ISSN [Online]: 2583-2654

IoT-Driven Real-time tracking and Emergency Communication for Vehicles

Prof Shankavi K, Sanjay H, Shakthi Priya S, Sharu Latha S, Subitha Infancia A
Department of ECE, Dr. T. Thimmaiah Institute of Technology

Abstract: IoT-based real-time accident detection and emergency response system to enhance road safety. A pressure sensor detects collision impact, while an ultrasonic sensor monitors surrounding obstacles to identify abnormal vehicle behavior. A Wi-Fi-enabled IoT module enables live status updates through a web interface. Wheel temperature is monitored to detect overheating, and a body temperature sensor tracks the driver's health, triggering SMS alerts when needed. An emergency touch sensor activates SOS mode, instantly sharing the vehicle's location. A civil alert button allows bystanders to report road issues via SMS. The HC-05 module ensures communication in remote areas. The integrated system reduces response time and enhances safety through automated, real-time alerts.

Keywords- Accident detection, Emergency response, IoT, Real-time monitoring

I. INTRODUCTION

Road accidents remain one of the leading causes of fatalities worldwide, often aggravated by delayed emergency responses and inefficient accident detection mechanisms. Traditional accident reporting methods, which rely heavily on bystanders, are unreliable especially in remote or low-traffic areas where timely assistance may not be available. To address this critical challenge, this paper presents an IoT-based, real-time tracking and emergency communication system designed to detect vehicular accidents automatically and trigger instant alerts.

The proposed system integrates a suite of sensors including pressure, ultrasonic, temperature, and body temperature sensors to detect collisions, abnormal driving behavior, vehicle overheating, and driver health conditions. A GPS module tracks the vehicle's live location, while communication modules like GSM, Wi-Fi (ESP8266), Bluetooth (HC-05), ensure robust alert delivery across various connectivity conditions. Emergency alerts and sensor data are transmitted to a cloud platform such as ThingSpeak for live monitoring and are shared via SMS with emergency contacts and response units. This system not only automates emergency communication but also empowers passengers and bystanders to report critical incidents through touch and civil alert buttons, thus enhancing public safety infrastructure.

The World Health Organization reports that road traffic injuries are one of the leading causes of death globally, particularly among young people. A significant factor contributing to the severity of such accidents is the delay in emergency response, often caused by the lack of immediate incident reporting, especially in remote areas. Therefore, the development of automated, real-time accident detection and emergency alert systems is imperative to improve road safety and minimize fatalities.

The emergence of the Internet of Things (IoT) has enabled the deployment of intelligent systems that monitor, process, and communicate real-world conditions in real time. Leveraging this potential, the proposed system integrates multiple sensors, microcontrollers, GPS, GSM, Bluetooth (HC-05), LoRa modules, and cloud computing platforms to build a comprehensive accident detection and emergency communication framework. automated detection, the system includes manual emergency activation mechanisms. A touch sensor allows the driver or passengers to trigger an SOS alert, while a civil alert button empowers bystanders to report accidents or breakdowns, contributing to community-

ISSN [Online]: 2583-2654

driven safety. For areas lacking internet connectivity, the HC-05 modules offer long-range, low-power communication capabilities, ensuring uninterrupted alert transmission.

II. METHODOLOGY

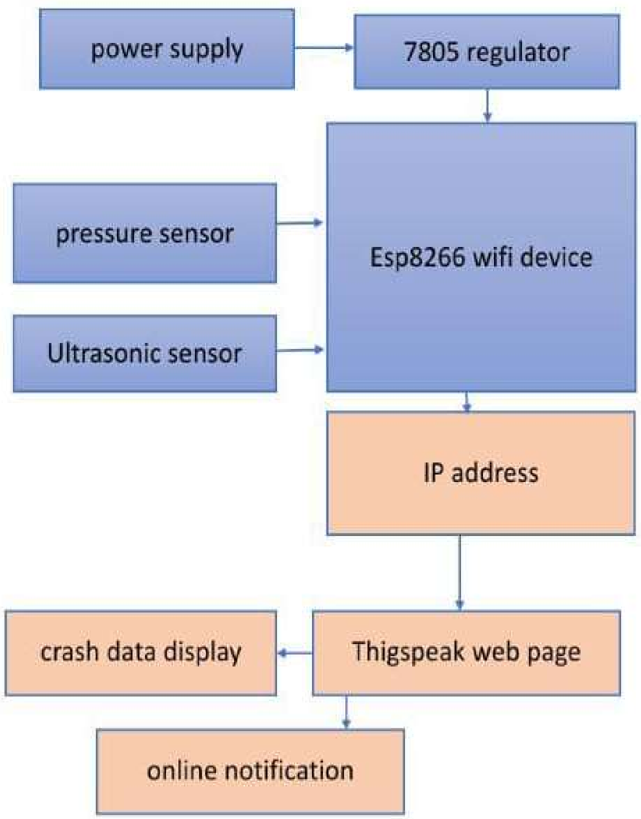

Fig 1: Data acquisition and Processing unit

Responsible for sensing and local processing of accident-related data. It includes sensors like pressure, ultrasonic, temperature, and touch sensors that detect physical impact, proximity, heat, or manual triggers. These sensors are connected to a Nano microcontroller, which processes the data in real time. The ESP8266 WiFi module provides wireless internet connectivity, while the HC-05 Bluetooth module allows short range mobile device communication. A 7805 voltage regulator ensures stable 5V power to the entire unit. The system continuously monitors environmental parameters and prepares data for transmission.

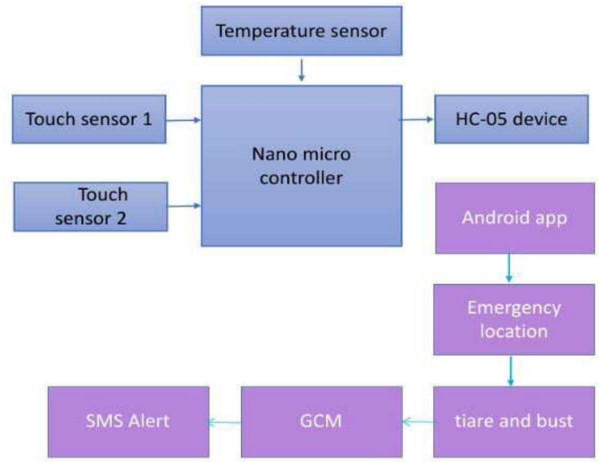

Fig 2: Communication and Emergency system Notification

The communication of processed data and the generation of emergency alerts. The ESP8266 module sends sensor data to the cloud via an assigned IP address, updating a ThingSpeak web page for real-time monitoring. Simultaneously, crash data is displayed and online notifications are generated. The system integrates with an Android app to show emergency alerts and location. Using Google Cloud Messaging (GCM), it sends push notifications, and SMS alerts are triggered to inform emergency contacts. The module also shares the GPS location to assist in quick response and rescue operations.

III. IMPLEMENTATION

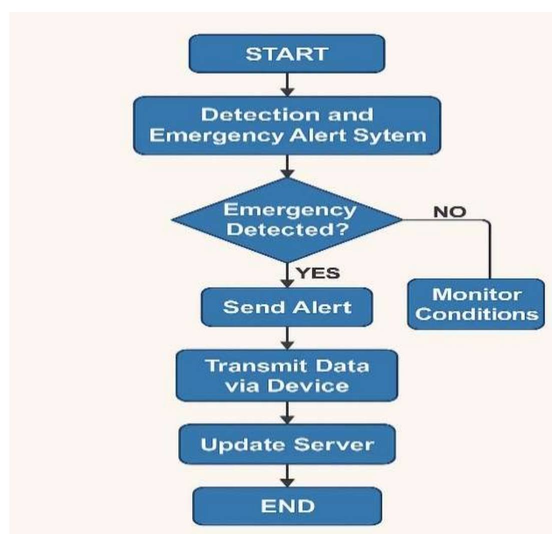

Fig 3: Flow chart

ISSN [Online]: 2583-2654

After detection of an accident or it detects whether any of the medical or criminal emergency button is pressed, the system sends the vehicular emergency location in the form of a Mobile SMS to the registered phone numbers of the family, police station, rescue team, hospital, etc

IV. DETAILS OF EMERGENCY TYPE

(i) Type-1(Accident): This is the most significant and common kind of emergency for a moving vehicle. The system notifies the control room or the registered mobile numbers of an emergency when a car collides or is involved in an accident.

(ii) Type-2 (Medical): Occasionally It occurs that a driver or passenger in a car may suddenly get unwell and won't be able to find a nearby hospital, call for assistance, or travel to the hospital. If that's the case, they can manually activate the system by pressing a button, designating a medical emergency as the type of emergency. The closest hospital receives a notification from the control room designating this kind of incident as an emergency medical scenario, and the hospital responds appropriately.

(iii)Type-3 (Criminal): In the event of a criminal incident, an automobile can also request assistance from the control room by employing this device or nearest police station are informed.

(iv) Type-4 (Civil): The system functions similarly to Vehicle-to-Vehicle communication used in intelligent traffic systems. It enables real-time, automated response for efficient disaster management and public safety. In the event of a natural calamity causing road blockage, sensors detect the obstruction and trigger an alert. This information is instantly communicated to the nearest civil service office and police station.

(v) Type-5 (Mechanical): If a vehicle meets some mechanical problems like vehicle breakdown nearest workshop is informed.

V. RESULT ANALYSIS

The system successfully collected real-time data from all connected sensors. Pressure sensor output increased sharply during impact, confirming collision detection. Ultrasonic sensor showed obstacle presence when distance dropped below 10 cm. Wheel and body temperature sensors flagged alerts when values crossed safe thresholds. SOS and civil alert touch sensors activated the Bluetooth alert system correctly. Data was sent to ThingSpeak cloud and visualized on the dashboard without delay. In no-internet areas, LoRa module transmitted emergency messages over long range.

GPS module accurately sent location data with each alert, ensuring quick response.

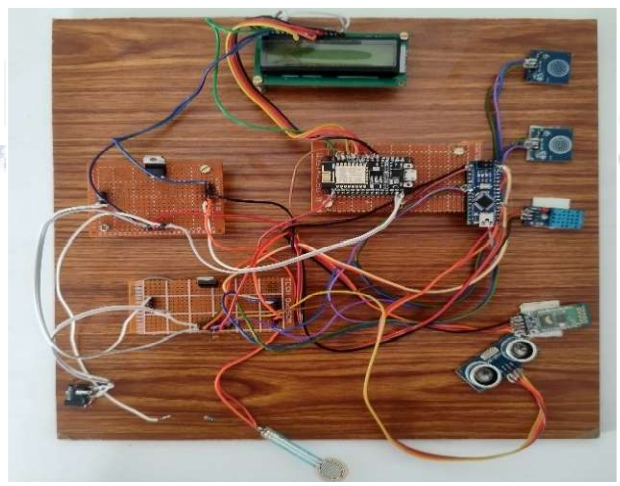

Fig 4: Final Hardware Prototype

IoT-based smart monitoring system integrates various sensors and modules on a wooden baseboard for applications like smart agriculture, home automation, or weather tracking. It uses an Arduino Nano for sensor data processing and an ESP8266 NodeMCU for wireless communication via Wi-Fi. Keysensors include DHT11 (temperature/humidity), HC-SR04 (ultrasonic), pressure, touch, and a possible soil moisture or flex sensor. A 16x2 LCD displays real-time data, and an HC-05 Bluetooth module provides secondary connectivity. The system is powered by a 12V supply regulated to 5V. Components are connected with jumper wires, and a

ISSN [Online]: 2583-2654

switch controls power. This compact, modular prototype demonstrates effective embedded system and IoT integration.

Fig 5: Accident Detection using pressure sensor

A pressure sensor consistently reading 1024 may indicate extreme force or impact, suggesting a possible accident detection scenario. In such systems, sudden spikes to maximum sensor output can be interpreted as collisions or crashes. However, it's crucial to confirm this with additional sensors (like accelerometers) and verify circuit integrity to rule out false positives.

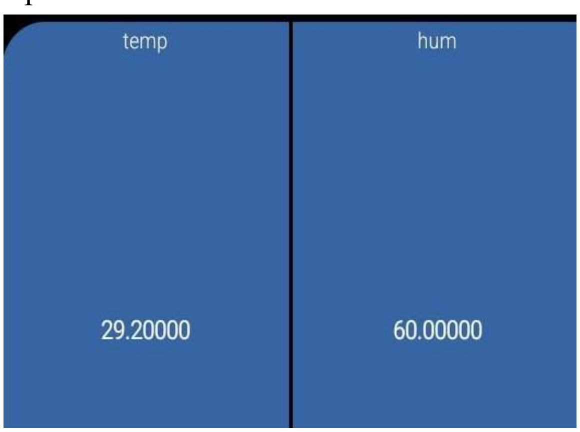

Fig 6: Medical output

The system provides real-time monitoring of environmental conditions relevant to a patient's health status. It displays temperature (29.2°C), pressure (1024 hPa), and humidity (60%) in a simple, readable format. Real-time values help identify abnormal room conditions that may affect a patient's recovery or well-being. The humidity reading, updated a minute earlier, highlights data freshness and potential lag

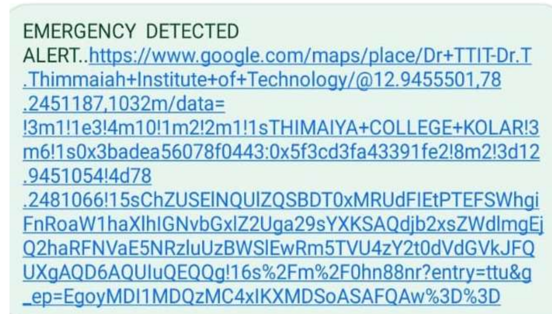

Fig 7: Criminal output using Touch Sensor

An automated emergency alert system is triggered via a touch sensor to indicate a potential issue at a monitored civil infrastructure site. When activated, it sends a real-time alert containing a Google Maps link with exact coordinates precise location data allows responders to act quickly and accurately.

Fig 8: Civil output

"VEHICLE FRONT DETECTED" is a real-time alert indicating the presence of an object or vehicle ahead. It uses an ultrasonic sensor to measure distance and triggers a warning when a nearby obstacle is detected. The alert is displayed on an LCD and can also be sent via SMS using an ESP8266 or GSM module. This enhances driver awareness and helps prevent collisions. GPS integration allows the system to share the exact location for emergency response. It's a key feature in smart vehicle and road safety applications. And using ultrasonic sensor will get a should alert

Fig 9: Mechanical Alert Output using Touch sensor

The "VEHICLE BREAK DOWN ALERT ALERT"

is a critical, high-priority notification signaling an urgent mechanical issue. Its capitalized and repeated "ALERT" emphasizes the need for immediate attention by transport teams or roadside assistance. This alert typically indicates that a vehicle has become non-operational due to failure, posing risks of delays or stranded passengers. It serves to inform stakeholders promptly to minimize disruption. Quick response may involve dispatching a repair crew, rerouting logistics, or sending a replacement vehicle. Such alerts are essential in fleet management and public transport safety. They support efficient, real-time decision-making during transit emergencies.

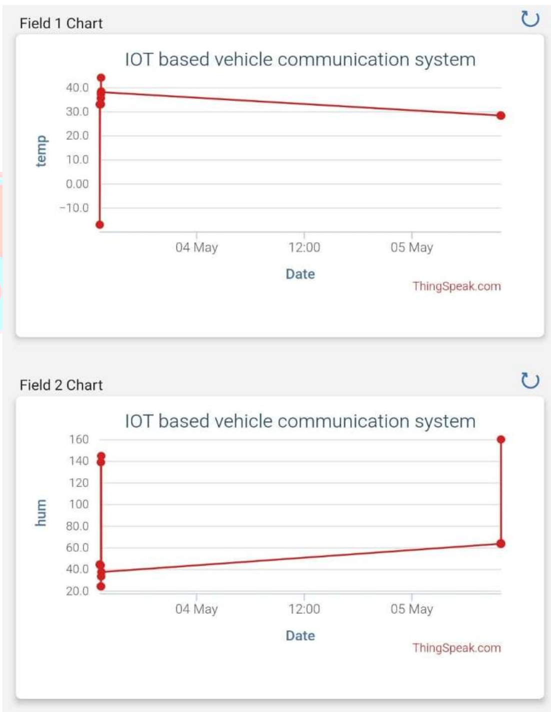

Fig 10: Graphical representation of temperature and humidity

ThingSpeak IoT-based vehicle communication system. The first chart represents the temperature (temp) over time, showing a decrease from around 40°C to below 30°C between May 4 and 5. The second chart displays the humidity (hum), which shows an increase from around 40% to 120% within the same time period. These charts indicate fluctuations in environmental conditions monitored by the vehicle's IoT system. The data provides insights into the vehicle's internal or external environment for safety or efficiency purposes.

VI. CONCLUSION

The IoT-Driven Real-Time Communication and Location Tracking System significantly enhances road safety and emergency response efficiency. By integrating sensors like pressure, ultrasonic, temperature, and GPS, it enables comprehensive vehicle and environment monitoring. IoT connectivity and LoRa communication ensure real-time data transmission and long-range alerts, even in remote areas. Manual SOS triggers and civil alert buttons provide an additional layer of responsiveness for swift assistance. Rigorous testing proves its potential to save lives through immediate accident detection and timely alerts. This system marks a major advancement in technology-driven accident prevention and rescue operations

REFERENCES

[1]. George Y., et al. "An Efficient LoRa-Enabled Smart Fault Detection and Monitoring Platform for the Power Distribution System Using Self-Powered IoT Devices." IEEE Access, vol. 10, 2022, pp.73403-73417.

[2]. K. Rana, A. C. Vaz, and N. T. Hegde, "Revolutionizing Vehicle Safety: IoT-Enabled Inter-Vehicular Communication for Real-time Data Transfer and Emergency Response via Wi-Fi," 2024 IEEE Conference on IoT and Smart Systems, vol.

[3]. R. Tanaka, D. Nobayashi, K. Tsukamoto, T. Ikenaga, G. Sato, and K. Takizawa, "Performance Evaluation of Dynamic Transmission Parameter Control Method for Mobile Terminal with 920 MHz LoRa Communication," IEEE Pacific Rim Conference on Communications, Computers and Signal Processing (PACRIM),

[4]. T. Karunathilake and A. Förster, "Beyond Safety: Leveraging LoRa Communication in Urban Vehicular Networks," 2024. DOI: 10.1109/WIMOB61911.2024.10770424.

[5]. S. Sanchana, M. A. P., and B. N. Jyothi, "Application Development for Real-Time Location Tracking for Underwater Vehicles Using Low-Cost GPS with GSM," Sixth International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET)

[6]. N. Divya, P. Vijay, T. Yaswanth, U. Lokesh, and T. Venu, "RF and IoT-Driven Automated Lane Clearance System for Enhanced Emergency Response,

[7]. G. Harshit, K. H. Akhil, N. Mishra, P. Achyutha, and M. P. V, "V2V Communication Assisted Emergency Route Optimization," Proceedings of the 6th International Conference on Mobile Computing and Sustainable Informatics (ICMCSI-2025)

[8]. D. Kornack and P. Rakic, "Cell Proliferation without Neurogenesis in

ISSN [Online]: 2583-2654

Adult Primate Neocortex," Science, vol. 294, Dec. 2021, pp. 2127-2130, doi:10.1126/science.1065467.

[9]. M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 2020.

[10]. R. Nicole, "Title of paper with only first word capitalized," J. Name Stand. Abbrev., in press.

[11]. Zhaosheng yang. Study on the schemes of Traffic signal timing for priority vehicles Based on navigation system, 2020.

[12]. Wang wei, fan hanbo, traffic accident Automatic detection and remote alarm Device

[13]. D. H. Cho, "Navigation Service System and Method Using Mobile Device," 2014, uS Patent 8,775,067.

[14]. S. Koley and P. Ghosal, "Addressing Hardware Security Challenges in Internet of Things: Recent Trends and Possible Solutions," in 12th IEEE International Conference on Advanced and Trusted Computing (UIC- ATC-ScalCom-CBDCom-IoP), 2015, pp. 517–520

[15]. S. Tripathi, U. Shetty, A. Hasnain and R. Hallikar, "Cloud Based Intelligent Traffic System to Implement Traffic Rules Violation Detection and Accident Detection Units," 2019 3rd International Conference on Trends in Electronics and Informatics (ICOEI), Tirunelveli, India, 2019, pp. 347-351, doi: 10.1109/ICOEI.2019.8862694.