ambulances through intersections, improving survival chances.

4) Integrated Patient Health Monitoring

Continuously measures vital parameters like pulse rate and body temperature.

5) Wireless Data Transmission

Zigbee enables reliable, real-time communication between ambulance and hospital.

6) Bidirectional Communication System

Supports two-way communication, allowing hospitals to send acceptance

### **6. FUTURE SCOPE**

1) Integration with GPS Tracking

→ Replace or combine RFID with GPS to track ambulance location in real time over long distances and across multiple junctions.

2) IoT-Based Cloud Monitoring

→ Upload patient data to cloud platforms for remote monitoring by multiple hospitals simultaneously.

3) AI-Based Traffic Optimization

→ Use machine learning algorithms to predict traffic density and automatically create optimal routes for ambulances.

4) Smart City Integration

→ Integrate the system with centralized smart city traffic management systems for coordinated control of multiple signals.

5) Mobile Application for Hospitals

→ Develop a mobile app for doctors to receive patient data and send acceptance directly from smartphones.

6) Multi-Ambulance Priority Handling

→ Implement priority algorithms to manage situations where multiple ambulances approach the same junction.

7) Use of 4G/5G Communication Instead of Zigbee

→ Upgrade to high-speed communication technologies for wider coverage and faster data transmission.

8) Automatic Route Guidance System

→ Integrate with navigation systems to guide the driver to the nearest available hospital dynamically.

9) Advanced Health Monitoring Sensors

→ Include ECG, blood pressure, and oxygen level sensors for detailed patient monitoring.

10) Camera-Based Emergency Vehicle Detection

→ Combine RFID with computer vision systems for more accurate detection and redundancy.

11) Database and Record Management System

→ Maintain patient history and ambulance movement records for analysis and future reference.

### **7. RESULTS AND DISCUSSION**

The implemented RFID Based Intelligent Ambulance Monitoring and Traffic Control System was tested under controlled conditions to evaluate its performance in real-time scenarios. The RFID reader module successfully detected the presence of the ambulance-mounted RFID tag within its effective range and transmitted the unique identification data to the Arduino controller without significant delay. Upon verification of the tag, the controller dynamically altered the traffic signal sequence by switching the corresponding lane to green, ensuring uninterrupted movement of the ambulance through the intersection. After the ambulance cleared the junction, the system automatically restored the normal traffic signal operation, demonstrating proper synchronization and control logic.

The patient monitoring subsystem accurately acquired physiological parameters such as pulse rate and body temperature using the respective sensors. The measured data was processed by the Arduino and transmitted to the hospital unit through Zigbee communication. The Zigbee modules provided stable and low-latency wireless communication, enabling real-time data transfer between the ambulance and the hospital monitoring system. The received data was successfully displayed on the hospital interface, allowing medical personnel to observe the patient's condition continuously.

Furthermore, the bidirectional communication feature was validated by enabling the hospital unit to send an acceptance signal back to the ambulance. This signal was correctly received and processed by the ambulance unit, and the corresponding hospital information was displayed on the onboard LCD. The overall system exhibited reliable performance, efficient coordination between subsystems, and minimal response time, thereby confirming its effectiveness in reducing emergency delays and enhancing pre-hospital patient care.

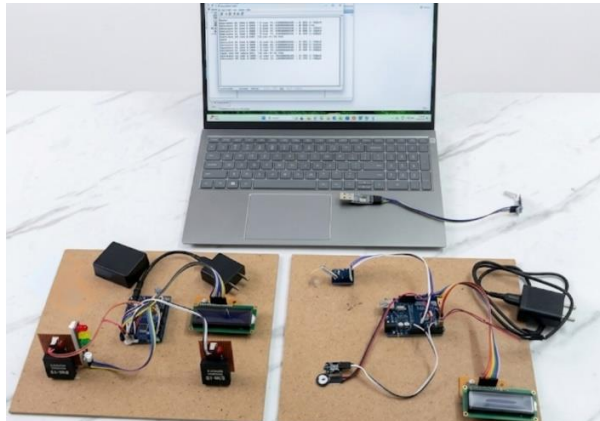


Fig9:Experimental setup

### 8. CONCLUSION

The RFID Based Intelligent Ambulance Monitoring and Traffic Control System has been successfully designed and implemented to address the critical issue of ambulance delays in congested traffic conditions. The system effectively utilizes RFID technology for automatic identification of emergency vehicles and enables dynamic control of traffic signals using a microcontroller-based approach. By prioritizing ambulance movement at intersections, the system significantly reduces waiting time and ensures faster transit during emergencies.

In addition to traffic management, the integration of patient health monitoring using sensors and wireless communication through Zigbee enhances the overall functionality of the system. Real-time transmission of vital parameters such as pulse rate and body temperature allows hospitals to prepare in advance, thereby improving the quality of emergency medical care. The bidirectional communication between ambulance and hospital further supports informed decision-making and efficient coordination.

The implementation demonstrates that combining embedded systems, wireless communication, and automation can provide a reliable and cost-effective solution for real-world problems. Overall, the system improves emergency response efficiency, reduces human intervention, and contributes toward the development of intelligent transportation and healthcare systems.

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