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Review Artificial Intelligence Technique for Accident Detector in Road Transport Systems

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Abstract
Road traffic security is a major apprehension, especially in the areas with the challenging landscapes, blind spots, and limited communication networks. The traditional accident detection systems repeatedly fail due to their dependence on real-time data and manual activation. This research explores the use of ML and AI-powered IoT systems to improve disaster finding and security of drivers. By analyzing the behavior of vehicles and the patterns of driver fatigue, AI models can precisely detect accidents and send real-time alerts through GSM/GPS to crisis contacts and the hospitals.
A key focus of this study is to develop an AI-based system for the detection of driver fatigue using eye movement analysis and to replace the traditional blink sensors for better accuracy. Similarly, automated speed control and obstacle monitoring using AI can improve accident prevention by detecting potential risks. Unlike conventional methods, our system operates efficiently even in the areas with poor connectivity, ensuring faster emergency response.
Based on previous studies, we identified key challenges and improved the technique to enhance road planning, traffic management, and accident prevention strategies. By integrating machine learning, IOT, and real-time data processing, this study presents a scalable, cost-effective, and intelligent road safety solution, contributing by reducing deaths and advancing AI-driven transportation safety systems.
Keywords: *Road traffic security, AI-powered IoT systems, GSM/GPS, challenges*

1. INTRODUCTION

Road safety remains a major concern, especially in the hilly areas where sharp turns, steep slopes, and blind spots make driving dangerous. Annually, 1.35 million people lose their lives in travel accidents, while 20 to 50 million suffer minor injuries, also leading to disabilities. On a global scale, the cost of traffic accidents is $518 billion, with national costs ranging from 1% to 2% of GDP [1].
Current accident detection systems require manual activation, making them ineffective in all critical conditions. Moreover, the existing solutions lack automated speed control and real-time alerts for emergency response. A smart AI and IoT-based scheme are necessary to become aware of road accidents automatically, fling real-time information through GSM/GPS, and to reduce risks by notifying hospitals, police, and emergency contacts [2].
AI and ML play a vital role in predicting the role of accidents and driver fatigue. This study explores AI and ML applications in road safety, addressing key challenges in immediate motor vehicle tracking, traffic management, and Internet of Vehicles integration [3]. The research

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also investigates the impact of 5G and 6G technology on top of transportation systems for improved safety.

The proposed system introduces an AI-powered smart IoT solution that enhances road safety through:

- **Self-regulated accident detection & alerts** – Instantly notifying emergency services and reducing response time.
- **AI-based driver fatigue monitoring** – Evaluating eye movements to detect sleepiness and prevent fatigue-related accidents.
- **Speed control using AI algorithms** – Automatically reducing excessive speed in vital situations.
- **AI-Driven Alerts for Driver Awareness** – Providing real-time warnings to reduce accidents caused by lack of focus.
- **Blockage Distance Monitoring** – Using AI-powered computer vision to prevent accidents [4].

By utilizing AI, IoT, and advanced wireless communication, this system aims to minimize road accidents, improve emergency response, and enhance overall transportation safety.

2. KEYWORDS

Road Traffic Safety, AI-Based Accident Detection, Machine Learning in Transportation, Driver Fatigue Monitoring, Real-Time Emergency Alert System

3. LITERATURE REVIEW

J.J. Leo et al. (2014) designed a road safety system using piezoelectric sensors. The system identifies vehicles on curved slopes and alerts drivers using LED lights. When a vehicle approaches, the sensor activates an LED on the opposite side to warn drivers to slow down and avoid accidents. A study by R. Ganiga et al. (2017) suggested the recognition of accidents using piezoelectric sensors. The result was emergency management with genuine data and help on time. Anuradha A. et al. (2018) proposed a Crucial Hint System to avoid accidents on sharp curves and foggy areas. The system captures the speed and distance data between vehicles and uses an algorithm to provide visual alerts for helping drivers to make safer decisions. R. C. Jing et al. (2019) developed an IOT-based driver assistance setup using sensors to measure the distance between the vehicles and the objects. It provides real-time road condition updates and safety suggestions to reduce accidents in hilly areas. S. Kumar and S. Srivastava (2019) proposed an "IOT-Based Accident Prevention System for Hilly Terrain." It uses sensors to monitor speed, acceleration, and angle, providing real-time alerts to drivers about dangerous curves or high speeds. T. Xiong et al. (2020) developed an IOT-based road safety system using road sensors and a vehicle-installed camera. It identifies dangers like sharp turns and warns drivers to slow down for reducing accidents in hilly areas. Machine learning is growing rapidly and impacting daily life. To combine it into road transportation, a proper framework is needed [5]. Algorithmic modeling approaches are based on training data which are categorized as supervised or unsupervised. Unsupervised algorithms group includes similar data while supervised algorithms classify input data and match them to expected results [6, 7]. Usually, disaster exposure and attentive methods are mostly categorized into 3 types:

1. **Elegant mobile system [8-12];**
2. **Hardware integrated systems [13–17];**
3. **Misfortune alert system [18–31]**

31. *Smart mobile systems*

Zhao et al. [8] used an accelerometer and GPS to detect accident sites but did not alert emergency services. Reddy et al. [9] improved this by sending accident alerts to hospitals via mobile, but their system relied on a single sensor, which could fail or cause false alarms. Hamid M. et al. [10] used G-force, noise, and speed for detection, but their system had a high false

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alarm rate at low speeds. Patel et al. [11] developed an Android app which used an accelerometer and GPS to find accidents and send voice to urgency numbers, but it also depended on a single sensor. Similarly, Isha Khot et al. [12] created an application which not only detected accidents using an accelerometer and GPS but also notified nearby users and emergency services. However, all these smart phone-based systems depend on the phone's sensors, making them unreliable if the sensor fails or if the phone is not in use. Additionally, they may generate false alarms, especially at low speeds.

3.2. *Hardware-Integrated Systems:*

Different accident detection infrastructures apply sensors to detect crashes and send alerts. These sensors are generally located exterior of car. D. Bindu et al. [13] developed a system using a vibration sensor and microcontroller (AT89S52). It detects accidents and sends alerts to emergency numbers but does not assist save missions. A. Sheik et al. [14] proposed an IoT-derived system that collects mishap data using a GPS sensor and accelerometer. It sends messages to the emergency contacts with accident details to help ambulances reach the location quickly. C. Nalini et al. [15] designed a similar IOT-based system with a vibration sensor, buzzer and GPS. If the buzzer is not turned off within a minute of an accident, an alert is sent to urgency contacts. C.Dashora et al. [16] presented another IOT-based infrastructure where accident details are sent to a customer care centre and a person calls the nearest hospital. This method requires human involvement. N.K. Karanam et al. [17] developed a completely automated system using a crash sensor and GPS, removing the need for human intervention. The main limitation of IOT-based systems is their high cost compared to smart phone-based solutions. However, their accuracy could be improved using AI techniques.

3.3. *Accident alert system:*

Some accident detection and rescue systems use a combination of IOT and deep learning. Fugue et al. [18] created a system using an on OBU to collect accident-related data like speed and airbag status and then send it to the cloud for the machine learning-based accident prediction. The main issue is that not all vehicles support an OBU, R. Gokul et al. [17] presented a deep learning (DL)based system where a Wi-Fi camera on highways records traffic and send it for the for-video cassette psychiatry. If an accident is identified, an alert is sent to a control room. S.ghoseet al. [19] introduced a system using CNN to categorize live video footage as "accident" or "non-accident." The model was trained using YouTube videos and claimed 95% accuracy but does not handle rescue operations C.Wang.et.al.[20] used Yolo,v3 mock-up for accident discovery in various weather conditions, claiming 95.2 percent accuracy with a 7.5 percent false apprehension speed Akash Bhakat et.al.[21] utilized IOT & ML for mishap recognition. Instead of cloud processing, they used fog computing for local processing. However, accuracy may be low due to complex input data. Jae Gyeong Choi et, al. [22] proposed a collective deep learning method using dashboard cameras. The system relies on video and audio data but may fail if the camera is damaged in an accident. HawzhinHozhabr Pour et al. [23] combined CNN and SVM for accident detection, achieving 85% accuracy, which may not be dependable for original world use. A. Comiet, al. [24] used data mining to evaluate road accident patterns in Rome (2016–2019). Networks and k-means were best for evaluation, while neural networks and decision trees worked better for prediction. L. Li et al. [25] analyzed deadly accident data using association rules (Apriority algorithm) and k-means clustering to identify major accident causes (drunk driving, weather, road conditions, etc.). S.A. Samerei [26] studied bus accidents in Victoria, Australia (2006–2019) using association rules to identify key causes. Esparto, et al. [27] second-hand "path analysis "find a positive correlation between vehicle speed and crash frequency. G. Singh et, al.[28] urbanized an easy Dlreplicaintended for accident prediction but used only 148 sample which is not enough deep learning (Dl) preparation. Deep learning (Dl) is gaining popularity in accident detection, but

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most systems rely on highway cameras that send footage to the cloud for classification. The biggest challenges include a lack of accident datasets, camera maintenance issues, and low visibility in bad weather. Using pre-trained models can improve accuracy. [32]

TABLE .1 LITERATURE REVIEW

S.NO	AUTHOR NAME	TITLE OF THE PROJECT	YEAR	DESCRIPTION
1	J. J. Leo et al.	Road Safety System Using Piezoelectric Sensors	2014	The system detects vehicles on curved slopes and alerts drivers with LED lights. The sensor activates an LED on the opposite side when a vehicle approaches, warning the driver to slow down and avoid collisions.
2	R. Ganiga et al.	Mishap Recognition Using Piezoelectric Sensors	2017	The system uses piezoelectric sensors to recognize accidents and provides timely emergency services with accurate accident information and assistance.
3	Anuradha A. et al.	Critical Hint System for Preventing Accidents	2018	This system captures speed and distance data between vehicles and uses an algorithm to provide visual warnings in sharp curves and foggy areas, helping drivers make safer decisions.
4	R. C. Jing et al.	IOT-Based Driver Assistance System	2019	This system uses sensors to measure the distance between vehicles and objects and provides real-time reports on road situations and security suggestions to help reduce accidents in hilly regions.
5	S. Kumar and S. Shrivastava	IOT-Based Accident Prevention System for Hilly Terrain	2019	The system monitors speed, acceleration, and tilt to provide real-time alerts to drivers about dangerous curves or high speeds, improving safety in hilly terrain.

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6	T. Xiong et al.	IOT-Based Road Safety System	2020	This system uses road sensors and a vehicle-mounted camera to detect hazards such as sharp turns and warns drivers to slow down. It aims to reduce accidents in hilly areas.
8	Zhao et al.	Accident Detection Using Accelerometer and GPS	2018	Used accelerometer and GPS to detect accident areas but did not alert urgency services.
9	Reddy et al.	Accident Recognition with Alert System	2019	Improved upon Zhao's system by sending accident alerts to hospitals via mobile but relied on a single sensor by increasing the danger of failure or false alarms.
10	Hamid M. et al.	G-Force and Speed-Based Accident Detection	2020	Used G-force noise speed accident detection. However, the system had a high false alarm rate when accidents occurred at low speeds.
11	Patel et al.	Android App for Accident Detection	2020	Residential Androids functions as tousle an accelerometer &GPS for detecting accidents and sending voice alerts to emergency numbers. The system is dependent on a single sensor to make it unstable if the sensor fails.
12	Isha Khot et al.	Smartphone-Based Accident Detection System	2020	Created an app that detects accidents with an accelerometer and GPS. It's notifying nearby users and emergency services. The system is also dependent on Smartphone sensors which can fail and cause false alarms at low speeds especially.
13	D. Bindu et al.	Transport Mishap &attentive scheme	2020	Used a quivering antenna& microcontroller (AT89S52) form shap finding. It sends alerts to emergency numbers but does not support liberate operations.

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14	A. Sheik et,al.	IOT-Based mishap Alert & Rescue scheme	2020	An IOT-based system that collects accident data using GPS and accelerometer sensors. It sends messages to emergency contacts with accident details, helping ambulances reach the location quickly.
15	C Nailing et,al	IOT-Based mishap finding &announcement scheme	2020	Developed a similar IOT-based system with vibration sensors, buzzer, and GPS.
16	C. Dashboard et al,	IOT-Based mishap discovery scheme	2020	Introduced an IOT-based system where accident details are sent to customer care center &a person calls the adjoining sanatorium, requiring person involvement.
17	N.K Karanam et al.	Completely automatic IOT based mishap discovery scheme	2020	Developed a entire Lyme chemical mishap discovery scheme using run into sensors& GPS, removing the need for human intervention. The main drawback is its high cost compared to Smartphone-based systems. Accuracy can be improved with AI techniques.
18	Fogue et al.	IOT & DL based mishap discovery	2018	Used an OBU to collect data like speed and airbag status and then send it to the cloud for machine learning-based accident prediction.
19	R.gokul et,al	DL based mishap finding	2019	Introduced animation with a Wi-Fi camera on highways that records traffic and sends information to shade for video analysis
20	S. ghose et al.	CNN-Based Accident Detection System	2019	Used convolution neural networks (CNN) to organize be alive videocassette footage into "accident" or "non-accident" categories. Trained on YouTube videos, with claimed accuracy of 95%. Does not handle set free operation.

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21	C. Wang et al	YOLO v3-Based Accident Detection	2020	Used the YOLO v3 model for accident detection in various weather conditions. Claimed accuracy of 92.5 percent with a 7.5 percent false fear rate.
22	Akash bhakat et al.	IOT and Machine Learning (ML) detection system	2020	Used IOT& machine learning (ML) for mishap uncovering. Data is processed using fog computing instead of cloud though accuracy may be low due to the complexity of input data.
23	Jae gyeong choi et al	Ensemble DL Model for accident detection	2020	Used a combination of videocassette and acoustic information from control panel cameras for DL Model.
24	Haw him Hzhabr pur et al.	CNN and SVM-Based Accident Detection	2020	Combined CNN and SVM for accident detection, achieving 85% accuracy.
25	A. Comi et.al.	Data Mining for Accident Pattern Recognition	2020	Used data mining technique to analyze road accident patterns in Rome from 2016–2019. Found that K-N and k-means NN & Decision Trees are better prognostic investigation.
26	L. Li et al.	Data Mining for Accident Cause Analysis	2020	Analyzed fatal accident data with the Apriori algorithm and k-means clustering to identify major causes of accidents, including drunk driving, weather conditions, and road surface issues.
27	S.A. Samerei	Bus Accident Analysis Using Association Rules	2020	Studied bus accidents in Victoria, Australia, from 2006–2019. Used association rules to identify key causes of accidents.
28	E. S. Part et al.	Vehicle Speed and Collision Frequency Analysis	2020	Used "path analysis" to find a positive correlation between vehicle speed and crash frequency.

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29	G Singh et al	DL mock-up for mishap forecast	2020	Developed a basic deep earning model

4. EXISTING METHODOLOGY

The current system uses machine learning to detect accidents, without relying on traditional sensors. It analyzes data from the vehicle and sends the location of the accident to nearby hospitals, friends and family via GSM/GPS. Instead of using sensors like speed or pressure, the system uses machine learning models to identify accident signs and send alerts. The previous method for detecting driver fatigue, which used an eye blink sensor, is now improved with machine learning. It analyzes eye movements and blinking patterns to detect drowsiness and prevent accidents caused by fatigue.

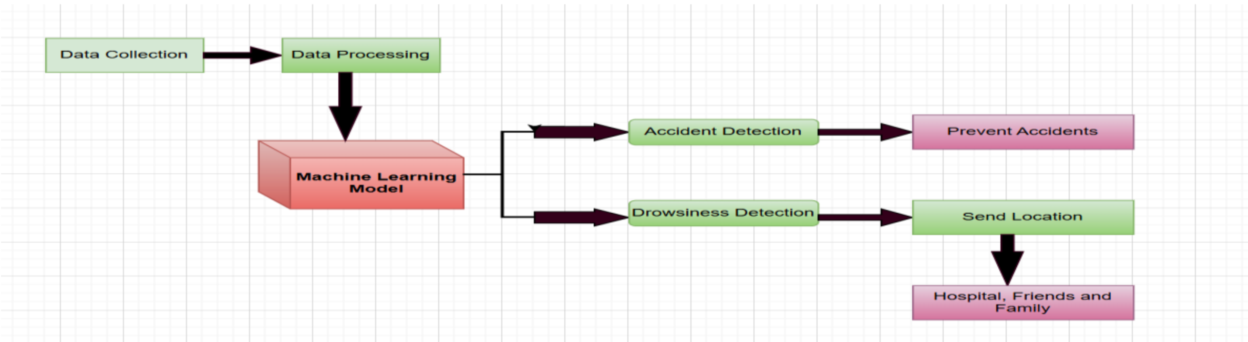

Fig 1: Basic Block Diagram

5. ADVANTAGES

- **No need for traditional sensors**
  Reduces hardware dependency and costs. Works in a variety of vehicles without additional installations.
- **Improved correctness with machine learning**
  Identifies accidents and sleepiness more successfully than classic methods. Evaluate multiple data points (e.g., vehicle behavior, eye movements) for better detection.
- **Real-time alerts via gsm /gps**
  Sends accident location instantly to emergency contacts and hospitals. Reduces response time, increasing chances of survival.
- **Enhanced Driver Fatigue Detection**
- Evaluates eye movements and twinkling patterns rather than relying on basic eye blink sensors.
  More accurate in detecting drowsiness and stopping accidents.
- **Flexibility and Steady Improvement**
  ML models can be updated and enhanced over time with more data. It can fit to different driving conditions and driver habits.

6. DISADVANTAGES

- **High Data Obligation**– Requires large datasets for correct ML model training.
- **False Identifications**– May stimulate incorrect alerts or miss genuine accidents.
- **Complicated Implementation** – Needs ML mastery and is harder to combine than sensor-based systems.

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- **Connectivity Issues** – Depends on GSM/GPS, which may fail in isolated areas.
- **Privacy Dangers**– Collecting vehicle and driver data raises safety concerns.

7. RESULT AND CONCLUSION

The machine learning-based accident identification and sleepiness prevention system enhances road safety by removing the need of traditional sensors. By analyzing vehicle data and driver behavior, it ensures exact accident detection and real-time alerts through GSM/GPS. As machine learning and AI continue to advance, these systems will become more accurate, flexible, and vital for modern transportation safety.

8. Future scope

- **Modern Accident Detection** – AI models will enhance correctness using cloud-based learning and global data.
- **V2X Interaction**– Real-time data sharing with smart traffic systems will upgrade road safety.
- **Smart Urgency Response** – AI will assess accident seriousness and enhance ambulance transmission.
- **Enhanced Sleepiness Detection** – Future systems will combine facial recognition and physiological monitoring.
- **Smart City Integration**– AI-driven traffic management will reduce blockage and improve road planning.
- **Personalized Driver Assistance** – AI will analyze driving behavior and combine with wear ables for safety alerts.

As AI and IOT develop, these systems will become essential for intelligent transportation and accident prohibition.

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