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INTELLIGENT ACCIDENT DETECTION AND SMART ALERT SYSTEM FOR VEHICLES

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Abstract

The speed of our lives has been boosted with the advancement in the transportation system. In the present time, road traffic accidents have become a global concern all over the world. Road traffic accidents are considered as one of the prominent reasons for the reduction of life period, loss of lives, properties, and time. The death rate among people is rapidly increasing with the rapid increment in road accidents. For the victims, an accident acts as a catastrophic condition in the case when it occurs at the highways. In this article, an intelligent accident detection has been developed to detect accidents on the road. Intelligent accident detection involves location tracking as well as notification systems that detect the accidents immediately through the GPS location. The sensor connected to the vehicle gets activated in the case of any accident. Phone calls and notification messages will be sent to the nearby hospital, police station, and family members through the Global System for Mobile Communication (GSM).

Keywords: GPS, GSM, Arduino, Gyroscope, Road traffic accidents, Location tracking, Vehicle

Introduction

The civilization of human history has been rapidly changed due to the evolution of the transportation system. Transportation plays a vital role in our everyday life and its evolution has established effective communication among the people. However, in the present time, the rate of road accidents is increasing which leads to loss of life. Road traffic accidents have become a global concern that affects the lives of people. As per Association for Safe International Road Travel, approximately 1.35 million people death happens due to road accidents each year; on average approximately 3,700 people lose their lives on the roads every day. Around 20-50 million people suffers due to non-fatal injuries, often results in long-term disabilities. 50% of road traffic deaths occurs to pedestrians, cyclists, and motorcyclists. In the whole world, road traffic accidents are considered as the 9th leading death cause. Unavailability of the first aid provision during the time of the accident is one of the major reasons for the death of the person.

Sometimes it is difficult to access the exact location of the accidents and delay in getting information regarding the accident location leads to additional number of road accident deaths. Most accidents occur on the highways and other vehicles passing through the accident location are ignored to inform the police as well as hospitals. An immediate solution is needed for this problem; therefore, the development of intelligent accident detection helps in tracking the accident location and informing the police and hospital without the involvement of humans. Intelligent accident detection (Sharma & Sebastian, 2019)

Literature Review

Implementation of alert systems in intelligent accident detection will improve the security system in vehicles. Nowadays GPS is used to track vehicles and helps in determining the past activities of the vehicles. The Vehicle tracking system has been developed in the articles for providing security to the vehicles. In the vehicle, hardware is fitted that is invisible and it covers the unit and sends situation data to the monitoring data. Data from the tracking system is used in the case of a vehicle stolen and helps to find the last location of the vehicles. Accidents are spotted out by the accident detection and alert system; it sends GPS signals to the specified computer and mobile. The vehicle detection system has several benefits: it saves the life of the people, as well as industries related to the transportation system, get maximum benefits (Dogru & Subasi, 2018).

Smart technology helps to grow an interest in leading healthcare equipment manufacturers, dealers as well as suppliers to invest heavily in the Internet of Things. In result, they get returns in terms of real time promotions as well as efficient inventory management that helps to grow sales and reduced operational expenses. The Internet of Things is fragmented as well as the expertise referred to exist across the various parts of value chain. The aim of this article is to find out smart technology opportunities for automotive manufactures and the ecosystem limitations.

New technology brings a transformational to the automotive sector as well as these changes are both disruptive and rapid.

The main purpose of this transformation is centered connected vehicles as well as the associated opportunities and complexity. The ability to convert technology into new value with capabilities as well as advances, is hugely driven by the customization and analytics that is a key component of the Internet of Things (Smart technology). It left a significant impact on the smart vehicle to connect with the outside world will surely increase the experiences of driver as well as passenger.

The key opportunities for automobile manufacturers are described below,

1. Infotainment: In car streaming and other customer services

2. Operational: such as predictive maintenance, telemetric, software updates

3. Autonomous vehicles/self-driving

Across the wide swath of industrial Smart technology distributions, most successful use cases have been in the operational area. In this area, early deployments have tended to exist. There are many direct impacts of self-driving vehicles in different sectors.

In both consumer levels as well as in commercial, smart technology applications brings different types of new opportunities for vehicles such as vehicle tracking and connected cars and C-V2X.

Connected vehicles can communicate throughout the world by using different sensors. For example, vehicles can recognize the obstacles and alerts the driver by using the sensors. Furthermore, the communication has a significant impact in designing Internet of Vehicles. There are three stages of communication.

1. Vehicle to vehicle communication: In this stage vehicle can communicate with the other vehicle.
2. Vehicle to Infrastructure Communication: In this system, the vehicle can communicate with surrounding system like pedestrians, signaling system as well as obstructions
3. Vehicle to device communication: In this communication system, the sensors send the data to a device to process.

The purpose of smart technology is to establish an improved system that saves all the crucial data which is required for human beings without using their hands directly. However, there are some risks in using smart technology that left a great impact on the automobile industry.

The developed system shows the location and position of the chiles in real-time and generates data based on the time and position of the vehicles. All the data related to the vehicle are stored in the tracking system such as its location, time taken to complete the journey, and time to stop the vehicle. Data storage, data capture, data analysis, and data transfer are the important functions of the designed system (Chang et al., 2019). The purpose of the modified detection system is to find out an accident and alert important people.

Accidents and the intensity of accidents can be easily measured through intelligent accident detection. This technique is implemented in the vehicle to identify the percentage of vehicles that are involved during accidents and the intensities. Vehicle tracking and accidental alert systems are designed in the board that makes it more useful and valuable. The board helps to protect from the thief and the accident detection. Fire accidents are also detected through the device by placing the fire detector in one of the pins. The transportation system, traffic operators, and taxi companies are employed by tracking in India (Davydov & Bezzateev, 2020). The device is used by the taxi operator to estimate the distance of the vehicle. The device will estimate the traffic by determining the map in the case of accident detection. Tracking in countries like India will help to control the traffic problems. The study aims to save people from road accidents by alerting the nearest police station and hospital. The rescue team received the emergency alert after sensing the accidents. Vehicles are targeted by the project that contributes to the automobile market. The project aims to design the final product which is affordable for every person.

Various studies have been done on the alert system. In this study intelligent accident detection has been designed for traffic road accidents (Shaik et al., 2018). GPS receivers monitor the speed of the vehicle and make comparisons between the previous and current speeds of the vehicle. The location of the accident is sent by the system to an Alert Service Center. It helps the rescue team to reach the accident location without delay. In this article, a system has been proposed that notified the emergency services such as police, hospitals, and family members. Smartphones have been programmed by the system that supports the decision to detect the accident and store the records in the data center that can be used in the future. The accelerometer has been used to collect data regarding accidents. At each side of the vehicle, Gyroscopes are used. The system allows sending the message to the emergency contact including the police station hospital and close family members. A shock sensor has been implemented to detect accident location and additional information on the victim including name, age, blood group, and date of birth are sent to the public safety organization (Maskey et al., 2020).

Use Smart technology security analytics: It can be said that the security issues as well as the vulnerabilities regarding Smart technology, may be reduced by implementing the security analytics. It allows gathering, correlating as well as analyzing data from different sources that can help Smart technology security providers to detect potential threats as well as bite such issues in the bud. Ensure Communication Protection: The concept of Smart technology left an impact on connecting different devices. Some implemented encryptions are HTTP, AES 128, AES 256 as well as a host of others. Use public key infrastructure: PKI secures the encryption of data through both symmetric as well as asymmetric encryption processes. Some of the Smart technology PKI security methods are X509 digital certificate and Cryptographic key, can be used as public or private key management, revocation, and distribution.

Materials and methods

In the proposed system Arduino UNO, GPS Module, GSM Module, Gyroscope sensor, and Power Supply have been used. The Arduino platform is a well-designed open-source platform. Arduino programming language (APL) is used for the programmed boards. In the present time, Arduino is used in the industries apart from the hobbyists that are employed through the experts for creating the economic products. ATmega328P datasheet is used for the Arduino Uno microcontroller board, 14 digital input/output are used in the Arduino where 6 pins are used for analog inputs and another 6 pins as PWM output, a 16 MHz ceramic resonator, a USM

connection, an ICSP header, a power jack are used (Dar et al., 2018). All the basic requirements of microcontrollers are supported by the Arduino. It helps to control the microcontroller by connecting it with the computer through USB cable and operate it with AC to DC adapter (Jesudoss et al.,2019).

Figure 1: Arduino UNO

These satellites use signals to convey data to the earth. This signal information is received by the GPS receiver, which uses it to calculate the user's precise location (Vatti et al., 2018). The GPS receiver compares the time it takes for a satellite to transmit and receive a signal. We can calculate the satellite's distance using the computed time difference. The GPS unit can determine speed, journey distance, bearing, distance to destination, tack, dawn, and sunset times, and more after determining the user's location.

Figure 2: GPS Receiver Module

GPS allows users to track locations, goods, and even individuals all over the world and in all weather conditions. You can use GPS technology if you have a GPS receiver (Desai et al., 2018). These satellites use signals to convey data to the earth. The GPS receiver compares the time it takes for a satellite to transmit and receive a signal. We can calculate the satellite's distance using the computed time difference. By measuring the distance between a few additional satellites, the user's position can be validated and displayed on the unit's electronic map. The GPS unit can determine speed, journey distance, bearing, tack, dawn and sunset times, distance to destination and more after determining the user's location (Mohanta et al., 2018). The MODEM controls these modules (Iqbal & Khan, 2018).

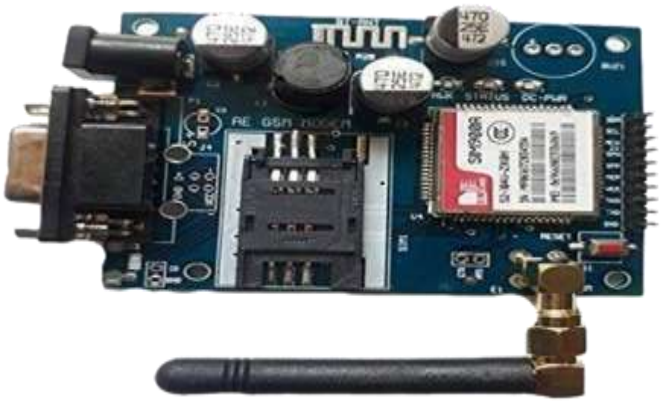

Figure 3: GSM Module

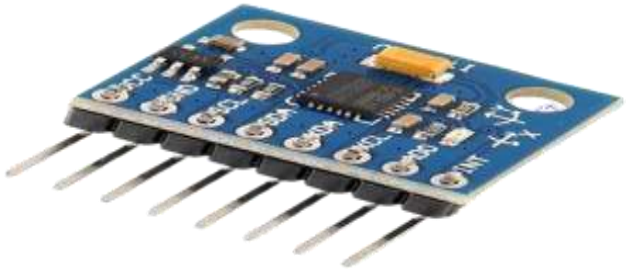

Figure 4: Gyroscope Sensor

A gyroscope sensor is a gadget that uses the gravitational pull of the earth to determine its orientation. It's a sort of sensor found within an IMU (Inertial Measurement Unit). A gyroscope is a gadget that detects rotation around a single axis. The device's heart is a rotor, which is nothing more than a freely rotating disc. A spinning axis goes through the center of a larger wheel, and the rotor is coupled to it.

Methods

The block diagram given below demonstrates a simple overview of the system's process flow.

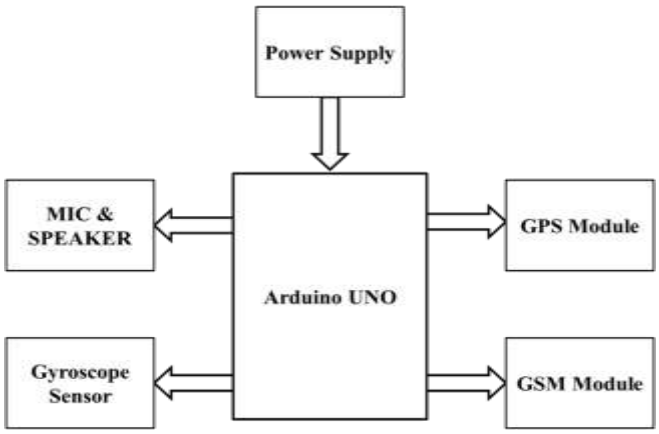

Figure 5: Block diagram

Working Methodology

Let us begin by assuming that an accident has occurred. The gyroscopic sensor will detect any irregularities in a matter of seconds. The gyroscopic sensor sends signals to the microcontroller, which in our instance is an Arduino. Before issuing the alert, the Arduino will wait for the victim to manually switch off the device (Menon et al., 2018). This aids us in avoiding false alerts in circumstances where the injury isn't life-threatening. This operation will take place at a certain

time. When the Arduino detects no input from the victim, it sends out alerts to the pre-programmed phone numbers. As a result, the emergency contacts will know the victim's exact location and will be able to alert the rescue team in the interim. As a result, the death counts due to traffic accidents will get reduced.

Figure 6: Signal Flow Diagram

Workflow

The gyroscopic sensor will activate after the accident has occurred. The gyroscope sensor operates on the idea of angular momentum conservation (Ashok Kumar et al., 2019). The GPS sensor will activate once the gyroscope has completed its task. For tracking or detecting a location, GPS receivers are commonly utilized in cell phones, fleet management systems, and military applications.

A GPS receiver must receive data from at least four satellites to be accurate. These GPS satellites use radio frequency to relay data to the receiver (1.1 to 1.5 GHz) (Menon et al., 2020).

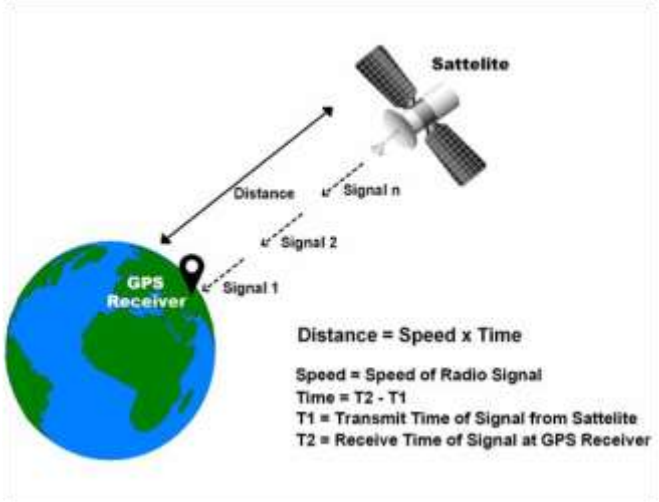

Figure 7: GPS Distance Calculation

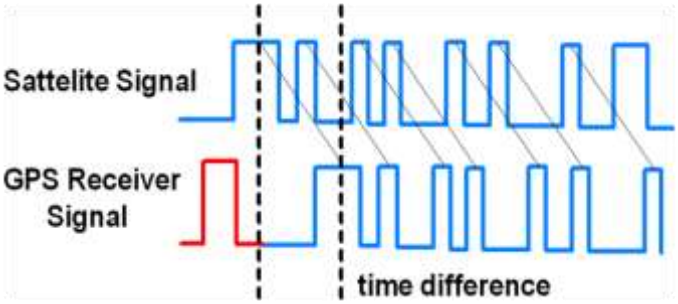

Figure 8: GPS travel time calculation

The pseudo-code is transmitted by the satellite, and the GPS receiver receives it. The difference between these two signals is the travel time, which is calculated by comparing them (Finogeey et al., 2018). The GPS receiver module generates output signals in NMEA string format (National Marine Electronics Association). It outputs serially on the Tx pin at a default Baud rate of 9600. This GPS receiver provides longitude, latitude, altitude, time, and other parameters in this NMEA output string format which are separated by commas. Each string begins with a dollar sign ($) and ends with a carriage return or line feed sequence. The GSM module will be activated once we get the victim's exact geographical coordinates. Around 800 million people utilizes GSM across 190 countries, which accounts for more than 70% of the worldwide digital wireless communication market (Hu et al., 2020). A geographical area is divided into hexagonal cells in GSM, with the power and load of the transmitter determining each side (number of end-user).

GSM employed two 25-MHz-wide frequency bands at first: uplink 890 to 915 MHz and downlink 935 to 960 MHz Later, two 75-MHz bands were added: uplink 1710 to 1785 MHz and downlink 1805 to 1880 MHz (Zantallis et al., 2019).During the execution of the program, the GSM modem gets the instruction 'STOP,' which causes the MC to generate an output, the contact points of which are utilized to disable the ignition switch. We can send the warnings via telephone servers in this way, regardless of the recipient's carrier or service provider (Khanna et al., 2018). As a result, both voice calls and text messages were used to send out alerts.

Results and Discussion

In the given figure below, the real-time results of the project have been shown. Once the accident occurs to the vehicle, immediately the emergency phone call was successfully made to the pre-programmed number, nearby hospital, and police station.

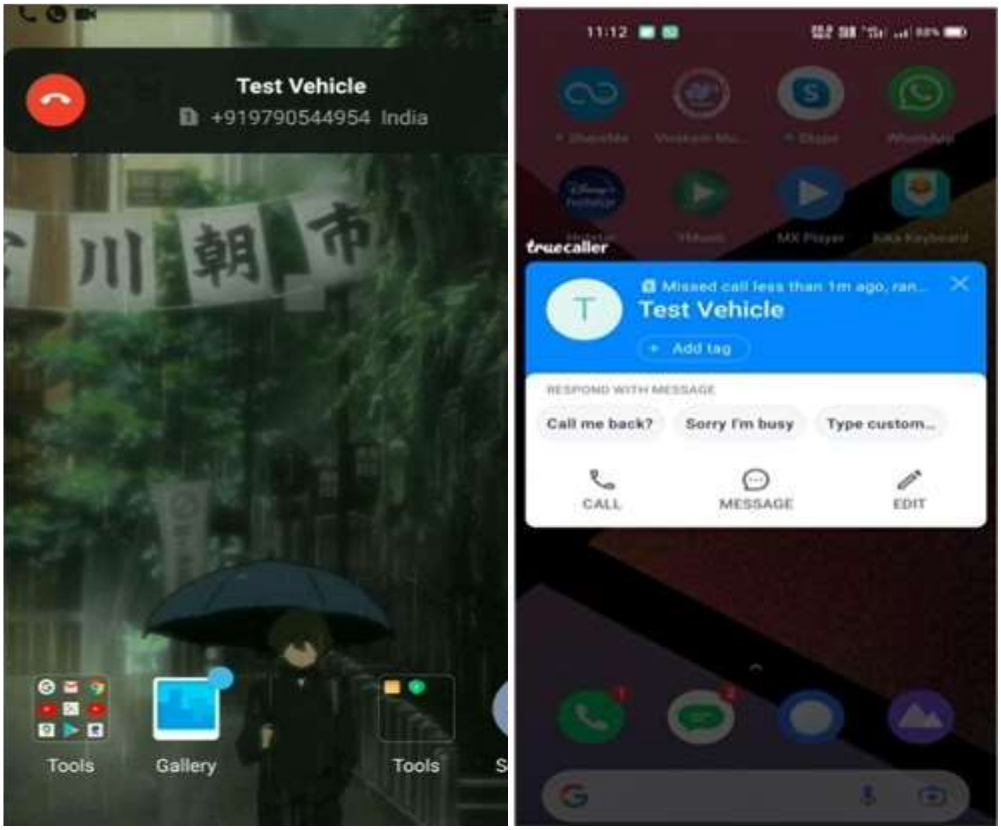

Figure 9: Emergency Phone Call after accident detected

After locating the accident site, the emergency alert message about the accident location with vehicle number was successfully issued to the pre-programmed number. An emergency message providing the precise geographical coordinates of the accident site was successfully delivered to the required contacts which were programmed and inserted.

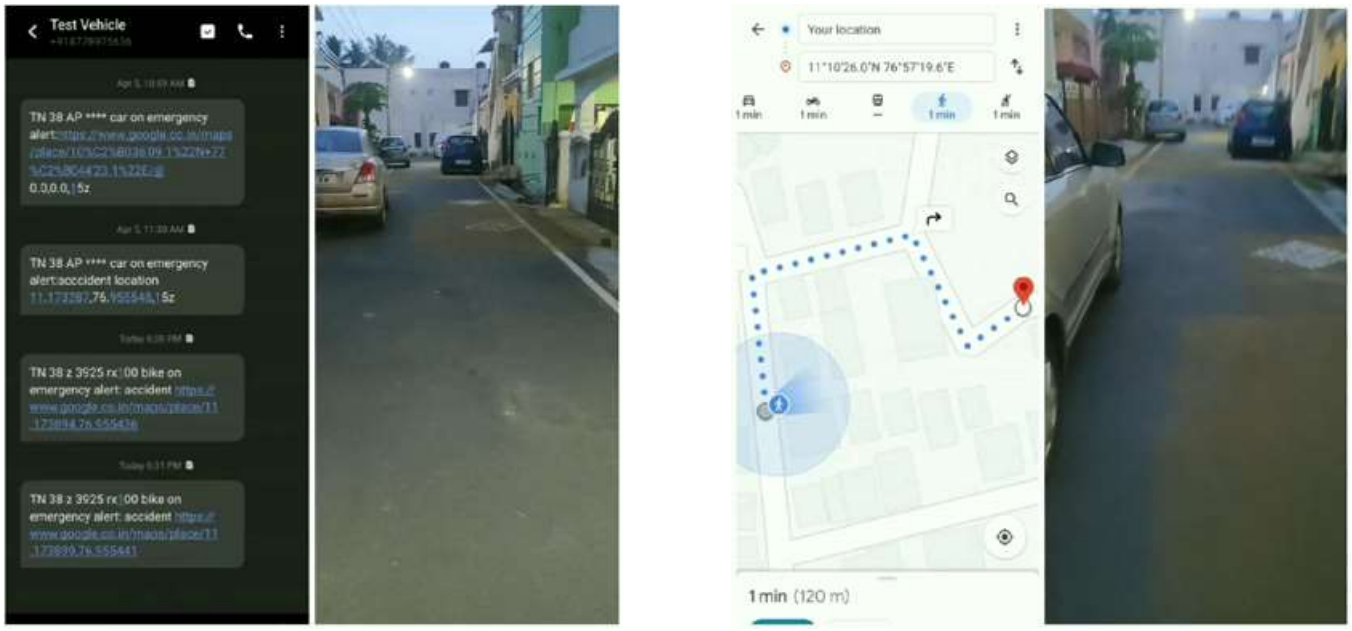

Figure 10: Emergency Alert Message delivery and vehicle location tracking

Conclusion

In this article, the prototype of an automatic accident detection system is proposed. This device could be used to prevent vehicle thefts in the future. Because of the high accuracy tracking technology, this prototype might be used to trace down those responsible for the horrible crimes. This prototype can also be integrated with emergency services in collaboration with local governments to quickly dispatch a rescue team to the accident location. The system must be implemented and put into practice shortly. The predominant purpose of this suggested accident detection and alert system is to reduce the number of individuals who die in various road accidents in unavoidable circumstances. Paramedics are called to the scene of any accident to increase the chances of survival. For accidents that occur in deserted locations or at night, this gadget is significantly more effective. This low-cost effective car

tracking and accident alert technology will play a far larger role in daily life in the future.

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