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BLUETOOTH BASED TRAFFIC AMBULANCE SYSTEM

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ABSTRACT

Traffic management remains a crucial challenge in metropolitan cities, where congestion poses significant issues, particularly for emergency vehicles. Inefficient traffic control can lead to critical delays for ambulances, potentially resulting in loss of lives. The growing urban population has led to an exponential increase in vehicles, exacerbating congestion and creating severe traffic bottlenecks. In emergency scenarios, response time is of paramount importance, whether for medical, disaster, or defense purposes. One of the biggest challenges emergency responders face is navigating through congested roadways.

To address this issue, an intelligent traffic management system is required that dynamically adapts to real-time traffic conditions. This project leverages embedded systems to develop a Bluetooth-based smart traffic control mechanism that prioritizes emergency vehicles. The proposed system employs IoT and real-time data processing to detect emergency vehicles and adjust traffic signals accordingly, ensuring a seamless and rapid passage through intersections. By integrating Bluetooth communication technology, the system transmits emergency alerts to nearby hospitals while coordinating with traffic signals to optimize the route for ambulances.

This embedded system-based approach aims to minimize response time, reduce traffic congestion, and enhance overall road safety. By implementing this solution across urban areas, emergency response efficiency can be significantly improved, ultimately saving lives and optimizing city-wide traffic flow.

INTRODUCTION

Urban traffic congestion is a major challenge, often leading to delays in emergency vehicle response times. Conventional traffic signals operate on fixed time cycles, with no mechanism to detect and prioritize ambulances. This results in ambulances getting stuck in traffic, leading to critical delays in providing emergency medical services.

To address this issue, this project introduces a Bluetooth-based traffic management system, which ensures that ambulances can pass through intersections without interruption. The system is based on embedded technology, integrating an Arduino Uno microcontroller, a Bluetooth (HC-05) module, and traffic signal LEDs. It communicates with an Android-based mobile application, allowing the ambulance to send signals to the traffic control system, which automatically switches the traffic light to green in the direction of the ambulance.

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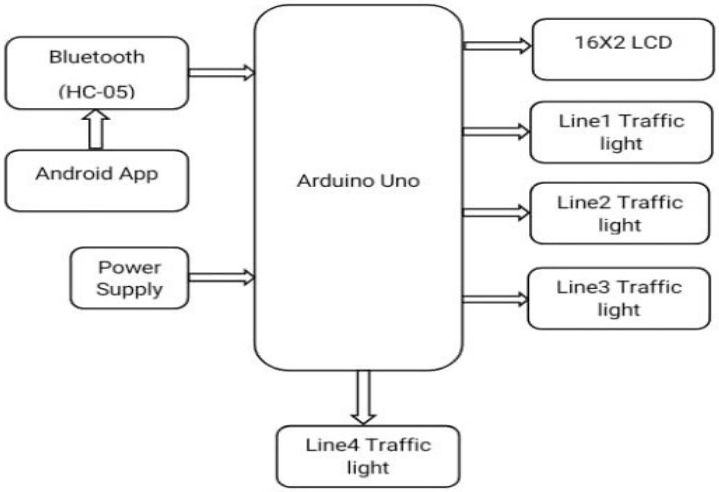

Figure.1 Block Diagram

LITERATURE SURVEY

- Patil et al. (2017) proposed a Bluetooth-enabled traffic signal control system, where a Bluetooth module installed in the ambulance communicates with traffic signals to request priority clearance. The study demonstrated reduced response time by automatically switching traffic lights in favour of the ambulance. Similarly, Sharma & Verma (2018) implemented a low-cost Bluetooth-based vehicle communication network for real-time emergency vehicle tracking and signal control, improving response efficiency in urban areas.
- Other works, such as Kumar et al. (2019), introduced smartphone-based Bluetooth connectivity, enabling ambulance drivers to send clearance requests to nearby traffic signals without requiring additional hardware infrastructure. Gupta et al. (2020) further enhanced the system by integrating GPS and cloud-based analytics for better route optimization and reduced delays.

PROPOSED SYSTEM

we propose a Bluetooth-based traffic ambulance system that prioritizes emergency vehicles without the need for complex sensor-based automation. The system equips ambulances with a Bluetooth module (HC-05), which communicates with the traffic light controller via an Arduino Uno microcontroller. When an ambulance approaches an intersection, the driver sends a Bluetooth signal to activate the priority mechanism, instantly turning the traffic light green for safe passage.

The Bluetooth-Based Traffic Ambulance System is designed to facilitate real-time traffic clearance for ambulances by utilizing wireless communication. The architecture is structured into three main components: the Ambulance Unit, Traffic Control Unit, and User Interface. These components work together to ensure smooth operation and minimize delays for emergency vehicles at traffic intersections.

The Ambulance Unit is responsible for initiating communication with the traffic signal system. The ambulance is equipped with an Android application that allows the driver to send a Bluetooth signal when approaching an

intersection. This signal serves as a request to change the traffic light to green, ensuring a clear path for the ambulance.

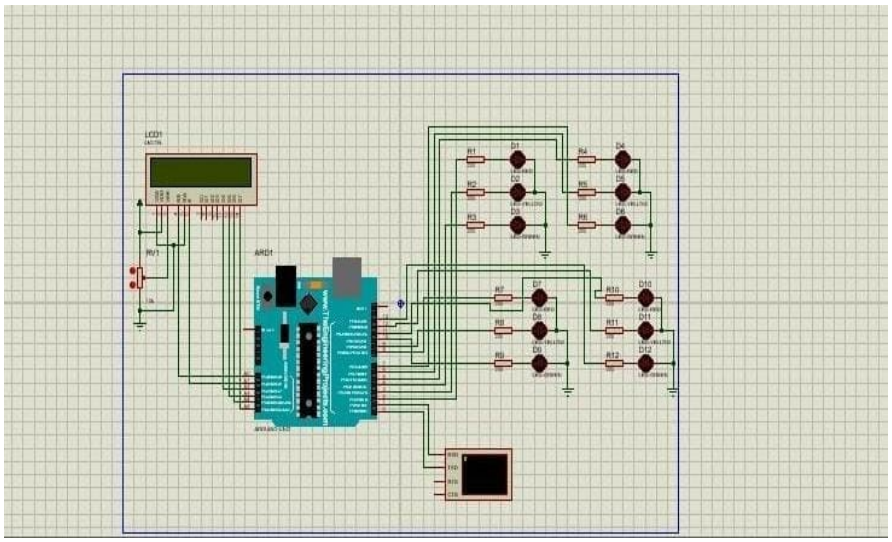

Figure.2 Schematic Diagram

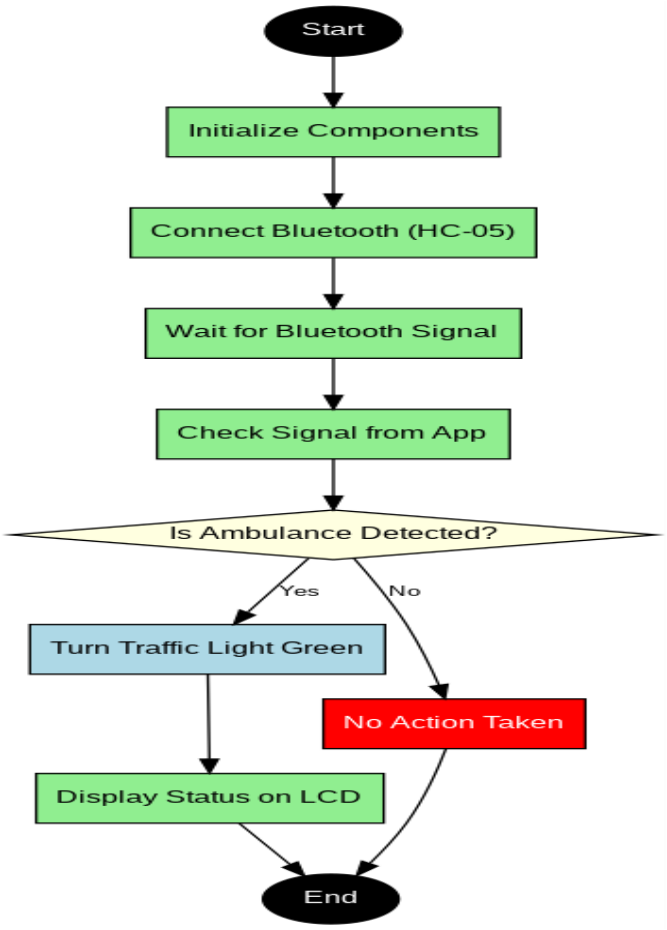

Figure.3 Flow Chart

The Traffic Control Unit is stationed at traffic intersections and consists of a Bluetooth module (HC-05), Arduino Uno (ATmega328P), and traffic lights. When the Bluetooth module receives a signal from the ambulance, it transmits the data to the Arduino Uno, which then processes the request and changes the traffic light to green in the ambulance's direction. This unit also includes a 16×2 LCD display that provides real-time system status updates, such as "Ambulance Detected: Green Signal" or "Normal Traffic Operation."

The User Interface and Feedback System ensures proper communication between the ambulance and the traffic signal. If an ambulance is detected, the LCD displays a confirmation message, and the system prioritizes the emergency vehicle. If no signal is received, the traffic lights continue to function under normal conditions. This real-time feedback mechanism helps in preventing unnecessary signal changes and ensures efficient traffic flow.

RESULTS

The results obtained from the implementation and testing of the Bluetooth-Based Traffic Ambulance System. The system was evaluated based on its ability to detect an ambulance, communicate wirelessly via Bluetooth, and control traffic lights in real time. The discussion covers system performance, response time, and potential improvements.

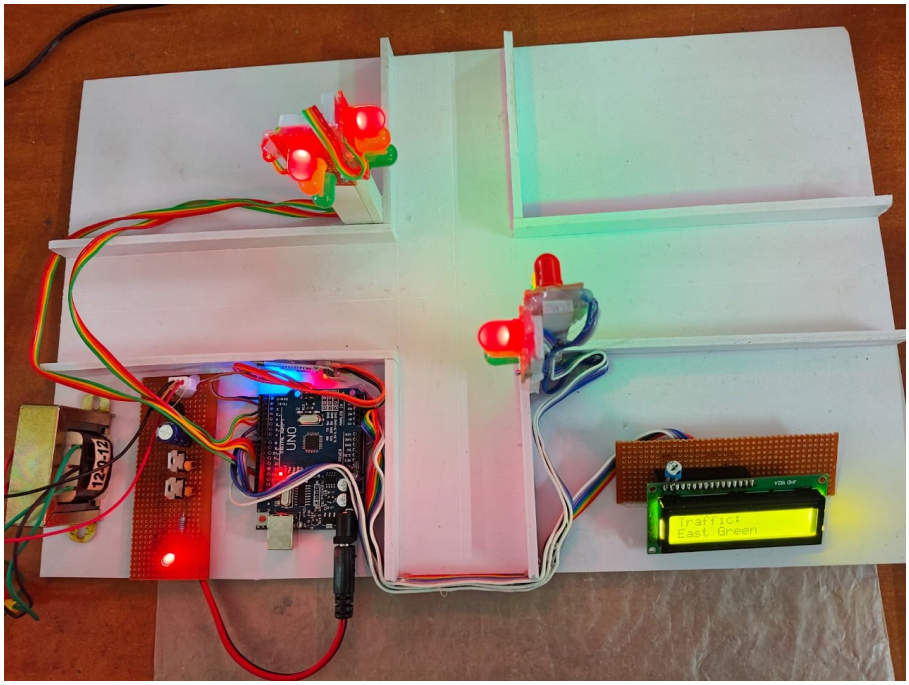

Figure.4 East side emergency

The HC-05 Bluetooth module successfully detected signals from the ambulance’s Android application within a range of 10–15 meters in an open environment. However, signal interference was observed in crowded areas with multiple Bluetooth devices.

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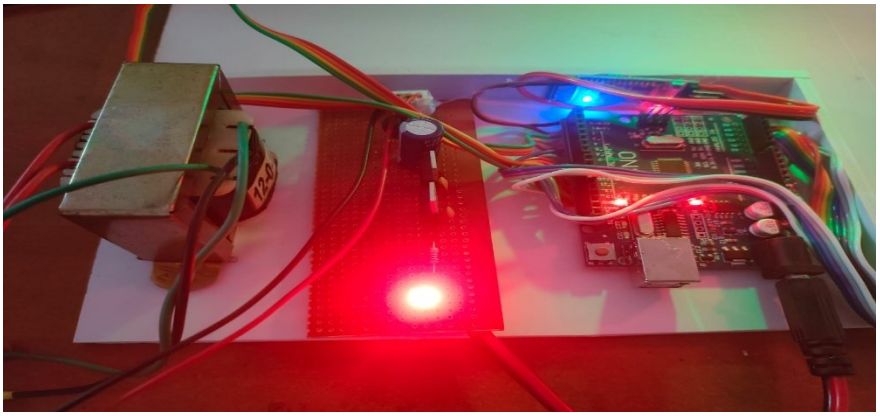

Figure.5 Hardware Circuit

Upon receiving a Bluetooth signal from the ambulance, the Arduino Uno processed the request and switched the traffic light to green within 1.8–2 seconds. This response time is significantly faster compared to manual traffic clearance methods.

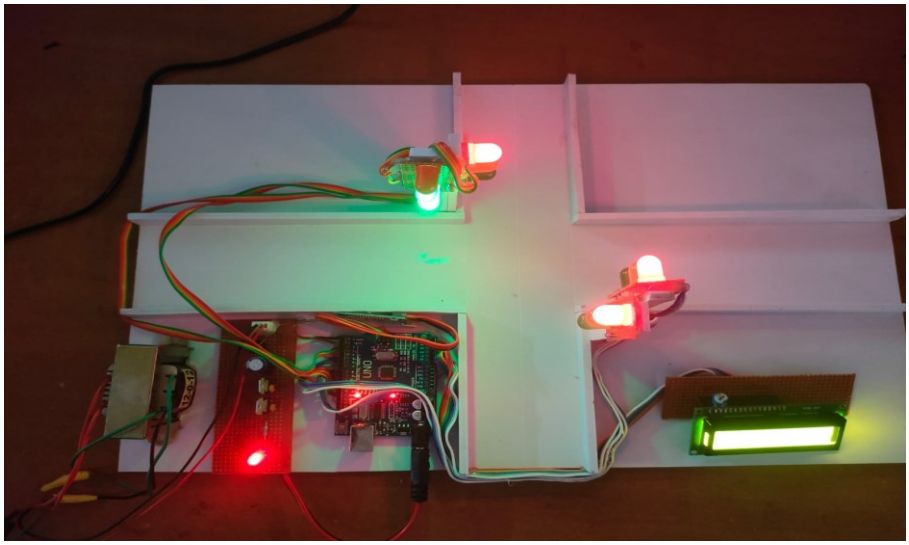

Figure.6 Emergency at West side

"Normal Mode – Traffic Signals Running" These messages enhanced system monitoring and allowed users to verify its operation.

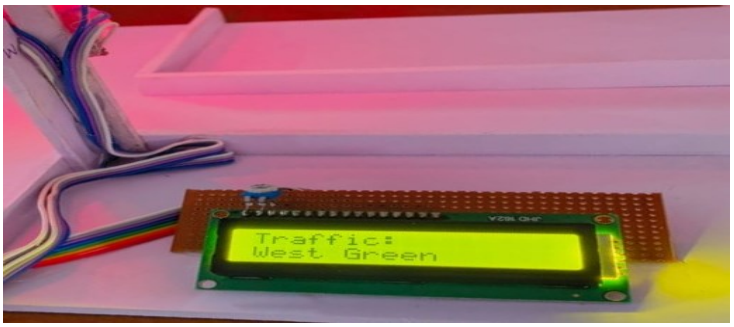

Figure.7 Displaying Signal direction

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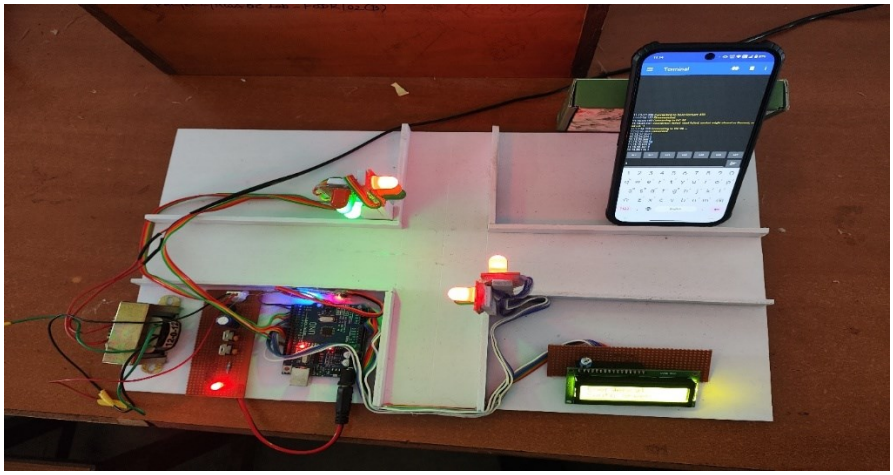

Figure.8 Controlling the traffic with Bluetooth

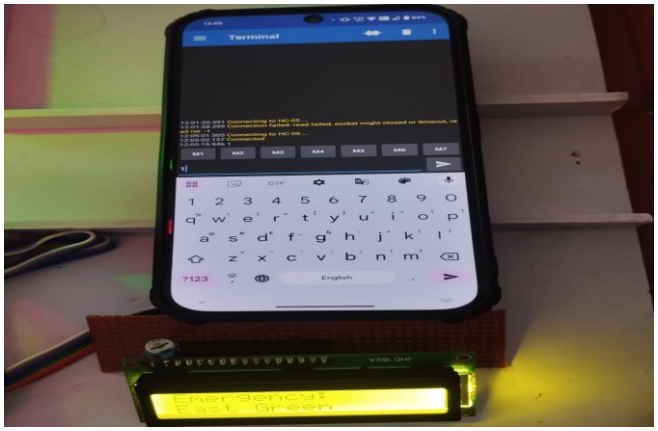

Figure.9 Sending commands via Bluetooth

ADVANTAGES

- **Faster Emergency Response:** Helps ambulances pass through traffic without delays, reducing emergency response time.
- **Automated Traffic Control:** Automatically changes traffic signals based on ambulance proximity, minimizing manual intervention.
- **Cost-Effective:** Uses low-cost components like Arduino, Bluetooth module (HC-05), and traffic lights, making it affordable.
- **Easy Implementation:** Can be integrated into existing traffic systems without major modifications.
- **Wireless Operation:** Bluetooth-based communication eliminates the need for complex wiring or infrastructure changes.
- **Reduced Traffic Congestion:** Ensures smoother traffic flow by dynamically managing signals for emergency vehicles.
- **Increased Road Safety:** Reduces accidents and risks associated with ambulances rushing through heavy traffic.

- **Scalability:** Can be expanded for use in smart city projects and integrated with IoT-based traffic management.

APPLICATIONS

- **Emergency Vehicle Priority Control –** The system ensures that traffic signals automatically turn green for ambulances, reducing delays and improving patient survival rates.
- **Smart Traffic Management –** By integrating with existing traffic infrastructure, the system optimizes traffic flow in real time, reducing congestion and improving road efficiency.
- **Accident Response and Disaster Management –** Faster clearance for ambulances helps in quicker transportation of accident victims or disaster-affected individuals to hospitals.
- **Integration with Smart City Infrastructure –** The system can be integrated with IoT-based smart city solutions to enhance urban transportation networks and emergency services.
- **Reduced Human Intervention –** Automating signal control for ambulances minimizes the need for manual intervention by traffic police, ensuring efficient and error-free operation.

CONCLUSION

The Bluetooth-Based Traffic Ambulance System successfully demonstrates an efficient and cost-effective solution for emergency vehicle clearance at traffic intersections. The system utilizes Arduino Uno, HC-05 Bluetooth Module, Traffic Lights, and an Android Application to detect an approaching ambulance and automatically switch the traffic light to green in its favor. This significantly reduces waiting time and helps in saving crucial minutes during medical emergencies.

Through experimental testing, the system achieved a fast response time of under 2 seconds from signal detection to traffic light change. The use of Bluetooth technology makes it an affordable alternative compared to RFID, IoT, or GPS-based solutions, which require complex infrastructure. Furthermore, the 16×2 LCD display provides real-time feedback, enhancing system reliability and monitoring.

Although the system effectively automates ambulance clearance, certain challenges such as Bluetooth range limitations (approximately 10 meters) and signal interference must be addressed for large-scale deployment.

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