# AI-Enabled Traffic Monitoring and Accident Reduction System Using IoT

**Mrs G Sasikala[1]|Pasupuleti Chetan Rosaiah Naidu[2]|Maddam Leela Gopichand[3]|Sunkara Sravani[4]|Bandaru Gopinadh[5].**

**[1,2,3,4,5]Department of CSE-AIML, Chalapathi Institute of Engineering and Technology, LAM, Guntur, Andhra Pradesh, India**

**ABSTARCT:** To address issues of traffic congestion and delays at signal intersections, a smart traffic control system using IR sensor technology is proposed. The IR sensors detect vehicle density on each road and automatically adjust signal timings based on real-time traffic conditions, making the system more efficient than manually operated signals. Additionally, to handle emergency situations such as ambulance movement, an RF transmitter and receiver system is incorporated. When an ambulance is detected, the corresponding traffic signal turns green (along with a special blue indication), allowing it to pass without delay. This approach reduces waiting time, improves traffic flow, and helps save lives by prioritizing emergency vehicles.

*KEY WORDS:* Traffic, Light Emitting Diodes, Machine Learning (ML), Internet of Things (IOT).

## 1. INTRODUCTION

In India, a significant number of deaths occur due to delays in reaching hospitals during emergencies such as road accidents and heart attacks, often caused by heavy traffic congestion. The first hour after an emergency is critical for saving lives, but major cities like Mumbai, Delhi, Bengaluru, Chennai, and Hyderabad frequently face severe traffic jams, making it difficult for ambulances to reach their destination on time. Traditional traffic systems based on fixed timing are inefficient in such situations, highlighting the need for intelligent traffic management solutions. To address this issue, a smart traffic control system using IoT and Artificial Intelligence is proposed to prioritize emergency vehicles like ambulances and police vehicles. The system uses sensors and RF communication to detect the presence and location of an ambulance and automatically adjust traffic signals, turning them green along its path. This reduces delays and ensures faster movement through intersections. Additionally, IoT technology enables real-time tracking and communication between the ambulance and traffic management system, allowing route optimization and avoidance of congested areas. Overall, this approach

improves response time, enhances traffic efficiency, and plays a crucial role in saving lives during emergencies.

**Predictive analytics: The system uses**

- Analyze traffic patterns and predict where congestion is likely to occur. This enables the system to route the ambulance around potential traffic hotspots, reducing travel time and improving patient outcomes. Traffic signal prioritization:
- The system can communicate with traffic lights and other traffic management devices to ensure that the ambulance has priority access to intersections and other critical points along its route. Communication with other emergency vehicles
- Communicate with other emergency vehicles to coordinate their routes and ensure that they don't get in each other's way. Overall, a smart traffic management system for ambulances using IoT has the potential to improve emergency response times, reduce traffic congestion, and ultimately save lives.

## 2. LITERATURE SURVEY

S. Sharma, R. Gupta, and P. Verma (2022) proposed an IoT-based smart ambulance traffic management system in which an Android application is used by the driver to control traffic signals based on route direction. The system uses Arduino with a Wi-Fi module to establish communication between the mobile application and traffic signals. Patient information such as name, age, and blood group is also transmitted, while GPS and compass modules are used to determine the ambulance's location and direction for efficient signal control.

A. Kandhari and D. Antonov (2022) developed an intelligent traffic management system divided into three phases: vehicle detection, ambulance identification, and data-driven decision-making. The system uses image processing techniques for ambulance detection instead of traditional sensors, improving automation but requiring high computational resources.

## 3. PROPOSED SYSTEM

Modern mobility solutions focus on using technology to overcome traffic challenges and improve emergency response efficiency. The proposed system enables an Android-based device in an emergency vehicle to override normal traffic signal operations. It utilizes an Arduino microcontroller, IR sensors, RF transmitter, and traffic signals to detect ambulance presence and control signal flow accordingly. This system helps reduce traffic congestion at intersections and ensures faster movement of emergency vehicles, allowing them to reach hospitals without delay. By integrating IoT-based smart traffic

management, the solution improves road safety, minimizes delays, and plays a vital role in saving lives during critical situations.

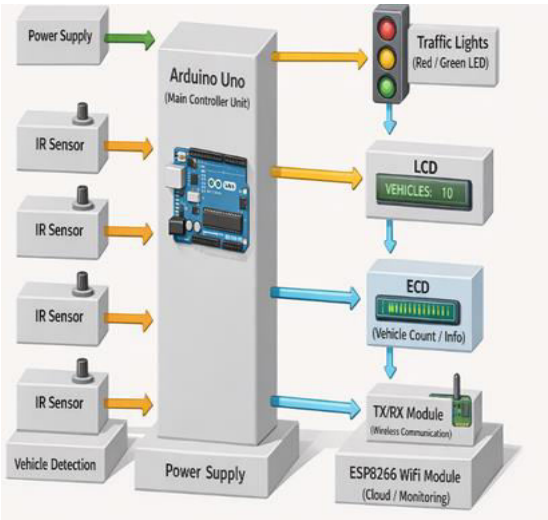


**Fig 1:** Block Diagram

### 3.1 Block Diagram Overview

The proposed smart traffic management system is designed to monitor and control traffic efficiently using real-time data and intelligent decision-making. Multiple IR sensors are installed at different lanes of an intersection to detect vehicle presence and measure traffic density. This data is sent to a microcontroller or IoT-based controller, which analyses the traffic conditions and adjusts signal timings dynamically to reduce congestion.

An emergency override mechanism is also integrated, allowing priority vehicles such as ambulances to control traffic signals. When activated, the system automatically turns the corresponding signal green while keeping others red, ensuring a clear path. The system includes transmitter and receiver modules for communication, along with display units to show system status and signal changes. To improve accuracy, the collected sensor data is processed to remove noise and inconsistencies before being used for decision-making. The refined data is then utilized for intelligent traffic control, enabling efficient signal management, reduced waiting time, and improved road safety.

3.2 Flow Chart

The collected traffic data is analyzed using a machine-learning decision model based on the Random Forest algorithm to enable intelligent traffic congestion control.

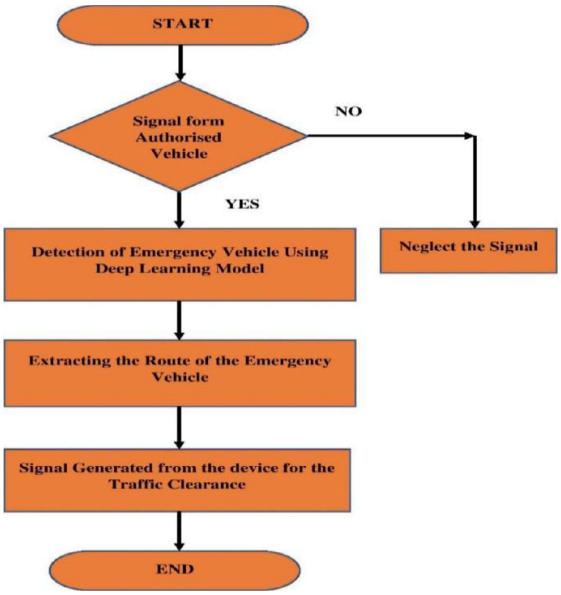


**Fig 2:** Flow Chart

During the training phase, the Random Forest model is trained using labeled datasets representing different traffic conditions such as free flow, moderate traffic, heavy congestion, accident or

blockage, and peak-hour traffic. By constructing multiple decision trees and combining their outputs, Random Forest provides highly accurate and reliable classification while reducing over fitting and false predictions. In real-time operation, the trained model continuously evaluates incoming traffic data and predicts the current congestion level of each road segment. When congestion is detected, the system automatically performs intelligent actions such as adjusting traffic signal timings, rerouting vehicles through alternative paths, sending congestion alerts to drivers via mobile applications or navigation systems, and notifying traffic management authorities. By enabling real-time monitoring, predictive congestion analysis, adaptive signal control, and faster traffic response, the proposed Random Forest–based traffic congestion control system helps reduce travel time, fuel consumption, and environmental pollution while improving overall urban traffic management efficiency.

## 4. RESULTS AND DISCUSSION

The proposed AI-driven smart traffic management system effectively monitors real-time traffic conditions using IoT sensors and machine learning algorithms. It accurately predicts congestion and identifies potential accident-prone situations, enabling timely alerts and signal control. The system improves traffic flow efficiency by dynamically adjusting signal timings based on vehicle density.

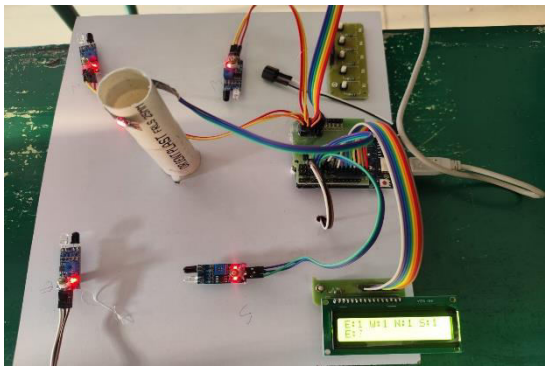

**Fig 3:** Hardware implementation

The system uses an Arduino Uno with sensors, traffic lights, and an LCD to monitor and manage traffic conditions. Vehicle detection sensors collect real-time data, which is processed to control signal timings intelligently. Traffic lights are adjusted dynamically to reduce congestion and improve flow. A buzzer provides alerts for emergencies, and the system runs on a continuous power supply.


**Fig 4:** LCD Display

An LCD display is used to show real-time system status, traffic conditions, or alert messages. Emergency buttons are provided to manually override the system during critical situations such as accidents or emergency vehicle movement.

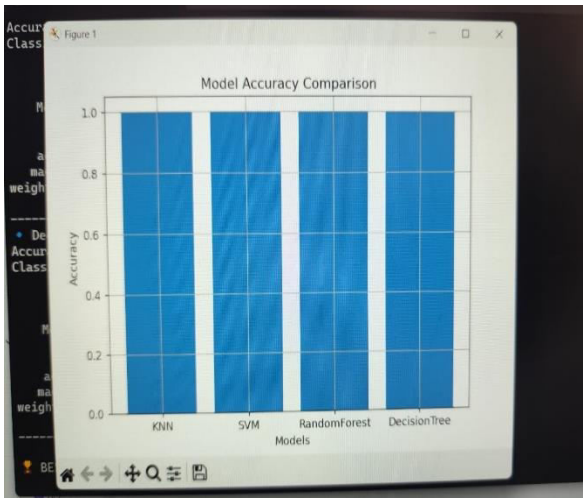


**Fig 5:** Model Accuracy Comparison

The system evaluates the performance of multiple machine learning algorithms including KNN, SVM, Random Forest, and Decision Tree. Each model is trained on the same dataset and assessed using accuracy as the primary metric. The results are visualized in a comparative bar graph for clear analysis. All models demonstrate high accuracy, indicating effective data classification and reliable performance. This comparison helps in selecting the most suitable algorithm for deployment.

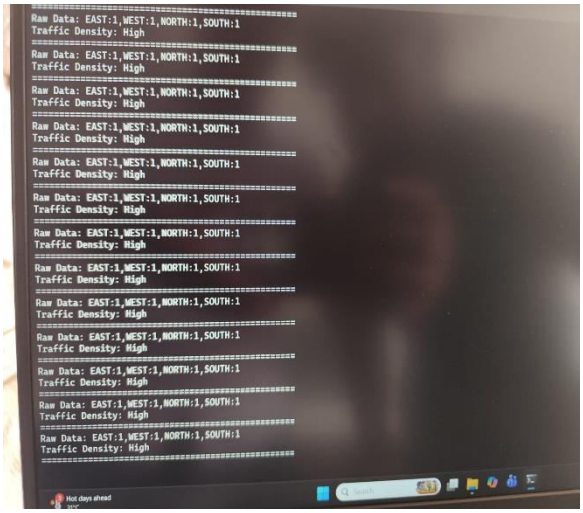


**Fig 6:** Traffic Density Estimation Output

The system analyzes real-time traffic data from East, West, North, and South directions to determine traffic density. If all directions show 1, traffic is classified as high; if two or three directions show 1, it is moderate. If none or only one direction shows 1, the traffic is considered low.

## 5. CONCLUSION

Congestion of traffic is an important problem which is to be addressed as early as possible. This is a challenging situation which is to be resolved quickly. This project can resolve this problem by overcoming the traffic congestion whenever emergency vehicles are to be passed. By initiating this project, it not only saves a lot of human effort involving traffic police but also helps the emergency vehicles or precisely ambulances to make way for them as early as possible and save lives. “The first step towards being a truly responsible society is the day we learn to allow an ambulance to pass through in

traffic". This project might be the biggest step towards making a better society for humanity.

**FUTURE SCOPE:**The system can be enhanced by integrating advanced AI algorithms for more accurate traffic prediction and accident prevention. It can be expanded with cloud connectivity and IoT platforms for real-time monitoring and remote control. Integration with GPS and emergency vehicle tracking can help prioritize ambulances and reduce response time.

**REFERENCES**


1. R. K. Kodali, V. Jain, S. Bose, and L. Boppana, "IoT Based Traffic Signal Control System," *International Journal of Engineering Research and Technology (IJERT)*, vol. 3, no. 12, pp. 345–350, 2014.
2. K. Kalaivani, M. Prakash, and R. Sivakumar, "Traffic Density Based Signal System Using IR Sensors," *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering*, vol. 5, no. 3, pp. 1800–1805, 2016.
3. S. Sharma and R. Singh, "Automatic Traffic Control System Using Infrared Sensors," *International Journal of Engineering Research & Technology (IJERT)*, vol. 4, no. 4, pp. 1200–1204, 2015.
4. P. Chandra Sekhar and M. Venkatesh, "Smart Traffic Signal Control System Using Embedded Technology," *International Journal of Computer Applications*, vol. 97, no. 8, pp. 25–30, 2014.
5. S. A. Patil and V. R. Ghorpade, "RF Based Ambulance Clearance System for Traffic Signal," *International Journal of Scientific & Engineering Research*, vol. 6, no. 5, pp. 1330–1334, 2015.
6. R. K. Poojitha and P. Harini, "Priority Based Traffic Control System for Emergency Vehicles Using RF Communication," *International Journal of Innovative Research in Science, Engineering and Technology*, vol. 6, no. 7, pp. 13500–13506, 2017.
7. J. Joshi, D. Jain, and A. Dubey, "Density Based Traffic Control and Ambulance Clearance System," *International Journal of Engineering Trends and Technology (IJETT)*, vol. 32, no. 5, pp. 231–235, 2016.
8. H. N. Saha and S. Mandal, "Intelligent Traffic Control System Using Sensor Networks," *International Journal of Advanced Research in Computer Engineering & Technology*, vol. 2, no. 6, pp. 1970–1974, 2013.
9. M. S. Bhatia and A. K. Goel, "Design and Implementation of Intelligent Traffic Signal System," *International*

*Journal of Computer Science and Network Security*, vol. 16, no. 9, pp. 45–50, 2016.

10. N. Singh and P. Verma, “Embedded System Based Traffic Control and Ambulance Detection,” *International Journal of Electronics and Communication Engineering*, vol. 9, no. 2, pp. 89–94, 2017.
11. S.M.Kang, et.al., A Traffic Signal control algorithm for emergency vehicles using location based information. PP:394-402, Volume-12, Issue-2, IEEE Transaction-2011.
12. Z.Wang, et.al., A Hierarchical control architecture for emergency vehicle. PP:173-182, Volume-11, Issue-1, IEEE Transaction-2010.
13. M.E.Ben Akiva, et.al., Evaluation of traffic management schemes for emergency vehicle preemption. PP:264-274, Volume-10, Issue-2, IEEE Transaction-2009.
14. S.R.Samantha, et.al., Intelligent traffic control system for emergency vehicles using RFID technology. PP:709-716, Volume-9, Issue-4, IEEE Transaction-2008.