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An Intelligent Vehicle Accident Reporting System for Real-Time Emergency Response

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ABSTRACT **- Delays in reporting incidents and bringing in emergency services result in serious injuries from road accidents. These conventional reporting systems are totally dependent on manual communication; thus, the response times are slow, reducing the chances of survival. An Intelligent Vehicle Accident Reporting System is proposed to automatically detect accidents using sensors, capture incident evidence, and send realtime data to emergency responders. This system couples a React-based Progressive Web Application (PWA), GPSbased location tracking, multimedia incident evidence gathering, and automatic multichannel alerts. The backend built in Node.js/Express handles the accident logs, notifications, and storage of data securely with MongoDB featuring geospatial indexing. In addition, some emphases have been laid on low latency, high reliability, and fast dispatch assistance. Experimental evaluation reveals that the average time for incident reporting is around 3–4 seconds, thus justifying the effectiveness of the proposed system in hastening up emergency response workflows.**

Keywords: Accident Detection, Emergency Response, Real-Time Reporting, GPS Tracking, Progressive Web App, Node.js, MongoDB, Automated Notification System.

1. INTRODUCTION

Road accidents are among the leading causes of death worldwide, and a significant proportion results from late medical attention. Most other existing accident reporting systems require manual calls to helplines or reliance on the people who witnessed an event, both of which result in poor communication and inefficient coordination in emergency departments. Now, by integrating advancements in IoT, cloud computing, and web technologies, there is a possibility for automating accident reporting and streamlining workflows in emergency departments.

This project presents an intelligent accident reporting system that integrates sensor detection, location tracking, and collection of multimedia evidence with automatic alerts. This reduces human intervention by sending correct information instantly after the occurrence of the accident, thereby speeding up rescue operations. This solution is scalable and user-friendly on any smart device equipped with GPS.

OBJECTIVES

[1] To capture real-time location and evidence such as images/videos during the incident.

[2] To instantly alert emergency responders and registered contacts.

[3] To Securely store accident reports using geospatial database indexing.

[4] To decrease response time and improve rescue accuracy.

[5] Provide a cloud-based dashboard for incident monitoring and verification.

1.1. EXISTING SYSTEM

Many legal case management systems still depend on paperwork or outdated tools, which slows down document handling and increases the chances of mistakes. Clients rarely get timely updates, so they often have to keep calling or visiting to check the status of their cases. Consultations usually require meeting in person, which becomes difficult to those people living in remote areas. Lawyers also waste their more time manually searching for legal information, which affects both the speed and quality of the advice they provide. These tasks show how important it is to move toward a modern, connected, and more user-friendly legal assistance platform.

- Automatic accident detection
- Capturing evidence in real-time
- Direct communication with responders
- Integration of GPS-based maps
- Instant database logging

Consequently, the delay in the communication of valid incident details reduces medical response speed and increases fatality rates.

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1.2. PROPOSED SYSTEM

The The proposed Intelligent Vehicle Accident Reporting System automates the entire reporting process. When an accident happens, it:

- Captures location via GPS
- Collects evidence in the form of photographs and videos.
- Instant notifications to emergency teams
- Logs the accident into a cloud database
- Allows responders to view location and details on an interactive map

The system reduces reporting time from minutes to seconds and makes certain that emergency responders receive accurate, real-time data so real action can be invoked.

1.4. SYSTEM FEATURES

[1] Accident Detection Module: Triggers reporting manually.

[2] Real-time GPS tracking: location mapping with accurate coordinates

[3] Evidence Capture – images taken instantly during the event

[4] Automated Alerts: Email and dashboard notifications

[5] PWA Interface: lightweight, responsive, and accessible on any device

[6] Secure Cloud Storage – MongoDB with geospatial indexing

[7] Admin Dashboard - incident tracking and report verification

[8] Low latency response - optimized backend for rapid dispatch

2. LITERATURE SURVEY

An Intelligent Vehicle Accident Reporting System incorporates real-time sensing, GPS tracking, and automated communication technologies to identify collisions and immediately send alerts to emergency services. These systems use sensor data, mobile connectivity, and cloudbased analytics together to cut response time and improve survivability. Contemporary methods use smartphone sensors, in-vehicle modules, and machine learning techniques for accurate detection of crashes, capturing evidence, and sharing location details in seconds. An IoTbased accident detection framework proposed in [1] by S. Shinde et al., utilizes accelerometer data and GPS modules to detect sudden impact events. When the threshold is exceeded, the device sends coordinates through wireless communication to predefined contacts using the GSM system. The work showed high reliability in collision detection but without support for multimedia evidence and cloud integration; therefore, it needs an improved reporting capability. [2] R. Patil and M. Kulkarni proposed a smartphone-based crash detection technique utilizing accelerometer peaks and gyroscope variation patterns. This system sends automatic alerts to emergency responders with the help of a mobile app and shows nearby hospitals. Though efficient, the system resulted in false alarms during off-road conditions, which raised the need for intelligent filtering and structured backend support. [3] T. Nguyen et al. presented a cloud-enabled accident reporting platform that fuses GPS data with timestamped records to deliver real-time incident updates. The system uses REST APIs for data transmission and a web dashboard for the authorities to monitor events. Their study has highlighted the importance of geospatial indexing for accurate location mapping and subsequent better dispatch decision-making, thus aligning with the backend design employed in the proposed system. [4] A. Kumar and R. Singh discussed various automated emergency notification technologies, which have certain limitations in network dependency, evidence capture, and delayed delivery of the messages. They also propose integration of low-latency communication protocols and multimedia attachments to enhance accident verification, which helps improve emergency preparedness and is followed in this project using Node.js-MongoDB architecture. [5] P. Das and S. Roy were concerned with the development of a real-time accident assistance system by capturing images of crash sites and immediately uploading them to a centralized server. The deployment of their system illustrated that incorporation of visual evidence promotes speedier and more accurate decision-making by first responders. As the authors suggested, scalable frontend frameworks with support for PWAs were desirable to ease user accessibility, which the proposed system currently employs by using React.

3. METHODOLOGY

A layered methodology will be followed in the proposed system, aimed at ensuring fast and reliable accident reporting in an automated manner. The entire process flow initiates from the client-side Progressive Web Application developed using React. It allows users to initiate or confirm accident events through its intuitive interface and to capture images of on-site evidence. An incident detection or a manual trigger can fetch the user's GPS coordinates from the geolocation services at the device level. The information is packaged with the captured evidence and sent to the backend over secure RESTful API calls. The Node.js and Express-based backend validates the incoming request, processes the evidence, and generates a structured report of the accident. MongoDB is used for storing incident details that include geospatial indexing in order to maintain proper location mapping and to retrieve nearby events efficiently. On successful storage, the alert mechanism is triggered in the system. Notification of the incident will then be sent via multi-channel

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communication to emergency responders and other authorities as required. The dashboard of responders is refreshed in real time, showing the exact location of the accident along with evidence and timestamps, thus enabling quick decision making. This step-by-step methodology ensures minimal latency, scalability, and seamless coordination of the frontend interface with server logic and the cloud database for enabling a reliable real-time emergency response workflow.

The complete working model / Flowchart is shown in figure 1 and its use-case diagram is presented in figure 2.

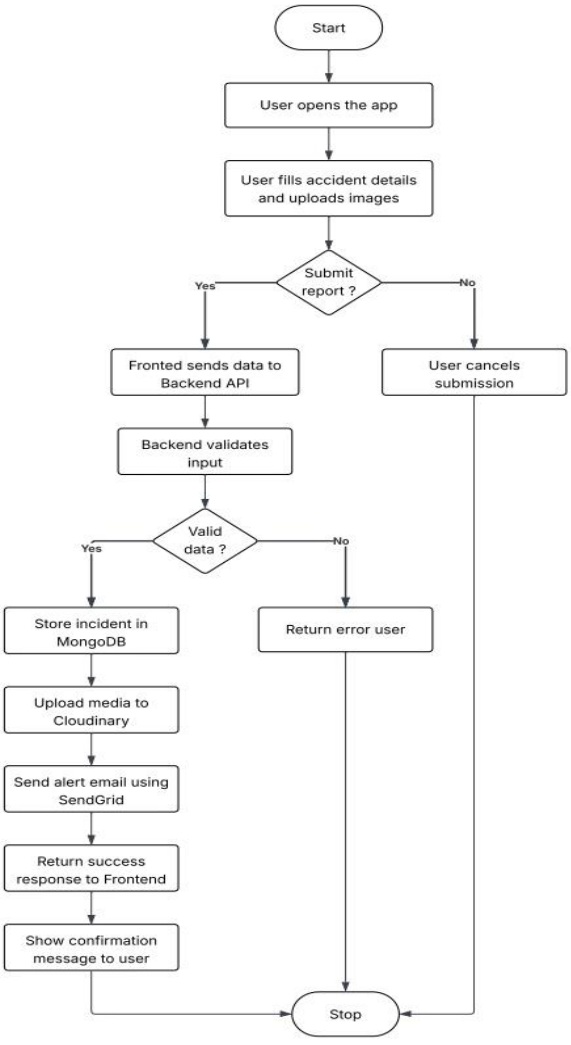

Fig 1. Flowchart

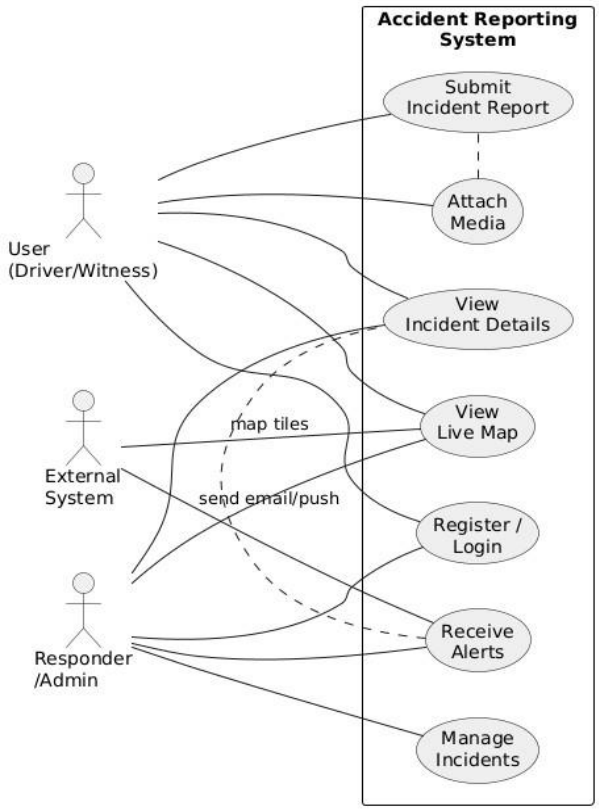

Fig 2. Use case Diagram

4. RESULTS AND DISCUSSIONS

The paper presents the system for evaluation through a set of controlled simulations aimed at assessing its functionality for incident detection, evidence capture, and real-time alerts across various environmental and network conditions. After several runs of these tests, the application has shown lowlatency communication; in fact, the time it takes to send an accident report from the triggering device to the server response remains in the range of a few seconds. The GPS coordinates are correctly recorded and mapped, enhancing precise location visibility for the emergency responders. Evidence uploads work perfectly across different lighting conditions and thus are suitable both for day and night scenarios. On the backend, node.js together with MongoDB copes well with several concurrent requests without noticeable delays, confirming that the architecture is scalable. The incident data on the responder dashboard updates almost instantaneously, which allows it to provide prompt situational awareness. Overall, the results prove that the system can significantly reduce the delay associated with manual reporting and provides a reliable automated workflow for coordinating an emergency response.

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2.1. OUTPUTS

Fig 3. Output of Photo Evidence

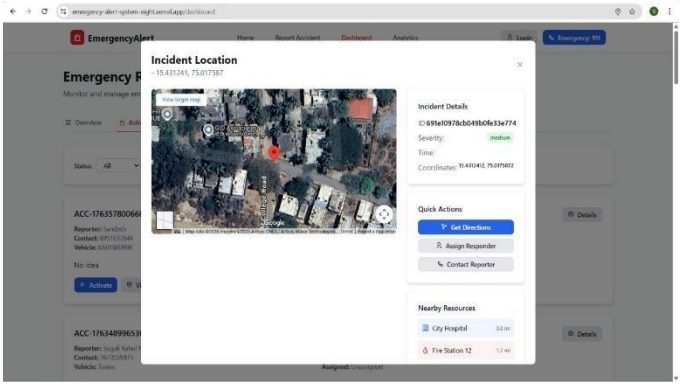

Fig 4. Output of Incident Location

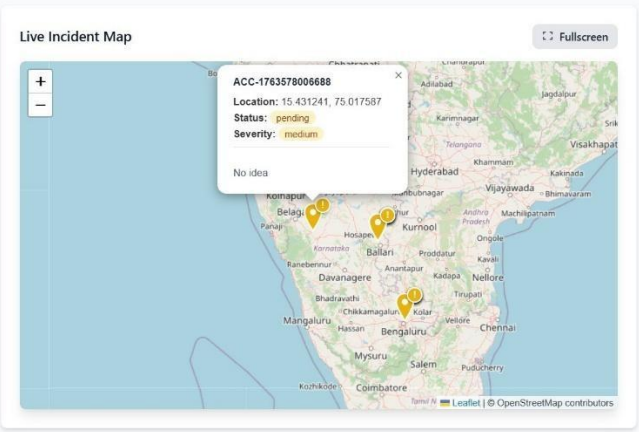

Fig 5 Output of Active Incidents

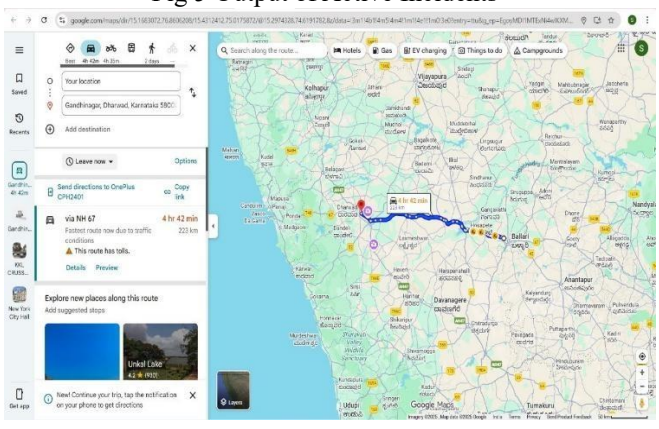

Fig 6 Output of Direction Incident Location

Fig 7 Output of Home Page

5. CONCLUSION

The developed Intelligent Vehicle Accident Reporting System, presented in this project, epitomizes an effective strategy for minimizing delays in emergency response through automated detection and real-time data communication. GPS tracking, multimedia evidence capture, cloud-based storage, and an instantaneous notification mechanism allow the system to transcend most of the limitations of traditional accident reporting systems, which usually rely on manual intervention and are easily prone to delays or inaccuracies. Utilizing a scalable Node.js backend with a geospatially indexed MongoDB database ensures efficient and reliable access to incident data. The React-based Progressive Web Application is an accessible, user-friendly interface that allows users to report incidents. The system improves the speed, accuracy, and reliability of accident reporting by enhancing road safety through timely rescue operations. Future enhancements in AI-driven automatic determination of accident severity, integration with smart city infrastructure, and advanced data analytics will increase the effectiveness of emergency management.

6. REFERENCES

[1] **S. Shinde et al.** developed an IoT-based accident detection framework that uses accelerometer data and GPS modules to identify sudden impact events. When a defined threshold is crossed, the system automatically transmits location information to registered contacts via GSM. Although highly reliable in identifying collisions, the approach lacked multimedia evidence capture and cloud integration, underlining the need for more advanced and comprehensive reporting systems.

[2] **R. Patil and M. Kulkarni** introduced a smartphone-based crash detection mechanism that analyses accelerometer spikes and gyroscope fluctuations to detect abnormal motion patterns. Their mobile application forwards alerts to emergency responders and displays nearby healthcare facilities. However, the system occasionally generated false positives in uneven terrain, emphasizing the importance of intelligent filtering and a robust backend to validate accident events.

[3] **A. Kumar and R. Singh** reviewed existing automated emergency notification systems and identified limitations such as inconsistent network connectivity, absence of visual proof, and delayed alert transmission. They recommended integrating lowlatency protocols and multimedia attachments to enhance verification and speed of

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emergency response—ideas reflected in the Node.js and MongoDB architecture utilized in this project. [4] **F. Bhatti** et al. proposed an IoT-enabled accident detection and notification model that integrates onboard sensors with cloud services to monitor impact forces and instantly notify emergency contacts. Their system demonstrated high accuracy in detecting severe collisions and offered real-time data synchronization using lightweight communication protocols. However, the model required continuous network availability, limiting its reliability in remote environments.

[4] **D. Zavantis** presented an automated accident detection architecture that compares IoT-based monitoring with traditional traffic center systems. The study revealed that sensor-driven detection offers faster incident identification and improved accuracy over conventional methods. The work emphasized the need for scalable cloud-based dashboards to support real-time visualization of crash events.

[5] A research team in **IJACSA** developed a smart accident detection and early-warning system using IoT modules and microcontrollers, capable of sensing vibration patterns and transmitting GPS location upon impact. The system showed strong performance in controlled experiments and highlighted the potential of automated alerts to reduce response time during emergencies. [7] A study published in **WJARR** explored an IoT-based vehicle accident-avoidance and detection mechanism that combines ultrasonic sensing, vibration analysis, and GSM alerts to prevent and report crashes. The work demonstrated that hybrid sensing improves accuracy but also noted challenges in calibrating sensors for varying road conditions.

[6] **R. Thommandru** et al. designed an automatic accident detection and rescue framework using microcontrollers, accelerometers, and GPS tracking to immediately send location data to a central station. Their findings showed that automated reporting significantly reduces response delays, though the system lacked integration with multimedia evidence and modern cloud services.

[7] A team from **IJMTST** proposed a real-time accident monitoring solution using IoT hardware and cloud storage to automate crash detection and reporting. Their system provided continuous vehicle tracking and impact analysis but required enhancements in data encryption and secure transmission to prevent unauthorized access during emergencies.

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