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Sarathi: The Smart Accident Detection and Quick Response

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ABSTRACT :

The rise in road accidents globally calls for an innovative, automated, and intelligent solution to reduce response time and potentially save lives. This paper presents a conceptual framework and ongoing development of Sarathi, a smart accident detection and quick response system aimed at integrating IoT, cloud communication, and health services in real-time. While the core system remains under confidential development to ensure originality and protect intellectual rights, this paper discusses the core ideas, practical objectives, industrial perspective, user-centric functionalities, and the structured vision toward implementation and enhancement. The paper avoids the use of diagrams or internal architectures to maintain confidentiality until the project reaches a complete and secure release stage.

Keywords: Smart Vehicle, Accident Detection, IoT, Emergency Response System, Real-time Alert, AI-ML, Cloud Integration.

1. Introduction

Accident detection and rapid response systems are increasingly becoming a core component in enhancing transportation safety. With the world witnessing a consistent rise in traffic accidents, especially in regions lacking automated emergency alerting systems, the need for intelligent solutions is critical. Sarathi is a proposed system still under development that aims to bridge this gap through a technologically advanced approach to real-time accident detection and hospital notification.

Nomenclature

AI – Artificial Intelligence
CrashEvent – System keyword for detected vehicle impact
ESP32 – Microcontroller used in vehicle module
GSM – Global System for Mobile Communication
GPS – Global Positioning System
IoT – Internet of Things
ML – Machine Learning
NodeServer – Backend server handling real-time events
UID – Unique Identifier of the vehicle box

2. Objective

The core objectives of Sarathi are:

1.To detect vehicular accidents automatically using sensor data and predefined thresholds.

2.To transmit essential accident data (location, time, impact level) to a central server.

3.To notify the nearest hospital and emergency services instantly.

4.To provide tracking access to family members of the victim.

5.To prepare the foundation for smart insurance claim automation and government accident analysis.

3. Problem Statement

Current solutions often lack automatic and real-time integration between vehicles, medical institutions, and families. Delay in reporting or locating victims often results in increased fatalities. Sarathi bridges this gap through automation and real-time data transfer.

4. Literature Survey

Multiple researchers have tried to address vehicle accident detection through mobile-based or microcontroller-based systems. However, these often fall short in automation, real-time coordination, or scalability.

1.Patil & Kulkarni (2018) proposed a GPS-GSM module for vehicle tracking post-crash but lacked server-based hospital integration.

2.Sharma et al. (2020) used an IoT-based system but only sent SMS alerts to the vehicle owner.

3.Park & Kim (2021) applied AI for crash prediction, but required powerful hardware.

Sarathi builds on this foundation with a robust cloud system, direct hospital linkage, real-time updates, and planned AI-enhanced automation.

5. Methodology

5.1 Hardware Setup
ESP32 Microcontroller: Handles data from sensors.

Sensors: Accelerometer + GPS module to detect impact and location.

Trigger Logic: Threshold-based impact detection initiates data transfer.

5.2 Server-Side Architecture
Backend: Built using Node.js, receives data over HTTP.

Database: Stores accident logs, timestamps, GPS coordinates, and user metadata.

Hospital Matching: Nearest hospital selected via geolocation APIs.

Notification System: Alerts sent via SMS/Email/API to hospitals and registered family contacts.

5.3 Frontend
Family Portal: Allows families to track victims' current status and hospital updates.

Hospital Dashboard: View and update patient reception and treatment logs.

Future Additions: Auto insurance claim module, AI-based severity scoring, legal reporting.

6. System Design

Note: Detailed design diagrams (block architecture, circuit design, data flow) will be published in the final version after system validation and copyright.

The system works in a tri-layered architecture:

- **Sensor Layer**: ESP32 collects crash data.
- **Network Layer**: Data transmitted to backend.
- **Service Layer**: Decision logic + Notifications + Web interface.

7. Results (Planned and Simulated)

- Accident successfully simulated and detected using ESP32 in lab environment.
- Data sent to dummy backend endpoint.
- Mock hospital selected based on coordinates.

- Alerts simulated using mock email/SMS scripts.
- Family tracking simulated using dynamic map rendering.
- Full-scale testing to begin after hardware and frontend integration is completed.

8. Applications

- Applicable for 2, 4, and multi-wheeler vehicles.
- Insurance sector integration.
- Government emergency response linkage.
- Corporate fleet vehicle monitoring.

9. Conclusion

Sarathi represents a new approach to accident detection — not just informing a contact, but acting instantly through automated intelligence. It ensures victims reach medical care faster, increasing chances of survival. While still under development, it is designed to be adaptable, scalable, and extensible for broader societal impact.

10. Future Scope

1.Integration with government emergency APIs (e.g., 112, local ambulance dispatch).
2.AI/ML for severity estimation and hospital bed prediction.
3.Blockchain for tamper-proof insurance claims and medical record sharing.
4.Language localization for use across different Indian states and international deployment.

11. Copyright and Confidentiality Notice

The This paper presents the foundational architecture and methodology of the Sarathi system. As the system is still under active development and undergoing copyright registration and intellectual property protection processes, the following limitations apply:
The complete source code, detailed system diagrams, and API endpoints are currently confidential and will not be disclosed until the final system is completed and protected.
This document is submitted strictly for academic review, evaluation, and proposal purposes only.

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