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IoT Based Accident Detection and Management System

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Abstract: *Accidents on roads are a significant concern worldwide, and the response time to such incidents is crucial in saving lives. The present work proposes a real-time automatic accident detection system using the Internet of Things (IoT) based on a NodeMCU microcontroller, GPS, gyroscope, and vibration sensor. The proposed system is designed to detect accidents in real-time and notify emergency services promptly. The system uses an accelerometer-based vibration sensor to detect any sudden changes in the velocity of the vehicle. A GPS module is used to provide the location of the accident, while a gyroscope sensor provides the orientation of the vehicle The NodeMCU microcontroller is responsible for reading the data from the sensors and sending it to the cloud server. The communication module used in the system is the MQTT protocol, a lightweight messaging protocol designed for IoT devices. The microcontroller sends the data to the cloud server using MQTT, which then sends the data to the emergency services. receives the data from the microcontroller using MQTT and sends it to the emergency services using AWS Lambda. The proposed system is designed to be lightweight, reliable, and cost-effective. It uses off-the-shelf components and can be easily deployed in any vehicle. With the increasing number of vehicles on roads, the automatic accident detection system using IoT can help reduce the response time to accidents and save lives. In conclusion, the proposed system is a step towards creating a more efficient and effective accident detection system that can significantly reduce the response time to accidents and ultimately save lives.*

Key Word: *Accident Detection, IoT, Emergency Service, Response Time.*

I.INTRODUCTION

The Vehicular accidents are unfortunately a common occurrence, and they can result in the loss of lives, injuries, and significant economic costs. When there is a lack of aid or inadequate response to an accident, the impact can be even more devastating. In such situations, the victims of the accident may not receive timely medical attention or other necessary aid, leading to an increased risk of fatalities or more severe injuries. Additionally, the lack of proper aid may lead to delays in clearing the accident scene, resulting in further disruption to traffic and potentially causing more accidents.

The impact of vehicular accidents and the loss of lives can be particularly devastating for the families and loved ones of the victims. They may experience emotional trauma, financial hardship, and other challenges in the aftermath of the accident. To mitigate the impact of vehicular accidents, it is essential to have efficient and effective emergency response systems in place, such as ambulance services, police response, and hospitals. Additionally, public awareness campaigns and education programs can help promote safe driving practices and reduce the risk of accidents.

Vehicular accidents and loss of lives due to less aid can have a profound impact on individuals, families, and society as a whole. It is crucial to prioritize the safety and well-being of all road users and to have adequate emergency response systems in place to minimize the impact of these accidents. IoT technology has the potential to save many people's lives from vehicular accidents by enabling faster and more accurate detection of accidents, facilitating real-time communication and data exchange between vehicles, infrastructure, and emergency responders, and providing advanced safety features that can prevent accidents from occurring in the first place. IoT-enabled sensors and cameras can detect accidents as soon as they occur, allowing emergency responders to be alerted quickly and respond in a timely manner. This can potentially save lives by ensuring that injured individuals receive prompt medical attention and other necessary aid.

IoT technology can enable vehicles to automatically make emergency calls in the event of an accident, even if the driver is incapacitated. This can help ensure that emergency responders are alerted as quickly as possible, potentially saving lives by reducing response times. IoT-enabled sensors and cameras can provide real-time data and information to drivers, helping them avoid accidents. For example, lane departure warning systems can alert drivers when they are drifting out of their lane, and forward collision warning systems can alert drivers when they are approaching another vehicle too quickly. By improving situational awareness and response times, IoT can help ensure that injured individuals receive prompt medical attention and other necessary aid, potentially reducing the severity of injuries and saving lives.

II.LITERATURE SURVEY

LITERATURE REVIEW 1

TITLE

An Intelligent Accident Detection and Notification System for Vehicles using IoT and Machine Learning.

AUTHOR

K. Deepak and K. G. Anantha Kumar

YEAR

2021

DESCRIPTION

The system uses various sensors to detect a sudden change in the vehicle's speed or orientation, which indicates an accident. The system includes a machine learning model to analyze the sensor data and accurately detect accidents while minimizing false alarms. Once an accident is detected, the system sends an alert to emergency services with the accident location and severity. The authors have designed and implemented a prototype of the proposed system using Raspberry Pi and Python programming language. The results of the prototype tests show that the proposed system can accurately detect accidents and notify emergency services in real-time.

LITERATURE REVIEW 2

TITLE

Driver Behavior Monitoring and Warning with Dangerous Driving Detection Based on the Internet of Vehicles.

AUTHOR

Lien-Wu Chen, and Hsien-Min Chen

YEAR

2020

DESCRIPTION

A design a driver behavior monitoring and warning (DBMW) framework to detect dangerous driving for enhancing road safety through the Internet of Vehicles (IoV). The designed DBMW framework applies onboard image sensors and wearable devices to detect the deviation degree of vehicles and trace the head motion of drivers, respectively. According to our review of relevant research, DBMW is the first framework for driver behavior monitoring and warning that provides the following features. DBMW can keep recognizing the located lane lines and estimating the power spectral density of lane deviation for a vehicle through image sensors. Experimental results show that DBMW outperforms existing methods and can significantly improve the detection accuracy and false alarm rates of dangerous driving behavior.

LITERATURE REVIEW 3

TITLE

A IoT based Accident Detection and Management System for the Emergency Rescue Services in a Smart City.

AUTHOR

Manjinder Kaur; Jyoteesh Malhotra; Pankaj Deep Kaur

YEAR

2020

DESCRIPTION

The density of vehicles improved on the paths has produced an abundance of difficulties for accident management in the centers. The lack of transporting patients and providing first aid and medical service at the appropriate time is the major cause of loss of human lives. This paper investigates the main possibilities arising from the initiation of the innovative notion of IoT and VANET with introducing architecture. The concept of an Internet of things and vehicular ad hoc networks that aims to prioritize emergency vehicles. The proposed system helps to detect the accident and provide medical aid at the appropriate time.

LITERATURE REVIEW 4

TITLE

Vehicle Position and Context Detection Using V2V Communication.

AUTHOR

Paul Watta, Ximu Zhang and Yi Lu Murphey

YEAR

2021

DESCRIPTION

A pre-crash detection and warning system in a host vehicle needs to accurately determine the position of each remote vehicle in its vicinity and the context of the driving environment. ADAS (Advanced driver-assistance systems) have extensively used camera radar and LIDAR for automatic detection of vehicles, pedestrians and other road users and their behaviors. However, these vehicle-resident sensors have short operation ranges and require objects to be within the line-of-sight. V2V communication has emerged to be a promising technology to augment vehicle-resident sensors with extended ability of an overall vehicle safety system by addressing a broader range of crash scenarios with improved warning. In this

paper we present an intelligent system, Geo+NN, developed using the synergy of neural network and geometric modeling. We extract the key geometric features using an analytic geometric model and use them as input to a neural network that is trained on real-world V2V signals to detect and predict remote vehicles' positions. Geo+NN system is evaluated on V2V communication data recorded during real-world driving trips by vehicles installed with DSRC devices. Experimental results show that Geo+NN has the capabilities of effectively detecting and predicting remote vehicles within the context of 8 positions

LITERATURE REVIEW 5

TITLE

Traffic Accident Prediction Techniques in Vehicular Ad-hoc Network

AUTHOR

Shweta Shendekar, Samrat Thorat, Dinesh Rojatkar

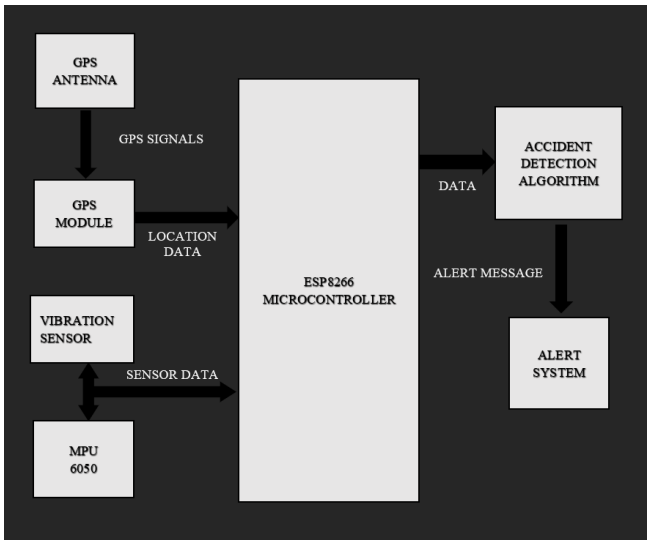
YEAR

2021

DESCRIPTION

Nowadays, development in transportation is significantly rising. Vehicular Ad Hoc Network (VANET) is an essential part of advanced transportation system framework. In recent years, numbers of vehicles and their uses have increased rapidly due to their high need and demand by people. This reason somewhere also leads to increase in rate of traffic accidents. In today's stressful lifestyle, road accidents are a major threat to human life and harm the safety of today's human beings. Thus, it is necessary to provide a prominent solution to this problem. Traffic accident prediction and prevention are important steps for vehicular safety purpose. Various traffic accident prediction techniques using machine learning, deep learning algorithms and fuzzy system are being tested by researcher. In this study, we have focused on using specific methods from available sources. Also, after proper analysis of each of these methods, work has been done to increase the scope of further development and create space for new research.

III.PROPOSED BLOCK DIAGRAM

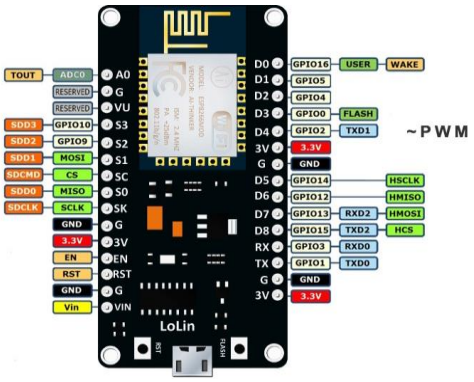


IV.PROJECT DESCRIPTION

1.Hardware Description:

ESP8266

Espressif Systems' Smart Connectivity Platform (ESCP) is a set of high performance, high integration wireless SOCs, designed for space and power constrained mobile platform designers. It provides unsurpassed ability to embed Wi-Fi capabilities within other systems, or to function as a standalone application, with the lowest cost, and minimal space requirement. ESP8266EX offers a complete and self-contained Wi-Fi networking solution; it can be used to host the application or to offload Wi-Fi networking functions from another application processor. When ESP8266EX hosts the application, it boots up directly from an external flash. In has integrated cache to improve the performance of the system in such applications. Alternately, serving as a Wi-Fi adapter, wireless internet access can be added to any micro controller-based design with simple connectivity (SPI/SDIO or I2C/UART interface).

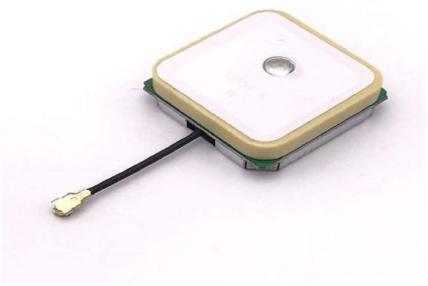


GPS ANTENNA

A GPS antenna, also known as a Global Positioning System antenna, is a device that receives signals from GPS satellites orbiting the Earth. It is designed to capture and amplify weak signals transmitted by the satellites and convert them into usable data for determining the antenna's location. The GPS antenna is responsible for receiving signals in the L-band frequency range (around 1.57542 GHz) that are emitted by multiple GPS satellites. These signals contain information such as the satellite's identity, precise time, and the satellite's ephemeris data (position and velocity). To ensure accurate positioning, the GPS antenna needs an unobstructed view of the sky to receive signals from multiple satellites simultaneously. Therefore, it is commonly installed in outdoor locations, such as the roof of a vehicle or a building.

GPS MODULE

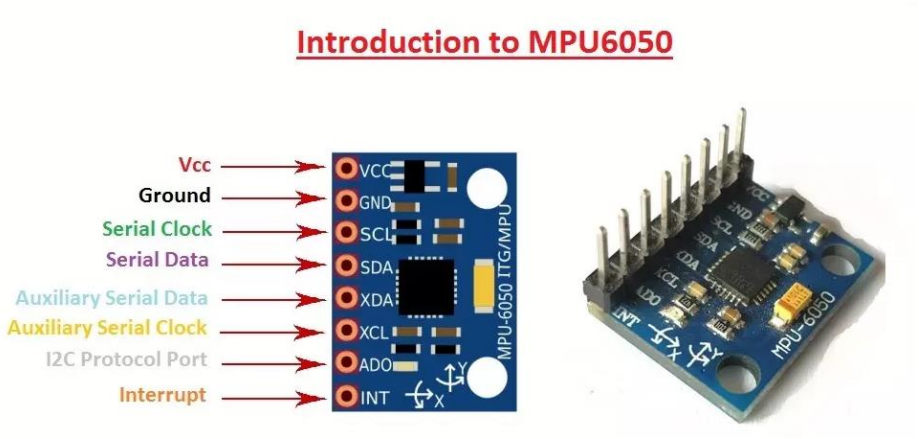
A GPS module is a compact electronic device that integrates a GPS receiver and other necessary components into a single unit. It is designed to provide accurate positioning and navigation information based on the signals received from GPS satellites. The GPS receiver is the core component of the module responsible for receiving signals from GPS satellites. It captures the signals transmitted by multiple satellites and extracts the necessary information, such as satellite location and time data. GPS module includes an integrated GPS antenna or a connector to attach an external GPS antenna. The antenna captures GPS signals from satellites and provides them to the GPS receiver for processing. The GPS module often incorporates a microcontroller or processor to handle the data processing tasks. It receives the GPS data from the receiver, performs calculations, and processes the received signals to determine the module's location. GPS modules may have onboard memory to store satellite data, ephemeris data, and other relevant information.



MPU 6050

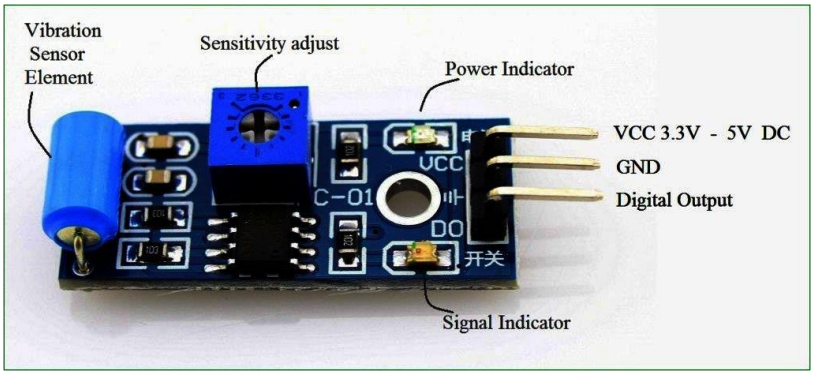
The MPU-6050 is a widely used 6-axis motion tracking device that combines a 3-axis accelerometer and a 3-axis gyroscope in a single integrated circuit. It is manufactured by InvenSense, now part of TDK. The MPU-6050 is designed to provide accurate motion sensing and orientation tracking capabilities for various applications. The MPU-6050 integrates advanced motion processing algorithms, allowing it to accurately measure motion and provide real-time motion tracking data. It

combines the measurements from the accelerometer and gyroscope to provide comprehensive motion information, including linear acceleration, angular velocity, and orientation estimation.



VIBRATION SENSOR

A vibration sensor, also known as an accelerometer or vibration transducer, is a device that measures mechanical vibrations or oscillations and converts them into electrical signals. It is commonly used in various applications to monitor and detect vibrations in machinery, structures, and other systems. The vibration sensor works on the principle of detecting changes in acceleration caused by vibrations. When subjected to vibrations, the sensor's internal components, such as a mass or piezoelectric material, experience relative motion. This motion generates electrical signals proportional to the acceleration or vibration intensity. Vibration sensors are employed to monitor the health and performance of rotating machinery, such as motors, pumps, turbines, and bearings. They help detect abnormal vibrations that may indicate faults or potential failures. Vibration sensors are utilized to monitor the integrity and stability of structures, such as bridges, buildings, and bridges.



SOFTWARE REQUIREMENTS

ARDUINO IDE

Arduino IDE stands for “Integrated Development Environment”. It is an official software introduced by Arduino.cc, that is mainly used for editing, compiling and uploading the code in the Arduino Device. Almost all Arduino modules are compatible with this software that is an open source and is readily available to install and start compiling the code on the go. In this article, we will introduce the Software, how we can install it, and make it ready for developing applications using Arduino modules.

C++

C++ is a high-level, general-purpose programming language that was first developed in the early 1980s by Bjarne Stroustrup. It is an extension of the C programming language and provides support for object-oriented programming (OOP). C++ is used in a wide range of applications, including operating systems, embedded systems, video games, and scientific computing. It is known for its efficiency, performance, and versatility.

One of the key features of C++ is its support for OOP, which allows developers to organize code into reusable and modular classes, and to use inheritance, polymorphism, and encapsulation to create more complex and flexible software. C++ also includes a wide range of built-in libraries and data types, such as arrays, vectors, strings, and maps, which make it easier to write complex programs. It also supports low-level memory manipulation, which allows for fine-tuning of performance in certain cases.

V.CONCLUSION

An accident detection system using IoT technologies offers several benefits and capabilities for enhancing safety and response in various scenarios. In this paper by integrating components such as GPS antennas, GPS modules, NodeMCU, vibration sensors, and gyroscopes, the system can effectively detect and respond to accidents. The system utilizes sensors and algorithms to detect accidents or collisions promptly. It can analyze data from GPS modules, vibration sensors, and gyroscopes to identify sudden changes in location, acceleration, or orientation associated with accidents. With GPS antennas and modules, the system can provide accurate location data in real-time. This information is crucial for emergency responders to quickly locate the accident site and provide assistance. In conclusion, an accident detection system leveraging IoT technologies offers advanced capabilities for detecting accidents, providing accurate location information, and facilitating immediate response and assistance. It enhances safety, improves emergency response times, and enables effective monitoring and analysis of accident-related data.

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