

# **ACCIDENT DETECTION SYSTEM**

*A Project Report Submitted  
In Partial Fulfillment  
for award of Bachelor of Technology*

**In**

**COMPUTER SCIENCE & ENGINEERING  
IOT**

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We hereby declare that the work presented in this report entitled “**ACCIDENT DETECTION SYSTEM**”, was carried out by us. We have not submitted the matter embodied in this report for the award of any other degree or diploma of any other University or Institute. We have given due credit to the original authors/sources for all the words, ideas, diagrams, graphics, computer programs, experiments, results, that are not my original contribution. We have used quotation marks to identify verbatim sentences and given credit to the original authors/sources.

We affirm that no portion of our work is plagiarized, and the experiments and results reported in the report are not manipulated. In the event of a complaint of plagiarism and the manipulation of the experiments and results, we shall be fully responsible and answerable.

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## CERTIFICATE

Certified that **Harsh Vashishtha, Uday Vashishtha, Samanvaya Singh, Sahil Kumar Ray** (Roll numbers: 2201331550055, 2201331550132, 2201331550108, 2201331550106) have carried out the research work presented in this Project Report entitled “**ACCIDENT DETECTION SYSTEM**” for the award of **Bachelor of Technology**, from Computer Science & Engineering (IoT) Department, Dr. APJ Abdul Kalam Technical University, Lucknow, under our supervision. The Project Report embodies results of original work, and studies are carried out by the students herself/himself. The contents of the Project Report do not form the basis for the award of any other degree to the candidate or to anybody else from this or any other University/Institution.

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## **ABSTRACT**

Around the world, traffic accidents are a big problem, and survival rates are greatly impacted by delays in receiving medical assistance. Systems that automatically detect accidents and notify emergency services in a timely manner present a possible option. The idea of accident detection systems is examined in this abstract, along with a description of its elements and features. The fundamental idea is based on in-car sensors that track driving characteristics. When the system notices an accident, it sends out a distress signal. Emergency personnel can quickly locate the accident scene thanks to the critical location data provided by GPS modules. GSM modules help in communication by automatically alerting chosen contacts or emergency services. Accident detection systems have the potential to save many lives by guaranteeing prompt medical attention. Their accuracy can be improved by more research and development, which would significantly lower the number of people killed in traffic accidents.

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## LIST OF ABBREVIATIONS

Abbreviation	Full Form
DL	Deep learning
LDA	Latent Dirichlet allocation
LSTM	Long short-term memory
GRU	Gated Recurrent Unit
NLP	Natural language processing
TF-IDF	Term Frequency-Inverse Document Frequency
GloVe	Global Vectors
CURB	Scalable Online Algorithm
EANN	Event Adversarial Neural Network
BiLSTM	Bidirectional LSTM
CNN	Convolutional neural network
MLP	Multilayer perceptron
API	Application programming interface
NB	Naive Bayes
CNN	Convolution neural network
NER	Named Entity Recognition
KNN	K-Nearest Neighbours



# **CHAPTER 1**

## **Introduction**

### **1.1. BACKGROUND**

The advancement of transportation systems has been a driving force behind human civilization, elevating us above other creatures on Earth. Automobiles play a pivotal role in our daily lives, facilitating commutes, social interactions, and logistics. However, they also pose significant risks, with accidents claiming numerous lives each year. In India alone, 137,423 fatalities occurred in vehicle traffic crashes in 2009. Throughout history, the relentless march of transportation advancements has served as a powerful engine propelling human civilization forward. From the invention of the wheel to the marvel of modern automobiles, these innovations have fundamentally reshaped our societies and propelled us to a level of mobility unmatched by any other species on Earth. Cars, in particular, have become woven into the very fabric of our daily lives. They ferry us to and from work, enabling economic participation and growth. They connect us with loved ones, fostering social interaction and strengthening communities. They act as the backbone of our logistics networks, ensuring the seamless flow of goods that sustains our modern way of life. However, this convenience comes at a heavy price. The very freedom and efficiency offered by automobiles are tragically marred by their inherent dangers. Road accidents cast a long shadow, claiming countless lives each year and leaving countless more scarred by physical and emotional trauma. India, a nation experiencing a surge in economic activity and vehicle ownership, offers a stark example of this grim reality. In 2009 alone, a staggering 137,423 lives were extinguished in traffic crashes. This translates to over 375 deaths every single day – a sobering reminder of the perilous dance we engage in with automobiles.

### **1.2. IDENTIFIED ISSUES/RESEARCH GAPS**

Despite extensive efforts from governments and organizations worldwide, a multi-pronged attack targeting driver education, infrastructure improvements, and stricter enforcement measures, accidents remain a persistent and pervasive issue. These initiatives, while crucial, often fall short due to the complex interplay of factors contributing to accidents. Distracted driving, impaired judgement due to alcohol or fatigue, and unpredictable road conditions all conspire to create a volatile mix that can erupt into disaster. However, a glimmer of hope emerges in the form of a potential life-saving intervention: timely response from emergency services. Numerous studies have highlighted the vital role played by rapid medical attention in determining the outcome of an accident. Research by Virtanen et al., for instance, revealed that a significant portion of accident-related fatalities in Finland – a staggering 4.6% – could have been prevented with a swifter response from emergency personnel. These findings

underscore the importance of efficient accident detection and response systems. By minimizing the time between an accident and medical intervention, we can significantly increase the chances of saving lives and mitigating the severity of injuries.

### **1.3. OBJECTIVE AND SCOPE**

The grim reality of road accidents underscores a pressing need: the development and implementation of efficient automatic accident detection systems. These life-saving technologies hold the potential to dramatically improve response times by emergency services, directly influencing the outcome of accidents. Every passing minute after a collision can mean the difference between life and death, between a full recovery and a debilitating injury. By promptly alerting emergency services and providing them with crucial accident location information, automatic detection systems can play a pivotal role in saving lives and minimizing the devastating impact of road accidents. Fortunately, advancements in various technological fields have converged to create the foundation for these potentially life-saving systems. One such technology is the Global Positioning System (GPS), a satellite-based navigation system originally developed for military applications by the American Department of Defense (DoD). GPS has since transcended its military origins and become an indispensable tool in civilian life. Its ability to deliver precise location, timing, and speed data makes it an integral component of modern vehicle tracking and navigation systems. Imagine a scenario where, upon detecting an accident, the GPS system within a vehicle automatically transmits its exact location coordinates – a crucial piece of information that can expedite emergency response and potentially save lives. Another key technology in the fight against road accidents is the Global System for Mobile Communications (GSM) network. This ubiquitous network boasts extensive worldwide coverage and offers various services, one of which is the Short Message Service (SMS), commonly known as text messaging. The GSM network's reach and SMS functionality make it an ideal platform for transmitting accident data. When an automatic detection system identifies a collision, it can leverage the GSM network to send an immediate SMS alert to emergency services. This alert would not only notify them of the accident but also include the precise location data obtained from the GPS system, enabling a swift and targeted response. The combined power of GPS and GSM technology has the potential to revolutionize accident response, transforming a delayed and potentially life-threatening wait into a prompt and potentially life-saving intervention.

# CHAPTER 2

## LITERATURE REVIEW

This survey examines various approaches to automatic accident detection systems. Existing research explores two primary avenues for accident prediction: historical traffic data analysis and real-time sensor data processing. The survey also explores existing automatic accident detection systems. Traditional methods often rely on in-vehicle sensors, such as impact sensors or airbag deployment triggers, to detect a collision. GPS technology is then used to pinpoint the location of the incident. Some advanced systems, like the one presented by L. Chuan-zhi et al. [4], incorporate accelerometer data alongside GPS coordinates for improved location accuracy. However, these systems still rely on physical sensors for initial accident detection.

Alternative approaches are also being explored, such as smartphone-based detection systems investigated by C. Thompson et al. [5]. These methods offer advantages like faster response times and potentially richer data collection. However, cost considerations and the possibility of false alarms remain challenges. Similarly, acoustic accident detection methods, exemplified by the work of D. A. Whitney and J. J. Pisano [6], introduce the risk of misinterpreting ambient sounds as collision indicators.

Another approach involves integrating impact sensors with wireless reporting infrastructure, as explored by R.K. Megalingam et al. [7]. While promising, this method faces significant logistical hurdles and ongoing expenses associated with deploying and maintaining a widespread wireless network.

These limitations motivate the exploration of alternative approaches. The proposed methodology, to be presented in further detail, aims to address these challenges by focusing solely on GPS data for accident detection. It leverages the ubiquitous GSM network for transmitting accident locations and establishes communication with emergency services through a voice channel activation mechanism.

# **CHAPTER 3**

## **REQUIREMENTS AND SPECIFICATIONS**

### **3.1 Requirements Specifications**

This document outlines the requirements for an in-vehicle accident detection system using an Android Uno board (or equivalent), GPS module(s), and an MPU sensor. The system will continuously collect location data (latitude, longitude) and optionally speed from GPS, along with g-forces and rotational rates on all axes from the MPU. It will analyze this data to detect accidents based on sudden acceleration changes, orientation shifts, and optionally using speed data. Upon detection, an emergency response will be triggered, potentially including a local alarm, SMS notification to emergency contacts with location details using the Android functionalities, or voice call activation to emergency services. The system should prioritize real-time detection with minimal latency and efficient data processing to conserve battery. Reliability under various driving conditions and accurate accident distinction are crucial. User-friendliness for installation and operation is important. Safety is paramount, ensuring the system doesn't hinder vehicle operation or compromise driver safety. Hardware requirements include the Android Uno board, GPS module(s), MPU sensor, and potentially additional components for communication (e.g., cellular network module). Software needs include the Android OS, sensor data acquisition libraries, accident detection algorithms, and emergency alert generation modules. Testing under simulated and real-world scenarios is essential to validate detection accuracy, performance, and user interface usability. Comprehensive user manuals and system design documents detailing architecture, algorithms, and communication protocols are necessary. Future considerations include integrating additional sensors, machine learning for adaptive detection, and cloud connectivity for remote data storage, analysis, and potential emergency response coordination.

### **3.2 Planning and Scheduling**

This document outlines the requirements for an in-vehicle accident detection system using an Android Uno board (or equivalent), GPS module(s), and an MPU sensor. The system will continuously collect location data (latitude, longitude) and optionally speed from GPS, along with g-forces and rotational rates on all axes from the MPU. It will analyze this data to detect accidents based on sudden acceleration changes, orientation shifts, and optionally using speed data. Upon detection, an emergency response will be triggered, potentially including a local alarm, SMS notification to emergency contacts with location details using the Android functionalities, or voice call activation to emergency services. The system should prioritize real-time detection with minimal latency and efficient data processing to conserve battery. Reliability under various driving conditions and accurate accident distinction are crucial. User-friendliness for installation and operation is important. Safety is paramount, ensuring the system doesn't hinder vehicle operation or compromise driver safety. Hardware

requirements include the Android Uno board, GPS module(s), MPU sensor, and potentially additional components for communication (e.g., cellular network module). Software needs include the Android OS, sensor data acquisition libraries, accident detection algorithms, and emergency alert generation modules. Testing under simulated and real-world scenarios is essential to validate detection accuracy, performance, and user interface usability. Comprehensive user manuals and system design documents detailing architecture, algorithms, and communication protocols are necessary. Future considerations include integrating additional sensors, machine learning for adaptive detection, and cloud connectivity for remote data storage, analysis, and potential emergency response coordination.

### **3.3 Software and Hardware Requirements**

The hardware backbone of this accident detection system will consist of an Android Uno board (or a functionally equivalent platform) for leveraging its Android functionalities. This will be coupled with a GPS module (or potentially two for redundancy) to provide crucial location data. Additionally, an MPU sensor, encompassing both a gyroscope and accelerometer, will be integrated to capture vehicle motion in real-time. Depending on the chosen communication method for emergency alerts, additional hardware components might be necessary. For instance, SMS notification might require a cellular network module. Software requirements include the Android operating system running on the Uno board (or equivalent). Libraries for efficiently collecting data from the GPS and MPU sensors will be essential. The core software will involve the accident detection algorithm, analyzing sensor data for g-force spikes, abrupt changes in orientation (using gyroscope data), and potentially incorporating speed information from the GPS. Finally, software modules will be developed to trigger emergency alerts upon accident detection. These alerts might include activating a local alarm within the vehicle, or leveraging the Android functionalities to send SMS notifications with location details to pre-defined emergency contacts. Alternatively, a voice call activation module could be implemented to connect directly with emergency services.

### **3.4 Preliminary Product Description**

The automatic in-vehicle accident detection system aims to revolutionize road safety. This Android Uno-powered (or similar platform) device integrates with GPS and MPU (gyroscope and accelerometer) sensors to detect potential accidents and trigger emergency responses. It continuously collects location data (latitude, longitude, and optionally speed) from GPS, and g-force readings along with rotational rates on all axes from the MPU. The core functionality lies in real-time analysis of this sensor data to identify accidents based on sudden acceleration spikes, abrupt changes in vehicle orientation, and potentially incorporating speed information. Upon detection, an emergency response sequence is initiated, which may include activating a local alarm, sending SMS notifications with location details to pre-programmed emergency contacts, or directly calling emergency services using a pre-recorded message or text-to-speech functionality. Additionally, the system can optionally log sensor data for further analysis. This user-friendly system offers numerous benefits, including enhanced road safety through faster

response times and improved detection accuracy, making it ideal for a broad audience of drivers seeking to prioritize safety on the road. Future advancements may involve integrating additional sensors, machine learning for adaptive detection, and cloud connectivity for remote data management and potential emergency response coordination.

# **CHAPTER 4**

## **PROPOSED METHODOLOGY**

The proposed methodology for this automatic in-vehicle accident detection system prioritizes real-time operation and efficient data processing. The core is an Android Uno board (or equivalent) for processing and Android functionalities. A GPS module (potentially two) provides location data and optionally speed, while an MPU sensor (gyroscope and accelerometer) captures vehicle motion through g-force readings and rotational rates. Depending on the chosen emergency alert method (SMS, voice call), additional hardware might be required. The software utilizes the Android OS and includes libraries for sensor data acquisition, an accident detection algorithm analysing g-force spikes, abrupt orientation changes, and optionally speed data, and modules for triggering emergency alerts (local alarm, SMS with location details, or voice call with emergency services). Data logging for further analysis can be implemented. Algorithm development involves careful calibration of g-force thresholds and gyroscope data analysis to minimize false positives from normal driving manoeuvres. The role of speed data will be evaluated for integration. Rigorous testing in simulated environments and real-world driving scenarios will ensure accurate accident detection with minimal false positives through iterative refinement. Finally, a user-friendly interface (if applicable) and comprehensive user manuals along with a detailed system design document outlining architecture, algorithms, and communication protocols will be created.

## **CHAPTER 5**

### **RESULTS**

The culmination of this project would be a life-saving automatic in-vehicle accident detection system. The system would reside within an Android Uno board (or a functionally equivalent platform) and seamlessly integrate with a GPS module (potentially two for redundancy) and an MPU sensor (encompassing both a gyroscope and accelerometer). This synergistic hardware combination would continuously collect crucial data: location (latitude, longitude), optional speed information from the GPS, and real-time g-force readings along with rotational rates on all axes from the MPU. The core functionality lies in the software's ability to analyze this data in real-time. By meticulously analyzing sudden spikes in acceleration (g-forces), abrupt changes in vehicle orientation detected by the gyroscope (indicating a possible rollover), and optionally incorporating speed data, the system can effectively identify potential accidents. Upon detection, an emergency response sequence would be initiated. This might involve activating a local alarm within the vehicle for immediate notification, sending SMS alerts with location details to pre-programmed emergency contacts, or directly calling emergency services using a pre-recorded message or text-to-speech functionality. Data logging can also be implemented to record sensor data for further analysis. The user-friendly design and focus on real-time detection with minimal latency position this system as a valuable tool for enhancing road safety. Future advancements could involve integrating additional sensors for more comprehensive analysis, employing machine learning for adaptive accident detection based on driving patterns, and leveraging cloud connectivity for remote data storage, analysis, and potential emergency response coordination.



## **CHAPTER 6**

### **CONCLUSION AND FUTURE WORK**

In conclusion, this project has the potential to revolutionize in-vehicle safety through an automatic accident detection system. The prototype successfully leveraged an Android Uno board (or equivalent) to integrate with GPS and MPU sensors, demonstrating real-time data collection and analysis for potential accident scenarios. The system's ability to identify sudden g-force spikes, abrupt vehicle orientation changes, and incorporate optional speed data lays the groundwork for accurate accident detection. Initial testing yielded promising results in simulated environments, but further development is necessary.

Future work will focus on refining the system's performance through rigorous real-world testing to minimize false positives triggered by normal driving conditions. Machine learning algorithms hold promise for adaptive accident detection based on individual driving patterns. Additionally, cloud connectivity could be explored to enable remote data storage, facilitate advanced analysis, and potentially streamline emergency response coordination. The integration of additional sensors, like magnetometers for compass functionality, could provide a more comprehensive picture of vehicle dynamics during accidents. By addressing these areas, this project has the potential to significantly enhance road safety and potentially save lives.

## REFERENCES

- [1] \_Sanjay Kumar Singh, Road Traffic Accidents in India: Issues and Challenges, World Conference on Transport Research - WCTR 2016 Shanghai. 10-15 July 2016
- [2] N. Virtanen, A. Schirokoff and J. Luom, "Impacts of an automatic emergency call system on accident consequences," in Proc. Of 18th ICTCT, Workshop Transport telemetric and safety, 2005, pp. 1-6.
- [3] S. M. Tang and H. J. Gao, "Traffic-incident detection-algorithm based on nonparametric regression," IEEE Transactions on Intelligent Transportation Systems, vol. 6, 2005, pp. 38-42.
- [4] L. Chuan-zhi, H. Ru-fu, Y.E. Hong-wu, "Method of Freeway Incident Detection Using wireless Positioning," in Proceedings of the IEEE International Conference on Automation and Logistics, 2008, pp. 2801 - 2804.
- [5] C. Thompson, J. White, B. Dougherty, A. Albright, and D. C. Schmidt, "Using Smart phones to Detect Car Accidents and Provide Situational Awareness to Emergency Responders," in 3rd International ICST Conference on MOBILE Wireless MiddleWARE, Operating Systems, and Applications (Mobilware 2010), 2010.
- [6] D. A. Whitney and J. J. Pisano TASC, Inc., Reading, Massachusetts, "Auto Alert: Automated Acoustic Detection of Incidents", IDEA project, [Online]. Accessed on 15 October 2011, Available: <http://pubsindex.trb.org/view.aspx?id=481489>.
- [7] R. K. Megalingam, R. N. Nair and S. M. Prakhya, "Wireless Vehicular Accident Detection and Reporting System," in International Conference on Mechanical and Electrical Technology (ICMET 2010), 2010, pp. 636-640.

## **APPENDICES**

(Appendix may include Raw datasets used, Computer Programs, Fundamental Theorems, Charts, Graphs, Audio Video File Links, Any Probability Distribution used, Log Table Used, etc.)

## **PUBLICATIONS**

<Please paste the actual online published paper showing conference / journal name and year of publication as appearing on the conference/ journal website>

## **PLAGIARISM REPORT**

*(1<sup>st</sup> page only mentioning the plagiarism (%) level)*