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Smart Intelligent Traffic Control System for Emergency Vehicles

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***Abstract*—The growth of industrialization and urbanization has stimulated a surge in population and vehicles, causing severe traffic congestion and impeding the timely movement of emergency vehicles, including loss of lives and heightened strain on healthcare facilities. In response, this study introduces a smart intelligent traffic control system for emergency vehicles. The proposed system integrates sound sensor technology with traffic signals to activate green lights for ambulances traversing congested areas. In the absence of ambulance detection, priority is accorded to high-density roads, effectively mitigating congestion. A blue indicator light signifies the presence of an ambulance at each intersection, enhancing public awareness. The project's objectives encompass optimizing traffic flow, refining emergency response times, and augmenting road safety in urban locales. By prioritizing ambulance passage and bolstering public awareness, the system reduces delays and diminishes the likelihood of adverse health outcomes.**

Keywords— Arduino Mega 2560, Sound sensor, LCD Display, Traffic management.

I. INTRODUCTION

The exponential growth of industrialization and urbanization has triggered a proportional surge in population density and vehicular traffic. This surge has catalyzed a crisis of traffic congestion and jams, posing formidable challenges for emergency services, particularly ambulances racing against time to reach critical patients. The effects of delayed emergency response are high, ranging from exacerbating the condition of patients to even loss of lives. Moreover, such delays burden hospitals and strain financial resources due to increased operational costs. In response to this pressing issue, a pioneering initiative has been undertaken: the development of a "Smart Intelligent Traffic Control System" tailored explicitly for emergency vehicles. This innovative project presents a holistic solution aimed at enhancing emergency vehicle prioritization and fostering public awareness within urban traffic landscapes. By harnessing the power of cutting-edge sound sensor technology integrated with traffic signal control systems, the project enables the automatic activation of green lights, expediting the passage of ambulances through congested thorough fares. In instances where ambulance detection is absent, the system intelligently allocates priority to high-density roads, effectively mitigating traffic congestion. To further bolster public awareness of ambulance movement, a distinctive blue indicator light illuminates at each signal where an ambulance is detected, signaling its active passage through the area. Through this synergistic approach, the project endeavors to optimize traffic flow, ameliorate emergency response times, and enhance overall road safety in urban environments. By seamlessly blending technological innovation with strategic traffic management, this initiative aspires to revolutionize urban mobility and alleviate the strain on emergency services, ultimately safeguarding the well-being of communities.

The increasing industrialization and urbanization have triggered a surge in vehicular traffic, exacerbating traffic congestion and jeopardizing the timely arrival of emergency vehicles, leading to fatalities. Delays in emergency response intensify health risks and burden

hospitals financially. To counter these challenges, a "Smart Intelligent Traffic Control System" tailored for emergency vehicles has been developed. This project aims to enhance emergency vehicle prioritization and public awareness in urban traffic settings by integrating sound sensor technology with traffic signal control systems. Through automatic activation of green lights for ambulances and intelligent allocation of priority routes, it seeks to optimize traffic flow, improve emergency response times, and enhance overall road safety.

II. LITERATURE REVIEW

[1] aims to alleviate traffic congestion and prevent accidents by segregating heavy and light vehicles into different lanes. By doing so, it can address critical issues
related to traffic congestion and fatal accidents, making roads safer for travel. This proposed system has the potential to significantly improve road safety and enhance overall transportation efficiency. [2] focused on evaluating MAC protocols for data dissemination in SMART ambulance systems, highlighting CSMA as the most effective. CSMA outperformed TDMA, SMAC, and 802.15.4 MAC protocols in key metrics like PDR, PLR, End-to-End delay, and

throughput. This indicates CSMA's superiority in managing network traffic and ensuring reliable data transmission. CSMA outperformed its counterparts by 30-60% in PDR, 40-60% in average PLR, 15-35% in average throughput, and 20-50% in average end-to-end delay. The collision avoidance mechanism of CSMA was cited as a major factor contributing to its superior performance, addressing concerns of network congestion and improving overall efficiency. In [3], hardware collects health data, which is then transmitted via serial communication to a PC in the ambulance. From there, the data is sent to the hospital. RF communication is utilized to control traffic, integrating health monitoring and traffic control systems. Health parameters are acquired in the monitoring system and relayed to the hospital server through the PC. Meanwhile, the ambulance driver can manage traffic using a keypad interface. Both systems operate concurrently, with the hospital monitoring patient health and the ambulance driver handling traffic. To enhance real-time functionality, we propose integrating a GPS navigation system with a congestion detection module. This combined approach aims to optimize emergency response and improve patient outcomes. [4] Traffic jams are a big problem in crowded cities like Chennai, especially for ambulances. The paper proposes "Intelligent Automatic Traffic Control for Ambulances," an Android app linking ambulances and traffic signals via the cloud. RFID technology enables traffic light control: when an ambulance halts at a red light, the signal's RFID detects it, signalling the cloud to turn the light green for the ambulance. Once the ambulance passes, the light returns to its normal function. This solution streamlines ambulance travel during emergencies, improving efficiency and potentially saving lives. This system saves time during emergencies and helps save lives. It's important to prioritize safety, including ambulance services. This system is accurate and also improves traffic light violation detection. It's cost-effective and uses trending IoT technology. It can reduce accidents at intersections where ambulances need to pass. This life-saving project should be implemented to help the public.

III. PROPOSED SYSTEM

The proposed system offers a complete solution to improve how emergency vehicles are prioritized and how the public is informed in urban traffic settings. By integrating sound sensor technology with traffic signal control systems, the project facilitates the automatic activation of green lights to expedite the passage of ambulances through congested areas. In the absence of ambulance detection, the system intelligently allocates priority to high-density roads, mitigating traffic congestion. Furthermore, to ensure continuous public awareness of ambulance movement, a blue indicator light illuminates at each signal where an ambulance is detected, signaling its active passage through the area. Through this integrated approach, the project aims to optimize traffic flow,improve emergency response times, and enhance overall road safety in urban settings.The proposed system combines sound sensor technology and traffic signal control systems to revolutionize emergency vehicle prioritization and public awareness in urban traffic scenarios. Utilizing sound sensors, the system detects approaching ambulances and promptly triggers green lights along their route, expediting their passage through congested areas. In instances where no ambulance is detected, the system intelligently prioritizes high-density roads

to alleviate traffic congestion efficiently. To ensure continuous public awareness, blue indicator lights illuminate at each signal where an ambulance is detected, signaling its active passage. This integrated approach not only optimizes traffic flow but also enhances emergency response times and overall road safety in urban settings. By seamlessly integrating technology with traffic management and emergency services, the system offers a comprehensive solution to urban traffic challenges, benefiting both emergency responders and the community at large. The proposed system represents a groundbreaking advancement in addressing the complex challenges of urban traffic management, particularly concerning emergency vehicle prioritization and public safety awareness. At its core, the system leverages sophisticated sound sensor technology seamlessly integrated with existing traffic signal control systems. This integration enables

the automatic activation of green lights along the route of approaching ambulances, significantly expediting their passage through congested areas. By utilizing sound sensors, the system can accurately detect the presence of an ambulance from a distance, ensuring timely and precise activation of green lights to create a clear path for emergency vehicles. This real-time response mechanism not only enhances emergency response times but also minimizes delays caused by traffic congestion, potentially saving crucial minutes in life-threatening situations. Moreover, the system demonstrates adaptability and intelligence in its operation. In instances where an ambulance is not detected, it intelligently allocates priority to high-density roads, where traffic congestion is likely to have a more significant impact. This dynamic prioritization strategy ensures efficient traffic flow management across the urban landscape, mitigating gridlock and optimizing overall road network performance. One of the system's key features is its emphasis on continuous public awareness of ambulance movement. Through the activation of blue indicator lights at each signal where an ambulance is detected, the system ensures that motorists and pedestrians are informed of an emergency vehicle's active passage through the area. This proactive approach enhances safety by alerting road users to yield the right of way and make way for emergency vehicles, thereby reducing the risk of accidents or delays.

The proposed system represents a transformative solution that revolutionizes emergency vehicle prioritization and public safety awareness in urban traffic scenarios. Through its innovative integration of sound sensor technology, dynamic traffic signal control, and proactive public communication mechanisms, the system offers a holistic approach to optimizing traffic flow, improving emergency response times, and enhancing road safety, ultimately contributing to more efficient and resilient urban transportation systems.

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FLOW CHART

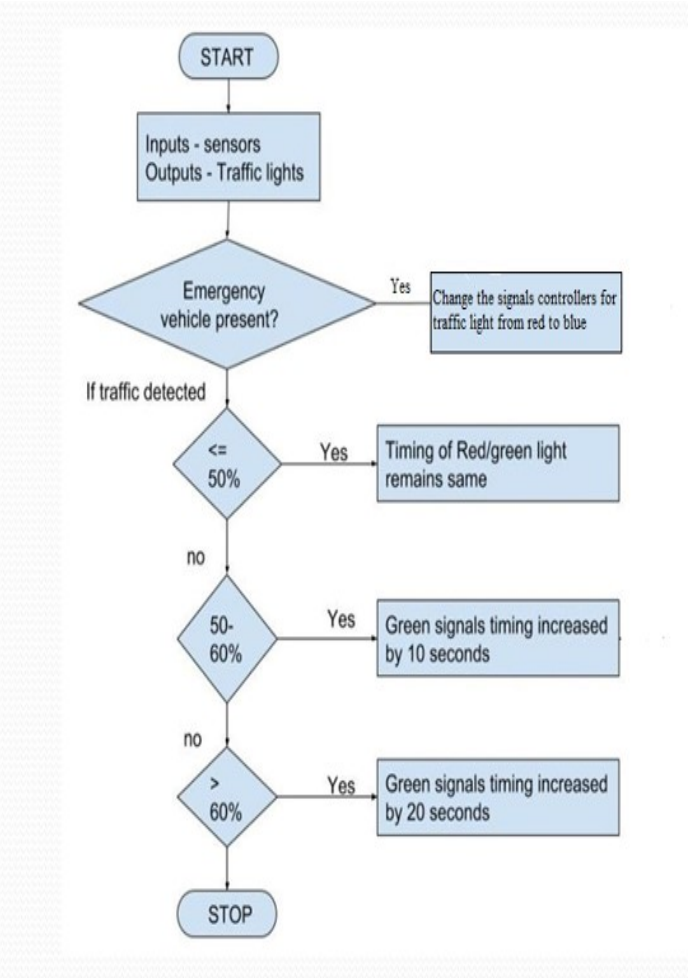

Fig 1: Flowchart

HARDWARE COMPONENTS USED

1. IR Sensor Interfacing with Arduino
2. Sound Sensor Interfacing with Arduino
3. Temperature Sensor Interfacing with Arduino
4. LCD Interfacing with Arduino

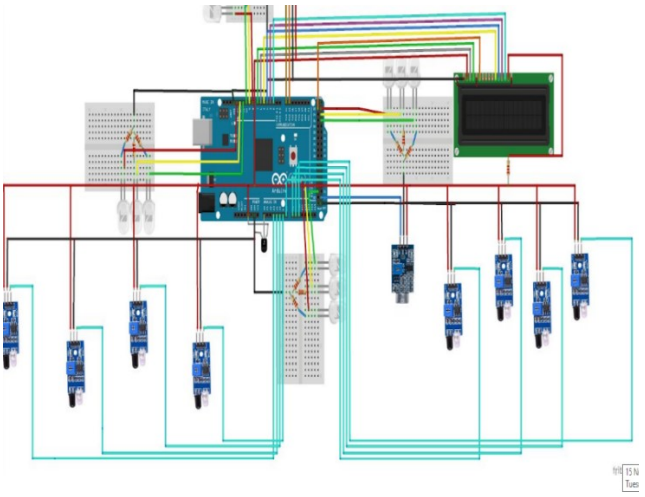

Fig 2: Circuit Diagram

IV. RESULTS & DISCUSSION

The Arduino Mega 2560 is utilized for traffic control system management. It collects data from a range of sensors integrated into the system. Based on this data, the system dynamically adjusts traffic signals to optimize traffic flow, ensuring efficient management of urban traffic environments. The utilization of the Arduino Mega 2560 in a traffic control system marks a significant advancement in urban traffic management. By integrating various sensors and data collection mechanisms, the system can gather real-time information about traffic conditions at intersections. This data is then analyzed by the Arduino Mega 2560, which makes split-second decisions to dynamically adjust traffic signals. For instance, during periods of heavy traffic, the system prioritizes green lights for congested directions, while it shortens green times where traffic is lighter, optimizing traffic flow, while ambulance sound detected that road prioritizes green lights remaining all sides indicate the blue light. Through this dynamic control mechanism, congestion is alleviated, and traffic efficiency is improved, ultimately enhancing the overall urban transportation experience. We found that using the Arduino Mega 2560 in the traffic control system is a big deal for city traffic management. It helps to collect data from sensors and adjust traffic lights in real-time. For example, when there's a lot of traffic, it makes green lights last longer in busy directions. If an ambulance is detected, it gives priority to that road and shows blue lights on other sides. This helps ease congestion and makes traffic flow better overall. The proposed system is a big step forward in making city transportation smoother and safer. In addition to using the Arduino Mega 2560, the proposed system gathers info from sensors to adjust traffic lights instantly. When there's heavy traffic, it keeps green lights on longer where it's busy. If an ambulance is heard, it switches green lights to its route and shows blue lights elsewhere. This helps to clear traffic and makes roads safer. The proposed system is a big improvement for city traffic, making it smoother and easier to get around, especially during emergencies.

Additionally, the proposed system's real-time data that enables instant traffic signal adjustments, extending green lights during congestion and prioritizing ambulance routes. This proactive approach enhances road safety and eases traffic, making urban travel smoother, especially in emergencies.

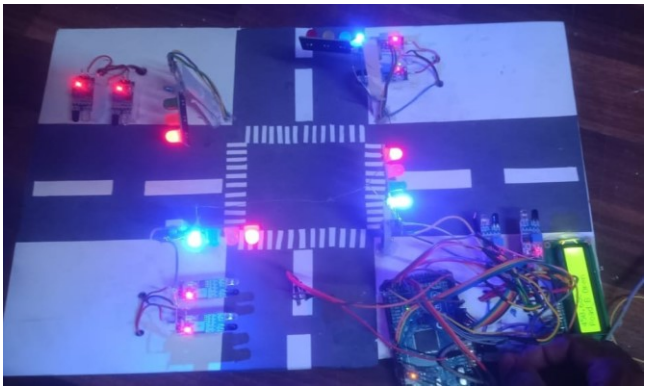

Fig 3: Ambulance Detection

V.CONCLUSION

A Smart Intelligent Traffic Control System for Emergency Vehicles integrates IOT technology, employing blue lights to signal ambulance presence. It incorporates temperature and IR sensors to detect obstacles in the vehicle's path. LCD display communicates with open roads and current temperatures, aiding emergency vehicle navigation. This system prioritizes emergency vehicles, optimizing traffic flow for faster response times. Through IoT connectivity, it dynamically adjusts traffic signals to create clear paths for ambulances. The smart intelligent traffic control system for emergency vehicles is a solution that uses advanced technology to help ambulances get to emergencies faster. By using special blue lights and sensors to detect obstacles, it helps ambulances navigate safely through traffic. It also has a LCD screen that shows which roads are clear and the current temperature to help ambulance drivers find the best route. The system can even change traffic lights in real-time to make sure ambulances can get through quickly. The smart intelligent traffic control system for emergency vehicles represents a significant advancement in urban emergency response. By leveraging IoT technology, including blue lights and obstacle-detecting sensors, it revolutionizes ambulance navigation through city traffic. The addition of an LCD display further enhances communication with emergency vehicle operators, providing vital information for route optimization.

Moreover, its dynamic adjustment of traffic signals ensures efficient passage for ambulances, ultimately saving critical time in emergency situations. This innovative solution not only prioritizes emergency vehicles but also enhances overall road safety and urban transportation efficiency. As cities continue to evolve, implementing such intelligent systems will be essential for improving emergency response times and saving lives.

REFERENCES

[1] Omkar Udawant, Nikhil Thombare, Devanand Chauhan, Akash Hadke , Dattatray Waghole JSCOE "Smart Ambulance System using IoT", DOP 2017.

[2] Prof. Deepali Ahir, Saurabh Bharade, Pradnya Botre, Sayali Nagane, Mihir Shah, "Intelligent Traffic Control System for Smart Ambulance" , Volume 5 , Issue 6 , DOP June 2018.

[3] G. Tejaswini, S. Kalyani, T. Sreeja, N. Reshma, B Amrutha, "Smart Traffic Management System", Volume 8, Issue 5, DOP May 2020.

[4] Salem Jeyaseelan W. R, Rajkumar Krishnan, Arunkumar M, Parameswari ALAGARSAMY "Efficient Intelligent Smart Ambulance Transportation System using Internet of Things", DOP 2024.

[5] B. Janani, Saradha, G. Vijayshri, T. Subha, "Intelligent Traffic Signal Control System For Ambulance Using RFID And CLOUD", DOP 2022.

[6] "Summary of Sales & Production Data MAA Newsletter August 2017," Malaysia Automative Association 2017 saw Kuala Lumpur.

[7] "Automatic Ambulance Rescue System," K. Athavan et al. 2012, Second International Conference on Advanced Technologies for Computing and Communication.

[8] The International Journal of Innovation in Engineering and Technology (IJIET) published a paper by S. Sharma and colleagues titled "Traffic Light Priority Control for Emergency Vehicle Using RFID" in its vol/issue 2(2) of 2013.

[9] The article "Smart Traffic Light Control System for Emergency and Detection of Stolen Vehicles" was published in the International Journal of Advanced Research in Science, Engineering, and Technology in 2014. It was written by T. N. Raju and his colleagues.

[10] A. S. Chitta and Dinesha P., "Emergency Vehicle Priority Management Using IOT approach" In 2016, the International Journal of Advanced Research in Computer and Communication Engineering published an article titled "IOT Approach."

[11] "Priority Based Traffic Lights Controller Using Wireless Sensor Networks," Shruthi K. R. and Vinodha K., International Journal of Electronics Signals and Systems (IJESS), vol/issue: 1(4), 2012.

[12] Adaptive Traffic Signal Flow Control using Wireless Sensor Networks, P. T. V. Bhuvaneswari et al., 2012, pp. 85-89.

[13] Kirithiga, Reeta, R., Kumar, Kavitha, V., and M, Jaishree, (2020), IoT-Based Traffic Signal Control for Ambulance, International Journal of Engineering and Advanced Technology, Vol. 9, pp. 3250–3254, India. https://doi.org/10.35940/ijeat.C6331.029320

[14] Dr. T. Senthil Kumar, (2020), Journal of Innovative Image Processing, Vol. 02/No. 03/ pp. 128–134, India https://doi.org/10.36548/jiip.2020.3.002

[15] V. Srinivasan, Y. Priyadharshini Rajesh, S. Yuvaraj, and M. Manigandan, "Smart traffic control with ambulance detection," IOP Conf. Ser. Mater. Sci. Eng., vol. 402, no. 1, 2018.

[16]"Automatic Ambulance Rescue System," K. Athavan et al. 2012, Second International Conference on Advanced Technologies for Computing and Communication.

[17]Traffic Signal Flow Control using Wireless Sensor Networks, P. T. V. Bhuvaneswari et al., 2012.