Road Accident Detection & Prevention using Alert System and Arduino

A Project Work Synopsis

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Abstract

Why not use today's technology to save lives and avoid accidents? Technology has advanced rapidly and now affects practically everyone's life to the point that the average person begins their day by checking their phone. Many automobile accidents happen on ghats in hilly terrain, and because nobody is present to watch the situation and warn the authorities, the victims frequently perish. Additionally, the most frequent cause of these collisions is that the drivers are unaware of another car approaching them in certain ghats. So, the suggested system can be used to solve this issue. When a vehicle approaches from the opposite direction in the proposed system, it may cause an accident, thus it offers accident prevention before it happens. If a moving vehicle is detected approaching from the other side of the road, an indicator will light up. And if an accident occurs, AI technology is utilised to identify them and notify the closest police station and hospitals through email, along with the location of the event. As a result, the victim's life might even be saved before the emergency services arrive. Additionally, as mentioned in the context of the environment, thermal cameras are used to estimate the number of casualties and count the number of fatalities in accidents in order to provide accurate aid.

Keywords:

1. Lidar and Radar Sensors
2. GPS Module
3. Environment Sensors
4. Communication Modules
5. IOT Gateway
6. Communication Protocol
7. Data Logging Tools

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1. INTRODUCTION

1.1 Problem Definition

The issue being addressed is how to integrate AI and IoT technology to improve traffic safety and accident avoidance. Using real-time data from vehicle sensors, current weather conditions, and previously reported incidents, this entails creating predictive models for possible accidents. Artificial intelligence (AI)-driven traffic control systems improve flow, reduce congestion, and lessen sudden pauses. Driver behaviour analysis can identify reckless or distracted driving and encourage safer driving habits. IoT-enabled infrastructure and vehicle connection facilitates the exchange of road data, while emergency response systems speed up assistance. To build a comprehensive, cutting-edge road safety ecosystem, the programme also focuses on data integration, infrastructure monitoring, public education, and policy creation.

1.2 Problem Overview

The current transportation system frequently encounters issues including human error-related accidents, heavy traffic, vulnerable infrastructure, and sluggish emergency response times. These problems add up to financial losses, property damage, and fatalities. The traditional approaches to managing traffic safety and responding to accidents are frequently reactive and deficient in real-time intelligence.

1.3 Hardware Specification

- Lidar and Radar Sensors
- Camera
- GPS Module
- Environment Sensors
- Communication Modules
- IOT Gateway
- Communication Protocol
- Data Logging Tools and Reliable Power Sources

1.4 Software Specification

1. Arduino IDE
2. Programming Languages and IDE’s
3. Programming Libraries like:- NumPy, TensorFlow, PyTorch, etc.

2. LITERATURE SURVEY

2.1 Existing System

The current system of traffic safety and accident prevention mostly relies on human intervention and conventional traffic control techniques. It includes reactive emergency response systems, limited monitoring of the state of the roads, and manual traffic signal control. The following are the main components of the current system:

Traffic signals are manually set or pre-programmed based on historical traffic patterns, which can cause congestion during rush hours and even accidents from sudden halt.

Limited Data Utilisation: Traffic camera and sensor data are frequently underutilised, and it's possible that accident data from the past can't be properly analysed for future insights.

Reactive Emergency Response: Eyewitness accounts or calls to emergency services are extensively relied upon for accident identification and emergency response, which causes delays and longer response times.

2.2 Proposed System

Through the integration of AI and IoT technologies, the suggested system seeks to revolutionise traffic safety and accident avoidance. It promises a proactive and data-driven strategy to improve traffic safety and lower collision rates. The following are the system's salient characteristics:.

Utilising AI algorithms, AI-Powered Traffic Management automatically modifies traffic signals, speed restrictions, and route suggestions based on current traffic circumstances, reducing congestion and abrupt pauses.

Predictive accident prevention uses AI models to identify probable accident-prone conditions by analysing real-time data from car sensors, weather sources, and past accident records. Drivers and authorities are given early warnings so they can take preventive action.

Vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication: IoT-enabled communication enables vehicles to communicate real-time information on traffic conditions, dangers, and collisions, enabling safer decision-making and lowering accidents.

Driver Behaviour Analysis: AI examines patterns of driving behaviour using both internal and exterior vehicle sensors. Real-time feedback is given to drivers to promote safer driving habits and decrease instances of aggressive or distracted driving.

3. PROBLEM FORMULATION

The primary issue is the consistently high number of traffic accidents, which frequently cause fatalities, property damage, and financial losses. The methods of traffic management now in use are rigid and incapable of being adjusted to changing traffic situations. The inability of manual traffic signal regulation and predetermined speed limits to account for the dynamic nature of traffic flow results in peak-period congestion, sudden stops, and higher accident risks. In addition, emergency response systems' reactive character, which depends primarily on eyewitness accounts and delayed communication, results in shorter response times and diminished effectiveness in saving lives. These difficulties are made more difficult by the current system's inability to fully utilise the data that is currently accessible. Additionally, there is a paucity of driver behaviour analysis, which leaves issues like aggressive driving, distracted driving, and exhaustion unresolved. The proposed system is a comprehensive solution that includes cutting-edge technology, offering a paradigm change. When AI algorithms are used for traffic management, real-time data can be used to dynamically change traffic signals, speed limits, and route suggestions. As a result, accident risks are reduced and traffic congestion is lessened, along with the chance of abrupt stops. Furthermore, AI-driven prediction algorithms identify potentially accident-prone conditions by analysing real-time data from various sources, such as vehicle sensors and weather updates. Authorities and drivers can take preventive action before an accident occurs thanks to timely alerts. The fusion of IoT-enabled communication between infrastructure and automobiles creates a network for the instantaneous transmission of vital information. Vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication gives drivers knowledge about the state of the road, potential dangers, and crashes, enabling them to make better decisions and drive more safely. The multifaceted strategy of the project includes enhancements to emergency response. IoT sensors quickly identify accidents and launch automatic alerts to emergency services, speeding up reaction times and improving accident management effectiveness. Using AI and IoT technology, the "Road and Accident Prevention Using AI and IoT" initiative seeks to enhance transport infrastructure and boost traffic safety. Its scope covers a wide range of technologies, systems, and elements and offers a comprehensive approach. IoT sensors and devices must be installed in order to gather real-time data on traffic, weather, road conditions, and vehicle speeds. AI algorithms can foresee and prevent accidents after analysing this data for patterns and potential dangers. The project incorporates real-time alert systems for informing drivers, pedestrians, and authorities of risks as well as vehicle-to-vehicle and vehicle-to-infrastructure communication for coordinated operations. Also included will be AI-powered driver assistance systems like adaptive cruise control and collision avoidance.

4. OBJECTIVES

By utilising cutting-edge technologies, the "Road and Accident Prevention using AI and IoT" initiative seeks to improve road safety. The initiative seeks to improve traffic safety and avoid accidents by combining IoT sensors, cameras, and AI algorithms. Traffic patterns and potential dangers will be revealed via real-time traffic monitoring and analysis. Artificial intelligence (AI) models will identify accident-prone locations and warn drivers and authorities to take safety precautions. Real-time alerts regarding threats including lane changes and pedestrians will be provided by driver assistance systems. By adjusting signal timings depending on actual traffic flow, intelligent traffic signalling will ease congestion. By identifying pedestrians at junctions and altering traffic signals accordingly, the project will also put pedestrian safety first. The information gathered will enable better urban planning, more efficient road safety measures, and informed policymaking. Through Internet of Things (IoT) devices that alert authorities automatically, emergency response will be optimised. The project will increase public awareness of defensive driving techniques and the contribution of AI and IoT to traffic safety. The project's success is ensured by cooperation with regional organisations and ongoing algorithm improvement. The project's ultimate goal is to lower the number of collisions, injuries, and fatalities while promoting safer roads for all users.

5. METHODOLOGY

Planning the project and defining the scope:

1. Establish the aims, targets, and boundaries of the project.

2. Determine the sites where IoT sensors, cameras, and AI systems should be installed.

3. Establish a budget, timeframe, and resource allocation for the project.

4. Data gathering and infrastructure configuration: Install Internet of Things sensors, cameras, and communication equipment at key locations including crossroads, sections of road, and pedestrian crossings.

5. To gather and interpret data from sensors and cameras, establish a central data hub.

6. Gathering and Processing Data: Utilise IoT sensors and cameras to gather real-time information about traffic flow, road conditions, weather, and vehicle movement. This data should be safely processed and stored in a database or cloud environment.

7. AI Model Construction: Create AI systems that forecast accidents, analyse traffic in real-time, and help drivers. Utilise historical traffic data, accident reports, and other pertinent information to train AI models.

8. Identify high-risk zones and potential collision scenarios by implementing accident prediction models. AI alerts should be incorporated into driver assistance systems to notify drivers to potential dangers.

9. Assistance for Drivers and Communication: Design user interfaces for smartphone apps and in-car screens so that drivers may receive notifications in real time.Create algorithms that determine safe following distances, recognise pedestrians, and detect lane departure.

10. Intelligent Traffic Signalling: Create algorithms that modify the timing of traffic signals based on current levels of traffic flow and congestion.Implement communication protocols between traffic signal controllers and the central system.

11. Safety for pedestrians and emergency response: Create pedestrian detection models for crosswalk safety using AI and video data.To notify authorities in the event of an accident, integrate automatic emergency notification systems.

12. Data analysis and suggested policies: To find accident trends, traffic patterns, and contributory causes, analyse the data that has been collected. To help local authorities develop policies and enhancements for improving road safety, produce reports and suggestions.

13. Public Education and Awareness: Create instructional resources, public awareness campaigns, and seminars to inform people about safe driving habits and the advantages of the AI/IoT system.

14. Iteration and testing: Test the entire system thoroughly in controlled settings and real-world situations. To make the necessary adjustments and enhancements, get input from users and authorities.

15. Deployment and Upkeep: Install the system in the chosen places, making sure it is properly integrated with the infrastructure already in place. Make a maintenance schedule to check sensors, update AI models, and fix any technical problems.

6. EXPERIMENTAL SETUP

Breathalyzer Testing Stations:

- Install breathalyser testing stations at strategic locations such as bars, clubs, and busy nightlife areas.
- Encourage patrons to voluntarily test their alcohol levels before driving.
- Offer incentives such as discounts or vouchers for using the breathalyzer and choosing alternative transportation if over the legal limit.

Ignition Interlock Devices:

- Mandate the installation of ignition interlock devices for individuals convicted of driving under the influence (DUI) offenses.
- These devices require the driver to provide a breath sample before starting the vehicle. If alcohol is detected, the vehicle won't start.
- Implement a system to regularly monitor the functionality of these device.

Sobriety Checkpoints:

- Conduct random sobriety checkpoints in areas with a history of drink and drive incidents.
- Use law enforcement officers to test drivers for alcohol impairment.
- Impose immediate penalties on individuals found to be driving under the influence.

7.CONCLUSION

The smart city's great road system has led to more road accidents as a result of people driving their cars at excessive speeds. Many fatalities still occur despite the development of several accident detection and prevention techniques. Poor automatic accident recognition, ineffective warning, and emergency service responses, at the very least, contribute to some of the issue's deterioration. In order to detect the accident in the first phase, an IoT kit is used. In order to confirm the results of the IoT model and carry out the rescue operation in the second phase, a deep learning-based model is used. The Internet of Things (IoT) module uses a force sensor to measure impacts on cars and a speed sensor to assess how fast they are travelling. The second step makes use of pre-trained models, particularly VGGNet and InceptionResNetV2, to lower the false detection rate and activate the rescue module. Activating a rescue module and sending information to the neighbourhood police station, hospitals, and family members are done if the deep learning module identifies an accident. With the help of the proposed model, we can lessen the amount of fatalities resulting from an accident's scene being devoid of emergency personnel. Because IoT and AI were integrated, the model had almost no false positives during training and incredibly few during testing. In order to address this issue in future work, we wish to address the fact that the suggested model does not account for the security component. The proposed model may additionally.

8. TENTATIVE CHAPTER PLAN FOR THE PROPOSED WORK

CHAPTER 1: INTRODUCTION

Accident rates have drastically climbed in recent years. Because to the growth in employment, more people are using bikes and cars, which increases the risk of accidents from overspeeding. Due to the lack of sophisticated procedures and the danger posed by excessive speed, the rate of accidents cannot be reduced. This report proposes a remedy to lower the accident rate in the nation. Systems for automatically detecting and alerting to accidents are now available. The major goal is to stop the accidents by employing wireless communication techniques to send a message to the registered mobile, hospital, and police station. When an accident happens anywhere, the message is quickly transmitted to the registered mobile phone using the GSM module. The brain of the system, Arduino, assists in sending messages to various system components. When an accident occurs, the vibration sensor will be engaged, and the GSM module will transmit the information to the registered number. Locating the accident site will be made easier with the aid of the GPS device. Using GSM and GPS modules, the proposed system will determine whether an accident has occurred and notify nearby medical facilities and registered cell phones about the location of the accident. The coordinates of the place can be supplied through a tracking system to cover the area. A vibration sensor, one of the system's main modules, can identify the accidents.

CHAPTER 2: LITERATURE REVIEW

With the quick advance of modernization comes a chaotic rise in traffic, which worsens congestion and causes serious collisions and accidents, endangering many lives. 50 million individuals experience severe injuries from accidents each year, and 1.35 million people lose their lives as a result. Finding a workable solution is a top priority for India as it focuses on developing smart cities. The most effective way to use IoT and machine learning techniques and create a smart road safety system that will analyse the physical characteristics of vehicles and study the behaviour of drivers in order to effectively reduce traffic, shorten travel times, and aid in crash prevention. IoT and machine learning are two of today's most rapidly developing technologies. IoT refers to the internet-enabled exchange of information between various physical items that are equipped with sensors and software for data analysis and transmission. Due to the accessibility of inexpensive sensors and efficiency, IoT enables users to gather and analyse data with little to no human involvement. An IoT Platform, which connects devices and sensors, combines data and applies analytics to provide the most useful information. These IoT platforms make it simple to communicate pertinent information that may be used for problem detection and recommendation generation. Machine Learning is a developing field of computer and artificial science that focuses on using data and algorithms in a precise manner similar to how humans learn. Machine learning makes use of data, several algorithms, and statistical techniques to accurately comprehend, suggest, categorise, and detect various circumstances. Thus, we may create a highly effective and user-friendly road safety system using these burgeoning technologies. For instance, as mentioned in [6], the naturalistic driver behaviour is used to collect and analyse the data for traffic planning to maintain safety in order to address the issue of traffic congestion leading to crashes and accidents due to the increase in population during the 2022 World Cup in Qatar. An IoT-based solution is put into place that gathers information about the vehicle, such as the trip's duration, GPS location, maximum, minimum, and average speeds, in order to analyse the data and forecast accidents and the construction of new roads to avoid collisions. The actions of the driver, particularly their level of tiredness, are also taken into account. To measure drowsiness, a framework and an application based on deep learning are put into place.

CHAPTER 3: OBJECTIVE

By utilising cutting-edge technologies, the "Road and Accident Prevention using AI and IoT" initiative seeks to improve road safety. The initiative seeks to improve traffic safety and avoid accidents by combining IoT sensors, cameras, and AI algorithms. Traffic patterns and potential dangers will be revealed via real-time traffic monitoring and analysis. Artificial intelligence (AI) models will identify accident-prone locations and warn drivers and authorities to take safety precautions. Real-time alerts regarding threats including lane changes and pedestrians will be provided by driver assistance systems. By adjusting signal timings depending on actual traffic flow, intelligent traffic signalling will ease congestion. By identifying pedestrians at junctions and altering traffic signals accordingly, the project will also put pedestrian safety first. The information gathered will enable better urban planning, more efficient road safety measures, and informed policymaking. Through Internet of Things (IoT) devices that alert authorities automatically, emergency response will be optimised. The project will increase public awareness of defensive driving techniques and the contribution of AI and IoT to traffic safety. The project's success is ensured by cooperation with regional organisations and ongoing algorithm improvement. The project's ultimate goal is to lower the number of collisions, injuries, and fatalities while promoting safer roads for all users

CHAPTER 4: METHODOLOGIES

Hardware Device Figure 1 represents the methodology used in our paper. The device can be activated by just merely pressing the emergency button once. This device gets activated and sends instant location with a distress message to the police pre-set numbers through a GSM module3 . Figure 4 shows the triggering button and how the device looks like and when the emergency button is double clicked, the device sends both the distress message with instant location and records the audio of the incident. When the same button is long pressed it activated call to the police and sends message to the police instant location. The location is located using GPS (UBLOX). The audio is recorded using audio recorder and call is made from GSM modem respectively. This GSM Modem (sim 900) can accept any GSM network operator SIM card and act just like a mobile phone with its own unique phone number. The plus point of using this modem will be that you can use its RS232 port to communicate and develop embedded applications. It can be used to send and receive SMS4 or make/receive voice calls. The hidden camera detector can be used anytime to find whether there is any hidden camera in the surrounding to help our privacy. The hidden camera detector works with the help of RF signal interface. When the RF signal is interrupted, camera can be detected. We can also connect the device with our mobile (through Bluetooth HC05), to find our location even if our mobile is lost which can be activated by clicking tracking your mobile button5 and the location of the mobile is sent to the pre-set number.

Android Application Figure 2 represents the general methodology of the application. When you click on the application, there is a thread and then it leads title main page, which consists of simple user interface. Depending upon the problem, we can choose the icon, which will guide the user during emergencies6 . When you click on the following icons the following pages like hidden camera detector, women Security, SOS message, video recorder pages will be opened. In our application, the user gives the input either manually or by the volume button. First the user starts the application by going inside it by clicking on the application icon. Then a thread of 2 seconds is rendered which displays the name of the application. Then after this process ends, the user interface where the user can interact with the application is displayed. This page lets the user interact with our application. When the user clicks on the each icon, it leads to that respective page7 . The 4 different icons used in our application is the woman safety, SOS message, video recorder, hidden camera. When you click on the emergency button (volume key+ power button), the application gets opened automatically then sends an emergency message and audio is recorded and sent to the pre-set contacts.

CHAPTER 5: CONCLUSION AND FUTURE SCOPE

Future technology will make it simple to create a tiny version of this intelligent system that can be utilised everywhere. It will be very beneficial for safety measures, and the accident rate will significantly drop. Additionally, it will be significant for the vehicle sector.

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