

Smart Ambulance with Intelligence Traffic Control Using RFID and IOT

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Abstract- This paper presents the design and performance analysis of a Smart ambulance with intelligence traffic control using RFID and IOT. Traffic congestion in urban areas poses a significant challenge, especially for emergency vehicles like ambulances, where delays can be life-threatening. Conventional traffic management systems operate on fixed timing mechanisms and lack adaptability for emergency situations, often causing ambulances to get stuck in heavy traffic. To address this critical issue, this project introduces a Smart Ambulance System with Intelligent Traffic Control, leveraging RFID, IoT and ESP32 to ensure seamless and priority-based traffic management. The proposed system integrates RFID technology, where each ambulance is equipped with an RFID tag, and RFID readers are strategically installed at traffic intersections. When an ambulance approaches a junction, the RFID reader detects the unique tag and sends a signal to the ESP32 microcontroller, which automatically controls the traffic signals to turn green for the ambulance's path while keeping the other signals red to prevent congestion. This mechanism ensures the ambulance can move without unnecessary stops, significantly reducing response time in emergencies. Additionally, an I2C LCD display is placed at intersections to inform other drivers about ambulance priority, improving coordination among vehicles.

Index Terms- RFID, IOT, EMERGENCY, ESP32, RFID TAG, RFID READER, I2C LCD AND PRIORITY

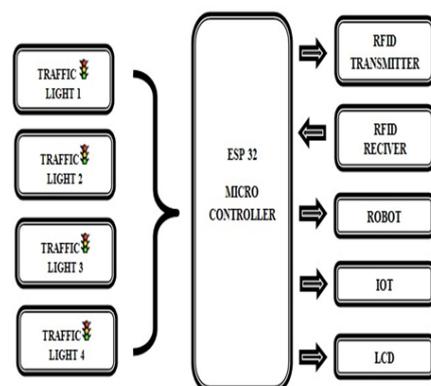
I. INTRODUCTION

Urban roads of the modern city, traffic congestion is a massive issue, which has the tendency to cause serious delay to emergency services like ambulances. Slow movement through clogged roads has the potential to make conditions life-threatening for patients in need of immediate treatment. Conventional traffic flow employs fixed time-based signals, which remain unchanged dynamically under emergency situations and make it tough for ambulances to reach hospitals within due time. In

order to overcome this problem, a Smart Ambulance System with Intelligence Traffic Control based on RFID, IoT, and ESP32 is proposed to provide priority-based traffic control for ambulances. The system employs Radio Frequency Identification (RFID) technology in which RFID tags are provided in every ambulance and RFID readers at traffic intersection points.

When an ambulance is coming to an intersection, the RFID reader reads the vehicle and sends a message to the ESP32 microcontroller, which automatically makes the traffic lights green for the ambulance path. Meanwhile, signals for other paths are kept red to avoid congestion and facilitate free movement of the emergency vehicle. In addition to this, an I2C LCD screen at intersections depicts real-time traffic conditions, thereby optimizing maximum coordination of vehicles. This goes towards minimizing confusion for other vehicles as well. This four-way intelligent traffic light system greatly enhances emergency response times via dynamic traffic flow control from real-time detection of ambulances. The solution is cost-effective, scalable, and compatible with future intelligent city infrastructures. The system makes cities achieve quick ambulance travel, optimized traffic control, and improved emergency response efficiency, finally resulting in life saving and overall congestion reduction.

BLOCK DIAGRAM:



II. DESIGN PROCEDURE

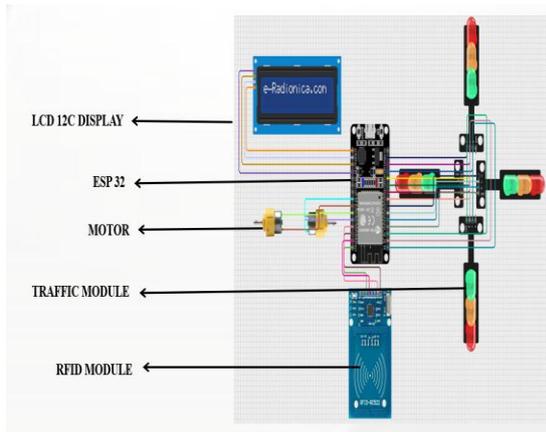


Fig 1: Schematic Diagram

The methodology for designing the smart ambulance using intelligence traffic control using RFID and IOT we use ESP32 as a microcontroller. The ESP32 is an ultra-low-power, high-featured microcontroller with built-in Wi-Fi and Bluetooth from Express if Systems. It features a dual-core processor based on the Ten silica Xtensa LX6, which has a clock speed of up to 240 MHz, and is ideal for most applications requiring high processing power, connectivity, and energy efficiency. The ESP32 has a number of digital and analog input/output (I/O) pins, which can be employed to interface with different sensors, actuators, and other electronics. The board is typically programmed using the Arduino IDE, offering ease of development and access to a vast library collection and community support. Digital Read (pin Number): Reads the state of a digital pin configured as input, returning `HIGH` or `LOW`.

- digital Write (pin Number, value): Sets the state of a digital pin configured as output to `HIGH` or `LOW`.
- analogRead (pin Number): Reads an analog value from a pin, returning a value between 0 and 4095 for the ESP32, corresponding to a voltage between 0V and 3.3V.
- analogWrite (pin Number, value): On the ESP32, this function is used to set a PWM signal on a digital pin, with a value between 0 and 255, where 0 represents 0% duty cycle and 255 represents 100% duty cycle

Radio Frequency Identification System is a technology-driven identification system which assists in identifying objects merely with the tags fixed on them, without any light of sight existing between the tags and the tag reader. The only

requirement is radio communication between the reader and the tag.

In this design we are having 4-traffic light modules, RFID transmitter, RFID receiver, IOT, LCD display. All the 4-traffic light modules, a RFID receiver module and an LCD display are connected to the ESP32 module. When an RFID transmitter is in the range of RFID receiver then the signal is transmitted to the receiver. When an ambulance is coming to an intersection, the RFID receiver/reader reads the vehicle and sends a message to the ESP32 microcontroller, which automatically makes the traffic lights green for the ambulance path. Meanwhile, signals for other paths are kept red to avoid congestion and facilitate free movement of the emergency vehicle. In addition to this, an I2C LCD screen at intersections depicts real-time traffic conditions.

III. IMPLEMENTED DESIGN

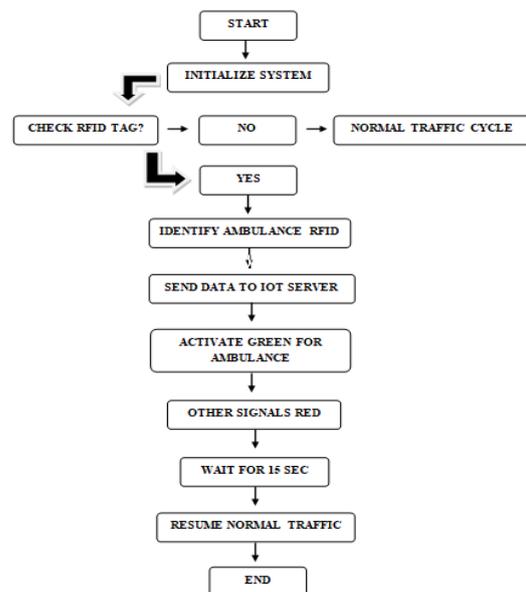


Fig 2: Flow Chart

The design works as when the design is initialized then it checks the RFID tag, here we have two different conditions. The 1st condition is when the RFID reader didn't receives the signal i.e NO, then the traffic cycle will be normal condition. The 2nd condition is when the RFID reader receives the signal i.e YES, then the it identifies the ambulance RFID then it sends the data to the IOT server then it activates the green signal for the ambulance and simultaneously the other signals turns RED. The traffic waits for 15 seconds (depends on the give input timings) after completion of the give timings it resumes to the normal traffic flow.

IV.RESULTS and DISCUSSIONS

Before scanning any RFID tag the traffic flow is normal as shown in fig 3.

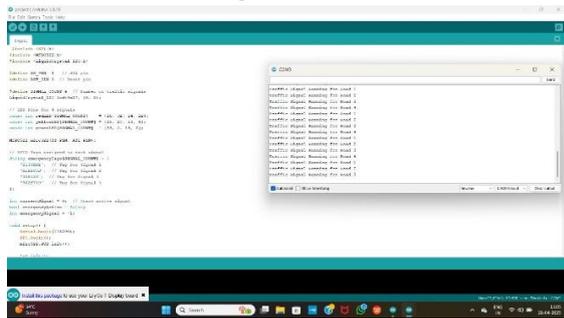


Fig 3: Normal traffic flow

After scanning the RFID tag as shown in fig 4. It will identify the ambulance.

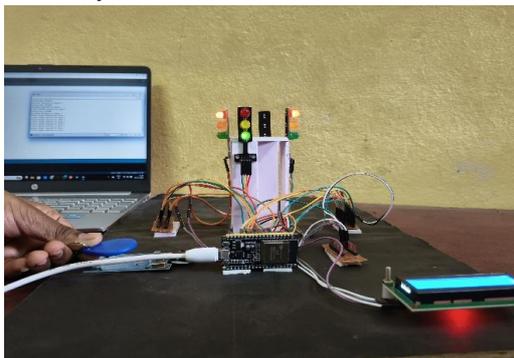


Fig 4: Scanning RFID tag

When the ambulance is detected at road number 1, then it identifies and sends the signal as Emergency detect at road number 1 and turns the signal to green in road number 1 and turns the signal to red in road number 2,3,4(remaining all)

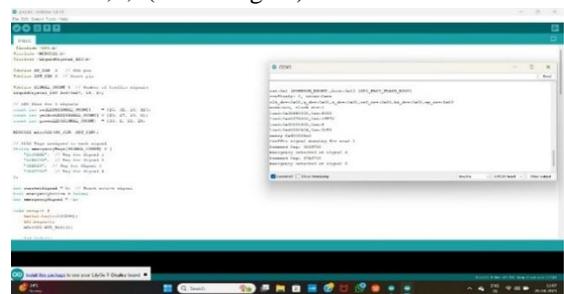


Fig 5: Identification of the ambulance

V. FUTURE SCOPE

The system can be integrated with city-wide smart traffic management systems to enable smooth priority control over multiple intersections. Predictive algorithms can be used to predict ambulance routes and automatically adjust traffic signals based on existing road conditions. Increasing

RFID and IoT systems by employing V2I and V2V technologies will enable ambulances, traffic lights, and nearby cars to directly talk to one another for better coordination. Increasing RFID and IoT systems by employing V2I and V2V technologies will enable ambulances, traffic lights, and nearby cars to directly talk to one another for better coordination.

VI. ADVANTAGES

Utilizes RFID technology in automatically recognizing incoming ambulances and giving priority to their movement.

ESP32 microcontroller dynamically changes traffic lights, providing a seamless and unbroken route for ambulances.

Avoids unnecessary delays, enabling ambulances to travel faster to hospitals and save lives.

Utilizes the MQTT protocol for real-time monitoring and remote control of traffic signals through a cloud-based system.

RFID and IoT-based implementation is less expensive in terms of infrastructure compared to GPS-based systems.

Utilizes low-power devices such as ESP32 and RFID readers, providing a cost-effective and low-maintenance solution.

I2C LCD screens at intersections notify other drivers of ambulance priority, decreasing confusion and enhancing road discipline.

VII. CONCLUSION

Intelligent Traffic Control system-based Smart Ambulance provides an automated, efficient and low-cost solution to alleviate ambulances' delay in city traffic. In contrast to traditional fixed signal timing-based or manually controlled traffic management systems, this proposed system utilizes RFID technology for real-time ambulance detection and ESP32-based automation for dynamic traffic signal adjustment. Apart from that, deployment of IoT through MQTT allows for monitoring and management of traffic flow remotely and ensure effective coordination between traffic agencies and emergency services. Priority to ambulances and traffic light optimization reduce emergency response time to a great extent, avert traffic congestion, and improve overall road safety. Its flexibility and compatibility with smart city infrastructure further establish it as an apt future-ready solution for urban

planning. The cost-effectiveness, energy efficiency, and simplicity of deployment of this RFID and IoT-based system make it a more favorable option compared to GPS or AI-based traffic management systems, which are generally connected with costly infrastructure and complicated processing.

Overall, the proposed RFID and IoT-based smart ambulance system not only enables smoother emergency vehicle movement but also improves traffic efficiency and saves lives. With additional improvement, the system can be expanded to encompass AI-based traffic analytics, 5G networking, and smart city models, leading to a yet smarter and more responsive urban traffic management system

VIII. ACKNOWLEDGMENT

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REFERENCES

- [1] G. Dave, J. Gross (2001) Emergency vehicle traffic signal pre-emption and collision avoidance system, U.S. Patent No. 6,326,903. 4 Dec. 2001.
- [2] R. Burke (2007) Resource, cost and Gantt chart, Project management techniques, College ed. Burke Publishing.
- [3] R. Burke (2009) "Financial management", Project management techniques, college edition. Burke Publishing, 2009.
- [4] K. Athavan, G. Balasubramanian, S. Jagadeeswaran, N. Dinesh (2012) Automatic Ambulance Rescue System, Proceedings of the 2012 Second International (Conference on Advanced Computing & Communication Technologies, pp.190-195.
- [5] T. Miyazaki, Y. Miyazono, M. Shirakawa (2013) Ambulance siren detector using FFT on depict, Proceedings of 1st IEEE/IIAE International Conference on Intelligent Systems and Image Processing 2013.
- [6] T. Roopa, A. N. Iyer and S. Rangaswamy, "Cro TIS Crowdsourcing Based traffic Information System," 2013 IEEE International Congress
- [7] K-H Chao, P-Y Chen (2014) "An Intelligent Traffic Flow Control System Based on Radio Frequency Identification and Wireless Sensor Networks", International Journal of Distributed Sensor Networks, 10(5), pp 1-10.
- [8] K. Sangeetha, P. Archana, M. Ramya, P. Ramya, (2014) Automatic Ambulance Rescue with Intelligent Traffic Light System, IOSR Journal of Eng., 4(2), pp. 53-57
- [9] A. Balamurugan, G. Navin Siva Kumar, S. Raj Thilak, P. Sivakumar (2015) Automated emergency system in ambulance to control traffic signals, International Journal of Engineering And Computer Science, 4(4) pp. 11533- 11539.
- [10] Banzi and M. Shiloh (2015) Getting Started with Arduino: The Open Source Electronics Prototyping Platform, Maker Media, Inc. (3rd edition).
- [11] Yang, Bo, Ranching Zheng, Keisuke Shimon, Tsutomu Kazakova'd Kimiko Nakano. "Evaluation of the effects of in-vehicle traffic lights on driving performances for unsignalized intersections." IET Intelligent Transport Systems 11, no. 2 (2017).
- [12] Reddy, K., & Singh, A. (2019). A Comparative Study of GPS and RFID for Real-Time Ambulance Tracking and Traffic Signal Control. *International Conference on Smart Cities and IoT (ICSCI)*, 12(4), 120-128.
- [13] Kumar, A., & Sharma, R. (2020). RFID-Based Traffic Management System for Emergency Vehicles. *International Journal of Embedded Systems and Applications S*
- [14] Gupta, S., & Verma, P. (2021). IoT-Based Smart Traffic Control System Using MQTT Protocol. *IEEE Internet of Things Journal*, 9(3), 2156-2164.
- [15] Chen, L., & Zhang, W. (2021). AI-Enabled Traffic Flow Optimization for Emergency Vehicle Navigation. *IEEE Transactions on Intelligent Transportation Systems*, 22(5), 3251-3262.
- [16] Patel, D., & Mehta, S. (2022). Automated Traffic Light Control System Using ESP32 and Cloud-Based IoT. *Journal of Intelligent Transportation Systems*, 15(1), 67-75.
- [17] World Health Organization (WHO). (2023). Impact of Traffic Congestion on Emergency Medical Response Times. *Global Road Safety Report*, Retrieved from www.who.int.
- [18] Government of India Smart City Initiative. (2023). Implementation of IoT-Based Traffic Solutions in Urban Areas. *National Smart City Development Report*, Retrieved from www.smartcities.gov.in.