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In-Vehicle Intelligent Transport System for Preventing Road Accidents Using Internet of Things

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Abstract

Road safety is the prevention and protection of human lives from road accidents by implementing road safety measures. Majority of the road accidents are caused due to the careless driving techniques followed by the driver. The presence of speed breakers and steep curves in the road will be inconspicuous in low visibility conditions, like at night, or when there is fog, rain or snow and this will lead to the road accidents. To avoid such accidents certain measures like automatic speed break detection system in vehicle and steep turns or curves detection in the road way using internet of things technology will improve the road safety and saves the human lives being injured and killed unnecessarily. The vehicle will give the alert or voice messages when it detects the speed breakers and steep curves or turns with the help of ultrasonic sensor.

Keywords: ITS, SafeRNET, CTS, Speed Breakers, VRU.

INTRODUCTION

The term internet of things generally refers to scenarios where network connectivity and computing capability extends to objects, sensors and everyday items not normally considered as computers, allowing these devices to generate, exchange and consume data with minimal human intervention. The large-scale implementation of IoT devices promises to transform many aspects of the way we live. For consumers, new IoT products like Internet enabled appliances, home automation components, and energy management devices are moving us toward a vision of the "Intelligent Transport System", offering more safety and comport to the road users.

A privacy-preserving protocol for enhancing security in vehicular crowdsensing-based road surface condition monitoring system using fog computing[1]. At the onset, proposes a certificateless aggregate signcryption scheme that is highly efficient. Based on the proposed scheme, a data transmission protocol for monitoring road surface conditions is designed with security aspects such as information confidentiality, mutual authenticity, integrity, privacy, as well as anonymity.

Cooperative intelligent transportation systems, vulnerable road users (VRU) safety can be enhanced by multiple means. On the one hand, perception systems are based on embedded sensors to protect VRUs. However, such systems may fail due to the sensors' visibility conditions and imprecision. On the other hand, vehicle-to-pedestrian (V2P) communication can contribute to the VRU safety by allowing vehicles and pedestrians to exchange information[2]. The cooperative VRU protection system can benefit of the redundancy coming from the perception and communication technologies both in line-of-sight (LOS) and non-LOS conditions.

Then the technology with internet of vehicles called SafeRNet, a safe route computation framework which takes advantage of these technologies to analyze streaming traffic data and historical data to effectively infer safe routes and deliver them back to users in real time and tis technology will improve the driver's safety in modern transport system[3].

The efficient distribution of intelligent transport system (ITS) messages is fundamental for the deployment and acceptance of ITS applications by mobile network operators and the automotive industry. The distribution of road hazard warning (RHW) messages to distant vehicles requires special mechanisms[4]. This paper introduces a novel cluster head selection technique for the distribution of RHW messages, and proposes an implementation of another legacy technique that was originally intended for mobile ad-hoc networks (MANETs).

RELATED WORK

There are many TIS technologies, applications, comparative frameworks, for example, Automated guided vehicles (AVGs), cooperative intelligent transport systems (CITS), Road hazard warning and so forth, give guidance and preventing the vehicle users from road accidents. These TIS technologies gives us the total control of the vehicles and gives the information about the surrounding environment though the alert signals or the voice messages. The In-Vehicle Intelligent Transport System will detect the speed breakers, steep curves, people identification system in the zebra-crossing. When these are detected by the ultrasonic sensor in the TIS system and the ultrasonic pulse signals passed to the PIC microcontroller and from there later the signals and intimated to the vehicle user via the voice messages. A study is made on systems like the intelligent vehicle system which is used to prevent the road and provides the road safety.

Sultan Basudan et al. proposed in their paper A Privacy-Preserving Vehicular Crowdsensing-Based Road Surface Condition Monitoring System Using Fog Computing[1] a privacy-preserving protocol for enhancing security in vehicular crowdsensing-based road surface condition monitoring system using fog computing. At the onset, this paper proposes a certificateless aggregate signcryption scheme that is highly efficient. Based on the proposed scheme, a data transmission protocol for monitoring road surface conditions is designed with security aspects such as information confidentiality, mutual authenticity, integrity, privacy, as well as anonymity. In analyzing the system, the ability of the proposed protocol to achieve the set objectives and exercise higher efficiency with respect to computational and communication abilities in comparison to existing systems is also considered.

Kalpana Seelam and Ch. Jaya Lakshmi proposed An Arduino based embedded system in passenger car for road safety[5] The motivation behind this work is an attempt to make an Arduino based embedded system which makes the passenger's journey even safer and more secure. This paper handles the road discipline such as speed control in different areas and horn control in horn prohibited zones. The features included in this paper are Vehicle Speed Control in school Zone and controlling the speed of the vehicle in different zones such as bridges, highways, cities and suburbs. It also includes Horn Control of Vehicle in No Honking Zone-Control horn disturbances in horn prohibited zones such as hospitals, public libraries, courts, schools and Alcohol detection to detect drunken driving.

Johan Casselgren and Ulf Bodin proposed Reusable road condition information system for traffic safety and targeted maintenance[6] Driver awareness of current winter road conditions (RCs) is known to affect the frequency of accidents due to sudden changes in these conditions. For example, partially icy roads that appear during autumn in northern areas typically result in collisions and ditch runs unless the drivers are generally aware of the situation. Availing motorists who drive under winter RCs of enhanced information is therefore highly desirable to increase their awareness of hazardous driving conditions. Such conditions need to be predicted ahead of time and presented to drivers before they attempt slippery road sections. Moreover, the identification of slippery RCs should quickly trigger targeted road maintenance to reduce the risk of accidents.

Poster: SafeRoute a framework for assessment of road safety[7] R. Vince Rabsatt proposed a framework of Navigation systems typically suggest directions to the user based on factors such as weather conditions, traffic information, and road hazards. By considering these factors, the system can suggest a route in which travel time is minimized. However, these navigation systems fail to include any meaningful information about the relative safety of different routes. For example, some roads are significantly more accident prone than others and can easily be avoided. By taking alternative paths, individuals can reduce risk, while often adding only minimal time to their commutes. We develop a model for road safety based on data from the California Freeway Performance Measurement System (PEMS) database. Our model for road safety considers risk using historical accident data based on factors such as the time of day, day of week, average speed, flow, and other traffic features. Our experimental results using the Random Forest classifier show a classification accuracy of 80% for identifying high-risk routes.

Mirjami Jutila et al. proposed in their paper ITS-G5 performance improvement and evaluation for vulnerable road user safety services[8] Cooperative intelligent transportation system (C-ITS) allows to improve safety of vehicles through communications between vehicles and infrastructure. C-ITS may also improve the safety of vulnerable road users (VRUs), but work on this issue is still in an early stage. ITS-G5 (IEEE 802.11p), the main technology for vehicle-to-vehicle time-critical communications, allows to deliver safety information over a rather long range with low latency, but obstacles in the link path and a large amount of vehicles sending at the same time may reduce performance. In this study, the authors assess and optimize the performance of ITS-G5 for time-critical safety conflict scenarios between vehicles and VRUs. The authors have tested various non-line-of-sight (NLOS) scenarios in urban environments and line-of-sight (LOS) simulations to support C-ITS message prioritization and scalability with different amount of vehicles. Example use cases with NLOS include pedestrians crossing streets from behind objects, and low-visibility scenarios, e.g. when VRU is behind a vehicle, behind a queue of vehicles, between vehicles, behind trees/bushes or behind a building. The LOS simulations utilize fuzzy weighted queueing mechanism for congestion control to overcome the packet losses and for data prioritization. Based on these results, the applicability of ITS-G5 for VRU applications is assessed and performance improved.

Mehrdad Bagheri et al. proposed Cloud-Based Pedestrian Road-Safety with Situation-Adaptive Energy-Efficient Communication[9] Pedestrian detection using wireless communication complements sensor-based pedestrian detection in driverless and conventional cars. This fusion improves road-safety particularly in obstructed visibility and bad weather conditions. This paper seeks developing such wireless-based vehicle-to-pedestrian (V2P) collision avoidance using energy-efficient methods and non-dedicated existing technologies namely smartphones (widespread among pedestrians and drivers), cellular network and cloud. Our road safety mobile app can be set to driver mode or pedestrian mode. This app frequently sends vehicle and pedestrian geolocation data (beacons) to cloud servers. Cloud performs threat analysis and sends alerts to road users who are in risky situation. However, constant pedestrian-to-cloud (P2C) beaconing can quickly drain smartphone battery and make the system impractical. We employ adaptive multi-mode (AMM) approach built on situation-adaptive beaconing.

Jianqiang Wang et al. proposed paper on The Driving Safety Field Based on Driver–Vehicle–Road Interactions[10] Vehicle driving safety is influenced by many factors, including drivers, vehicles, and road environments. The interactions among them are quite complex. Consequently, existing methods that evaluate driving safety perform inadequately because they only consider limited factors and their interactions. A unified model of the driving safety field is constructed, which includes the following three parts: 1) a potential field, which is determined by nonmoving objects on the roads, such as a stopped vehicle; 2) a kinetic field, which is determined by the moving objects on roads, such as vehicles and pedestrians; and 3) a behavior field, which is determined by the individual characteristics of drivers. These model can provide a new foundation for establishing driving safety measures and active vehicle control under complex traffic environments.

PROPOSED SYSTEM

The intelligent transport system using internet of things is implemented in the vehicle to provide the safe and comfortable driving for users and also provides the road safety to avoid the unnecessary accidents. The internet of things that connected physical objects that are accessible through the internet and system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

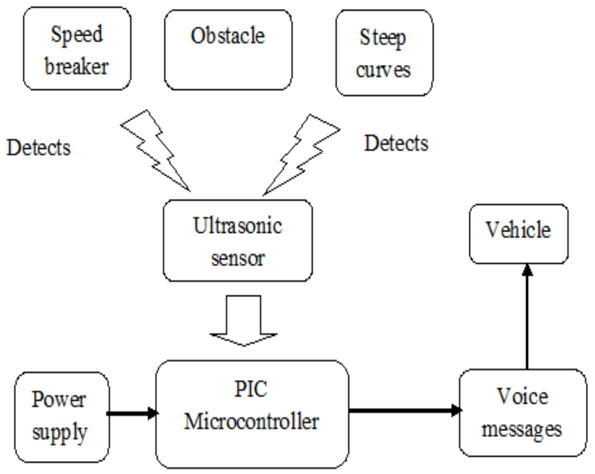

Figure 1. Proposed framework design of Intelligent Transport System

A. Framework Design

i. PIC microcontroller

The microprocessor interface is the primary place at which the signal comes and the action is being taken. The interface consists of a runtime interface which consists of Peripheral Interface Controller (PCI) microcontroller which serves as the heart of the system. The pic microcontroller basically gathers all the information and takes necessary action. The Hardware Control Execution serves as the path or the bus via the data is being transferred from the sensors to the PIC microcontroller. The Hardware Control Execution is responsible for data processing in the system.

ii. Power supply

A power supply is an electrical device that supplies electric power to an electrical load. The primary function of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load. As a result, power supplies are sometimes referred to as electric power converters. Some power supplies are separate standalone pieces of equipment, while others are built into the load appliances that they power.

iii. Ultrasonic Sensor

The Ultrasonic Sensor sends out a high-frequency sound pulse and then times how long it takes for the echo of the sound to reflect back. The sensor has 2 openings on its front. One opening transmits ultrasonic waves, (like a tiny speaker), the other receives them, (like a tiny microphone).

The speed of sound is approximately 341 meters (1100 feet) per second in air. The ultrasonic sensor uses this information along with the time difference between sending and receiving the sound pulse to determine the distance to an object. It uses the following mathematical equation to find the distance:

$$\text{Distance} = \frac{\text{Time x Speed of Sound}}{2}$$

Time = the time between when an ultrasonic wave is transmitted and when it is received
You divide this number by 2 because the sound wave must travel to the object and back.

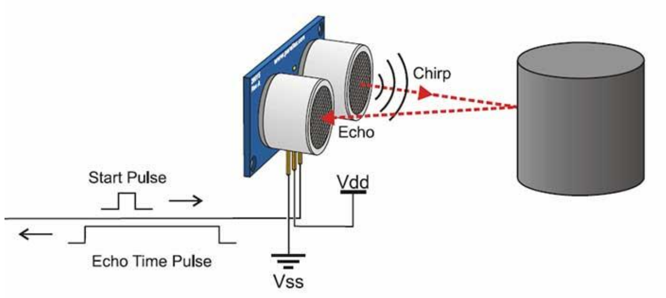

Figure 1. Ultrasonic Sensor

B. Speed Breaker Detection

The ultrasonic sensor is used to detect the speed breakers in the road to improve the road safety and the safe and comfortable driving to the vehicle user. There are two types of the speed breakers the flattened speed breaker and rounded speed breaker will be detected through the sensor and the information is passed to the PIC microcontroller. Then from the controller the information is passed via the GPIO port to the vehicle node before the arrival of the 100 meters.

C. People Identification

The sensors are kept at the vehicle and the vehicle reaches the nearby the location will receive the intimation through internet of things such as the alert system or the voice messages is given to the user. So, this intelligent transport system is implemented in the vehicle means it will reduce the road accidents and the damage of the vehicle. The system also provides the safe and comfortable driving to the vehicle user. Then, the sensor also detects the people who are crossing the road will be detected by the sensor and intimated to the vehicle user about the people crossing the road and avoids the accidents.

D. Steep Curve Detection

The steep curves are detected based on the curvature of the road. The curvature of the road is detected by the sensor based on the value. The curve lies on the left means the nature of the left sensor value will be larger and the curve lies on the right means the nature of the right sensor will be larger. Based on this, the sensor detects the curvature of the road and the information is passed to the vehicle user through the PIC microcontroller.

PERFORMANCE AND DISCUSIONS

The Intelligent Transport System technologies like speed break detection, people identification and steep curve detections are implemented the vehicle to prevent the road accidents and avoids the damage of the vehicle. By detecting these and intimating to vehicle users will also improve the road safety.

FUTURE WORK AND CONCLISION

By implementing the Intelligent Transport System in the vehicle by using internet of things will improve the road safety and provide safe and comfort to the vehicle user. The speed breaker detection module helps the users to drive the car in safe mode and prevents the car damages and human lives. Then the people identification while crossing the road also avoid the road accidents and intimates the user to slow down the vehicle in those zones. Thus, the automatic speed break detection system, people identification while crossing the road and the intimation of steep curves in the road using internet of things will improve the road safety and prevent the human live being unnecessarily killed. In this paper, we can further have extended with some automatic transport system to provide road safety and more fast results the act upon the environment changes and also to safe guard the human lives.

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