



An IOT based solution for Road Accidents

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ABSTRACT

Nowadays the vehicle accident rate has been increasing as compared to the previous decade. This system proposes a solution to minimize the action time after an accident. It has the capability of ensuring the driver's safety along with the co-passengers and can easily be integrated with the car. The vehicle is connected to a hardware device that detects the collision with the help of a vibration sensor. The hardware device also consists of a fire sensor that senses fire breakouts. It communicates with an application in the Smartphone through Zigbee Bluetooth whenever collision or fire is sensed. If the driver doesn't want to communicate any information, he can cancel using the reset switch. Once the Bluetooth connection is established, the application would track and communicate the victim's GPS location along with the patient's entire medical report to their companions as well as the nearest hospital through an SMS. The application also checks the availability of the blood in the nearest blood bank and sends a notification back as soon as the availability of blood is ensured.

Keywords: *Internet of things (IoT), Sensors, Accidents, Global positioning system (GPS), Short messaging service (SMS).*

I. INTRODUCTION

The IoT is an important topic in technology industry, policy, and engineering circles and has become headline news in both the specialty press and the popular media. This technology is embodied in a wide spectrum of networked products, systems, and sensors, which take advantage of advancements in

computing power, electronics miniaturization, and network interconnections to offer new capabilities not previously possible. An abundance of conferences, reports, and news articles discuss and debate the prospective impact of the Internet of things revolution-from new market opportunities and business models to concerns about security, privacy, and technical interoperability. The large-scale implementation of Internet of things devices promises to transform many aspects of the way we live. For consumers, new Internet of things products like Internet enabled appliances, home automation components, and energy management devices are moving us toward a vision of the Smart home, offering more security and energy efficiency.

The Internet of things allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention. When Internet of things is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical systems, which also encompasses technologies such as smart grids, virtual power plants, smart homes, intelligent transportation and smart cities.

Internet of things systems like networked vehicles, intelligent traffic systems, and sensors embedded in roads and bridges move us closer to the idea of Smart cities, which help minimize congestion and energy consumption. Internet of things technology offers the

possibility to transform agriculture, industry, energy production and distribution by increasing the availability of information along the value chain of production using networked sensors. The Internet of things is expanding at a rapid rate, and it is becoming increasingly important for professionals to understand what it is, how it works, and how to harness its power to improve business. The Internet of things platform can continuously monitor the location and conditions cargo and assets via wireless sensors and send specific alerts when management exceptions occur (delays, damages, thefts, etc.). The Internet of Things is introducing entirely new layers to the traditional concept of a car. By offering a fancy-free variety of infotainment services and connected car applications for drivers, the automotive industry has the potential to become an IoT champion among other industries and fuel the IoT cloud services adoption among car owners and walkers alike.

The Internet of Things (IoT) is the interconnection of uniquely identifiable embedded computing devices within the existing Internet infrastructure. Typically, IoT offers advanced connectivity of devices, systems, and services that goes beyond machine-to-machine communications and covers a variety of protocols, domains, and applications. The interconnection of these embedded devices (including smart objects), is implemented in nearly all fields of automation enabling advanced applications like a Smart Grid. The term things in the IoT refers to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, electric clams in coastal waters, automobiles with built-in sensors, or field operation devices that assist fire-fighters in search and rescue. Current market examples include thermostat systems and washer/dryers that utilize Wi-Fi for remote monitoring.

Road accident is most unwanted thing to happen to a road user, though they happen quite often. Delays in detecting and providing care for those involved in a road traffic crash increase the severity of injuries. Care of injuries after a crash has occurred is extremely time-sensitive: delays of minutes can make the difference between life and death. Hence, it is necessary to develop a system that would reduce the action time after an accident. The system we have proposed has the capability of saving many lives by quickly detecting and reporting the accidents. In this system, the Vibration and fire sensors are used to detect any accidents while driving. The data from the

sensors are transmitted to the Smartphone through Bluetooth communication. A microcontroller is used to interface the hardware components with the smartphone. An application is developed which performs all the tasks such as sending emergency notifications along with their GPS location and sending the patient's medical record to the hospital and blood bank as well as their companions. A separate database is designed, where the medical reports are stored. The system has the capability of ensuring the driver's safety and can easily be integrated with the car.

II. LITERATURE SURVEY

The contributions of various scholars are studied for survey and analyzing the merits and demerits in order to enhance the consequences for making the system work better.

In paper [1], the authors Antonio Celesti, Antonino Galletta, Lorenzo Carnevale, Maria Fazio, Aimelay-Ekuakille and Massimo Villari, discussed a possible alternative solution for addressing the traffic issue considering mobile traffic sensors directly installed in private and/or public transportation and volunteer vehicles. The system consists of an IoT Cloud system for traffic monitoring and alerts the users to avoid the risk of possible accidents based on OpenGTS and MongoDB. This system is very useful for drivers of critical rescue vehicles such as ambulances. Though, this system provides an acceptable response time, the driver would get disturbed by the repeated alert messages and not all roads can be equipped with fixed traffic sensors especially in peripherals areas of a city.

In paper [2], the authors Boon Giin Lee, Jae-Hee Park, Chuan Chin Pu and Wan-Young Chung, presents a novel approach to measure the ECG from the driver palms while holding on the steering wheel. In addition, photoplethysmograms sensor attached on a driver finger can also measure the similar heart rate pattern, known as pulse rate variability. Furthermore, this paper is also focusing on the integration of age and gender as vigilance measurement parameter as each individual exhibits distinct signal pattern. The vigilance monitoring application is developed in smartwatch, able to perform the features extraction, and then predict the driver vigilance class based on the Kernel Fuzzy-C-Mean trained model. A vibration warning will be triggered to the driver if the driver is estimated as drowsy in five consecutive time frames. The main issue in this paper is that since many

sensors are used, the system is found to be complex and the processing time will be more.

In paper [3], the authors Boon-Leng Lee, Boon-Giin Lee and Wan-Young Chung, proposed a completely standalone, distraction-free, and wearable system for driver drowsiness detection by incorporating the system in a smartwatch. It detects the driver's drowsiness level based on the motion data collected from the built-in motion sensors in the smartwatch, such as the accelerometer and the gyroscope. For this purpose, the magnitudes of hand movements are extracted from the motion data and are used to calculate the time, spectral, and phase domain features. Eight features serve as an input to a support vector machine (SVM) classifier. The main issue is that a large number of features have to be processed which would affect the processing time of the smartwatch and the accuracy and reliability of the system.

In paper [4], the authors Daxin Tian, Chao Lin, Xuiting Duan, Zhenggun Sheng, Qiang Ni, Min Chen, Victor C.M. Leung, proposed an improved position-based protocol to disseminate emergency messages among a large scale vehicle networks. Specifically, defined by the proposed protocol, messages are only broadcasted along their regions of interest, and a rebroadcast of a message depends on the information including in the message it has received. The simulation results demonstrate that the proposed protocol can reduce unnecessary rebroadcasts considerably, and the collisions of broadcast can be effectively mitigated. But VANET, being a wireless ad hoc network, serves this purpose completely but is prone to security attacks. Highly dynamic connections, sensitive information sharing and time sensitivity of this network, make it an eye-catching field for attackers.

In paper [5], the authors Chen Chen Lei Lei, Tie Qui, Zhiyan Ren, Tunna Hu, Fang Ti, proposed a cooperative driving scheme for vehicles at intersections in the IoV. The driver's intention is modelled by the BP neural network trained with driving dataset. Then, the identified intention is used as the control matrix of the Kalman filter model, by which the vehicle trajectory can be predicted. Finally, by collecting the information of vehicles trajectories at the intersections, we develop a collision probability evaluation model to reflect the conflict level among vehicles at intersections. It is applicable to the

intersections where vehicles are usually driving slowly and not to all circumstances. Only the conflict of trajectories precisely on the same occasion can be realized as a potential collision and not all complex collisions can be solved in this approach.

In paper [6], the authors Javier Rivas, Ralf Wunderlich, Stefan J. Heinen, presented a study that provides the bases to develop a 2-D sensor network using MEMS accelerometers placed on the width and length of the road surface to monitor continuously the traffic flow. In this paper, piezoelectric acceleration sensors, based on the same measuring principle as MEMS accelerometers, are used with the objective to analyse in detail the amplitudes and frequency ranges in which vibrations occur. From this information, the system determines the presence of vehicles, their travel direction, and speed of different types of vehicles. The major issue in this system is that it will not be efficient on different roads and weather conditions. The algorithms must be improved with more advanced techniques, and it uses a wired protocol to communicate with the nodes.

In paper [7], the authors Lih-Jen Kau, Chih-Sheng Chen, proposed a system to detect abnormal driving by analyzing normalized driving behavior. Serving as the virtual driver, a personalized driver model is established for the speed control purpose by using the locally designed neural network and the real-world vehicle test data. Three typical abnormal driving behaviors are characterized and simulated, namely, the fatigue/drunk, the reckless and the phone use while driving. An abnormality index is proposed based on the analysis of normalized driving behaviors and is applied to quantitatively evaluate the abnormality. But the numerical experiments convey that the effectiveness of the proposed scheme is not very accurate and can often misinterpret the driver's behavior.

All these systems mentioned above are used for accident prevention but there are no system which would efficiently detect accidents and reduce the action time after an accident. In order to overcome these disadvantages we propose the following system.

III. SYSTEM ARCHITECTURE

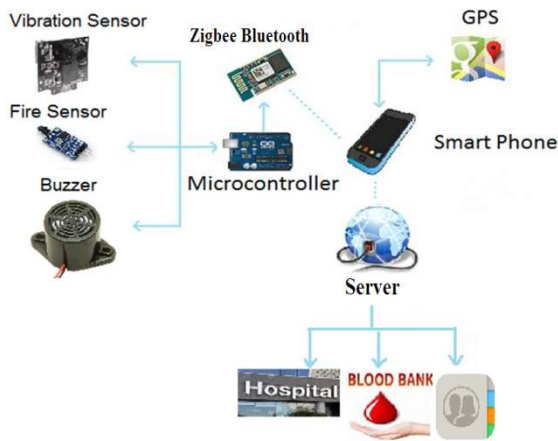


Fig.1. Architecture diagram of Hardware

Fig.1.shows a detailed architecture diagram of the hardware and how its components are interconnected.

IV. SYSTEM DESIGN

The System is divided into two parts

- Hardware
- Software

Hardware Components:

A. PIC microcontrollers

PIC microcontrollers are a family of specialized microcontroller chips produced by Microchip Technology in Chandler, Arizona. The acronym PIC stands for "peripheral interface controller," although that term is rarely used nowadays. A microcontroller is a compact microcomputer designed to govern the operation of embedded systems in motor vehicles, robots, office machines, medical devices, mobile radios, vending machines, home appliances, and various other devices. A typical microcontroller includes a processor, memory, and peripherals.

B. Vibration Sensor

Despite the advances made in vibration monitoring and analysis equipment, the selection of sensors and the way they are mounted on a machine remain critical factors in determining the success of any monitoring program. Money saved by installing inferior sensors is not a prudent investment since the information provided about the machine of interest often is not accurate or reliable.

C. Fire sensor

The fire sensor circuit exploits the temperature sensing property of an ordinary signal diode IN 34 to detect heat from fire. At the moment it senses heat, a loud alarm simulating that of Fire brigade will be produced. The circuit is too sensitive and can detect a rise in temperature of 10 degree or more in its vicinity. Ordinary signal diodes like IN 34 and OA 71 exhibits this property and the internal resistance of these devices will decrease when temperature rises.

D. Zigbee Bluetooth

ZigBee, like Bluetooth, has a large installed base of operation, although perhaps traditionally more in industrial settings. It is an industry-standard wireless networking technology operating at 2.4GHz targeting applications that require relatively infrequent data exchanges at low data-rates over a restricted area and within a 100m range such as in a home or building. ZigBee has some significant advantages in complex systems offering low-power operation, high security, robustness and high scalability with high node counts and is well positioned to take advantage of wireless control and sensor networks in IoT applications.

Software Components:

The mobile application is built using Android Operating System. Java is used for server-side scripting. PIC microcontroller is used as open-source prototyping platform for data and signal processing. The PIC board was programmed using the embedded C programming language. The GPS is used to send the exact location of the vehicle that had the accident. MySQL is used as the Database Management System (DBMS). It stores the medical report of the patients and sends to the hospital, blood bank and saved contacts in case of emergency.

The GPS receives the location of the vehicle that met with an accident and gives the information back. This information will be sent to a mobile number through text message. This message will give the information of longitude and latitude values. Using these values the position of the vehicle can be estimated. Once the location is identified, the rescue team will be sent to the accident location and helps them to respond immediately..

V. FUNCTIONAL ARCHITECTURE

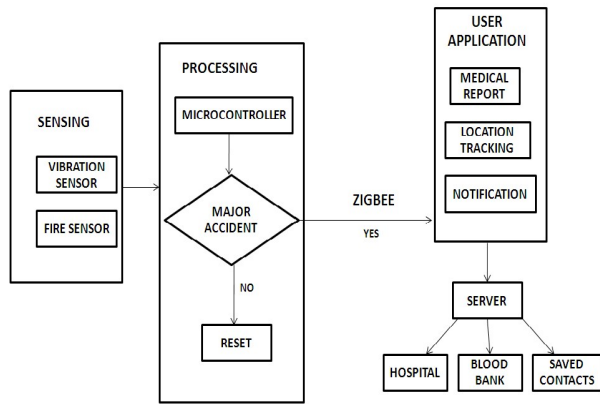


Fig.2. Functional Architecture diagram of the system

Fig.2.shows a detailed functional architecture diagram of the system and its working

In this section, we elucidate our proposed system at a high level scope. The system is composed of the following phases:

1. User registration
2. Sensing and processing
3. Location tracking and reporting emergency

User Registration:

This phase deals with the process of user registration. The vehicle's owner must prepare the vehicle for this system by installing the hardware device. After installing the device, the owner gives the Vehicle ID along with the medical report. The mobile application aims at providing a one-time only registration form for passengers' personal data. The personal data include: (a) Full name, (b) Blood type, (c) Phone number, (d) Email, (e) Medical history, (f) Date of birth, (g) Emergency contacts. The whole record of passenger information is uploaded to the database once the registration process is complete.

Sensing and Processing:

Vibration sensor, Fire sensor and buzzer is used in this phase. The vehicle is connected to a hardware device that detects the collision with the help of the vibration sensor. The hardware device also consists of a fire sensor that senses fire breakouts. As soon as the collision or fire is detected, the buzzer goes on. It communicates with the application in the Smartphone through Zigbee Bluetooth. If the driver doesn't want to communicate any information, he can cancel using the reset switch.

Location tracking and reporting emergency:

Once the Bluetooth connection is established, the application would track and communicate the victim's GPS location along with the patient's entire medical report to their companions as well as the nearest hospital through an SMS. The application also checks the availability of the blood in the nearest blood bank and sends a notification back as soon as the availability of blood is ensured. These combined modules altogether spontaneously notify the nearby hospital, blood bank and already saved contacts whenever an accident takes place, pinpoint the exact location, and helps the rescue teams to respond immediately.

VI. RESULT

The objective of our experiments was to verify if our system prototype was able to send alert notifications in a useful time to emergency contacts in order to reduce the action time after the accidents.

The System is divided into two parts

- Hardware
- Software

Hardware:

Vibration sensor and Fire sensor detects the collision and fire breakouts respectively. As soon as the collision or fire is detected, the buzzer goes on. It communicates with the application in the Smartphone through Zigbee Bluetooth. If the driver doesn't want to communicate any information, he can cancel using the reset switch. The PIC microcontroller consists of five ports namely A,B,C,D,E. The vibration sensor, fire sensor, buzzer, LED display and Zigbeebluetooth are connected to these ports. Fig.3 below shows the hardware connection of the system.



Fig.3. Hardware connection of the system

Software:

Once the Bluetooth connection is established, the application would track and communicate the victim's GPS location along with the patient's entire medical report as shown in Fig.4 to their companions as well as the nearest hospital through an SMS. The application also checks the availability of the blood in the nearest blood bank and sends a notification back as soon as the availability of blood is ensured.

Fig.4. Medical report of the system

VII. CONCLUSION AND FUTURE WORK

Many systems have been developed to sense the driver's behaviour and alert them in case of any difference in behaviour, but there's no system which would accurately detect accidents and send alert messages. The application would track and communicate the victim's GPS location along with the patient's entire medical report to their companions as well as the nearest hospital through an SMS. The application also checks the availability of the blood in the nearest blood bank and sends a notification back as soon as the availability of blood is ensured. This system proposes a solution to minimize the action time after an accident. In future, it can ensure the driver's safety along with the co-passengers by integrating this system with all the cars.

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