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Internet of Vehicle using Safety Case

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ABSTRACT

In India, mortality rates are increasing mainly due to road accidents. Many lives could have been saved if emergency service could get accident information and reach in time. The main aim of this project is to implement a system for upgrading the present technologies used in the vehicle security by developing a safety case. Safety case is used for continuously monitoring and storing data regarding the vehicle, which will be easy to discover the cause of accident by knowing the previous state of the vehicle. Our project is a combination of client, connection and cloud system. In this the status of horn, brake and indicator will be stored in Raspberry pi and data logger system. Our research has been targeted towards building a system for emergency rescue services in the event of a road accident. The project focuses on building a system which vehicle safety authorities can implement to enhance the reporting of vehicle crashes, provide post-crash analysis using motion sensors, record of the event in images and reduce the time it takes for emergency rescue to arrive at the crash location. We have achieved this using existing cellular network infrastructure already in place and also using GPS to pinpoint the exact location of the accident and send that data immediately to an emergency rescue authority using telegram and twilit service. Our main target was to build a low cost infrastructure that everyone can afford and use in their vehicle.

Keywords: Accident, Camera, Emergency Rescue, GPS, IOT, Raspberry pi, Safety Case.

1. INTRODUCTION

The risk of road accident or crash has become an unavoidable issue globally and of everyone's concern. According to WHO Road Traffic Injuries Fact Sheet about 1.24 million people die each year due to road traffic crashes. They have predicted that if no action is taken on this the figure would reach 1.9 million casualties by the year 2020. Many of them died only because of not getting EMS on time. If medical services were available to them on time many of them could have been saved. Thus, the need of quality EMS in India is an inevitable need of the masses. As the vehicle ownership percentage is increasing in India, parking has become a conflicting and confusing situation to the people. Lack of accessible parking can hurt the local business and decrease the quality of life for residents. In India, every 13 minutes a vehicle is being stolen. Thus we decided to implement a project to meet the solution for all these problems.

Our project is to reduce the mortality rate of road accidents by using GPS technology to instantly notify an emergency authority in the event of a crash. Not only that, our device (safety case) senses the exact GPS coordinates of the crash along with vehicle information

in the form of a notification and clear cut picture evidence of the accidents from the GPS send to the rescue authority. So that instant dispatch of ambulance can be made, because basic life support may be needed soon after the crash. The safety case will continuously monitor and store the data of the vehicle in the Raspberry pi. So that it will be easy to know the present and previous condition of vehicle. Camera is interfaced to know about the condition of people sitting inside the vehicle and also the previous and present condition of vehicle.

This report provides reader with high-level understanding of importance of security on vehicle related problems. More specifically, this report is intended to give the reader a basic understanding of the benefits and importance of vehicle security.

2. LITERATURE SURVEY

The IEEE journal on “Vehicle black box with 24GHz FMCW radar”, [4] proposed by Jung-Hwan Kim, Sun-Kyu Kim and Sang-Hyuk Lee, is an automobile Black Box is a digital data recorder used to record information related to accidents in automobile. It provides critical data for crash investigation as the Black box in an aircraft provides critical data for air crash investigations. Black box can effectively track the happenings in vehicles during and after the crash. The data from the Black box is accompanied by the inputs given by victims and eye witnesses. Most important requirements for designing evidence collecting automobile Black Box and various design approaches are identified in this survey. The true cause of accident can be found if the events that lead to the accident are known. Thus, finding out the cause for the accident is necessary which can be achieved using Black Box.

The IEEE journal on “Accident Alert and Vehicle Tracking System”, [5] proposed by Kiran Sawant, Imran Bhole, Prashant Kokane, Piraji Doiphode, Prof. Yogesh Thorat created an accident alert system using GSM and GPS modem and Raspberry Pi. A piezoelectric sensor first senses the occurrence of an accident and gives its output to the microcontroller. The GPS detects the latitude and longitudinal position of a vehicle. The latitudes and longitude position of the vehicle is sent as message through the GSM. The static IP address of central emergency dispatch server is pre-saved in the EEPROM. Whenever an accident has occurred the position is detected and a message has been sent to the pre-saved static IP address.

The IEEE journal on “Accident Detection and Reporting System using GPS, GPRS and GSM Technology”, [6] proposed by Md. Syedul Amin, Jubayer Jalil, M. B. I. Reaz explains about Glass Box. It focuses on building an infrastructure which vehicle safety authorities can implement to enhance the reporting of vehicle crashes, provide post-crash analysis using motion sensors, record of the event in images and reduce the time it takes for emergency rescue to arrive at the crash location. We have achieved this using existing cellular network infrastructure already in place and also using GPS to pinpoint the exact location of the crash and send that data to an emergency rescue authority (such as Hospital, Fire Department, Police) using GSM text service.

The IEEE journal on “Accident Detection and Ambulance Control using Intelligent Traffic Control System”, [7] Mrs. Manasi Patil, Aanchal Rawat, Prateek Singh, Srishtie Dixit, described a better traffic management system using Raspberry pi and RFID technology. The vehicle has a raspberry pi controller fixed in it which is interfaced with sensors like gas sensor, temperature sensor and shock sensor. These sensors are fixed at a predetermined value before accident. When an accident occurs the value of one of the sensor changes and a message to a predefined number (of the ambulance) is sent through GSM. The GPS module which is also interfaced with the controller also sends the location of the vehicle. When the message is received by the ambulance, a clear route has to be provided to the ambulance. The ambulance has a controller ARM which is interfaced with the RFID tag sends electromagnetic waves. When an ambulance reaches the traffic signal the RFID reader which is placed on the joints detect the electromagnetic waves of the tag. If the traffic signal is red, then the readers goes through the database in fraction of seconds and turn the red light green. And automatically in such condition the RFID on opposite joints turn the opposite signal red. This provides a clear route to the ambulance.

The IEEE journal on “Black Box: An Emergency Rescue Dispatch System for Road Vehicles for Instant Notification of Road Accidents and Post Crash Analysis”, [12] proposed by Sayem Chaklader, Junaed Alam, Monirul Islam, Ali Shihab Sabbir describes that to utilize the capability of a GPS receiver to monitor speed of a vehicle and detect accident basing on monitored speed and send accident location to an Alert Service Center. The GPS will monitor speed of a vehicle and compare with the previous speed in every second through a Microcontroller Unit. The system will then send the accident location acquired from the GPS along with the time and the speed by utilizing the GSM network. This will help to reach the rescue service in time and save the valuable human life.

3. WORKING

The main function of the system is to provide vehicle security by providing a safety case to the vehicle. It will continuously monitor the data regarding vehicle and store it in the Raspberry pi. In this the usage of sensors such as alcoholic sensor, ultrasonic sensor, piezo sensor, and fire sensor and so on is done. These data's are fed in to Raspberry pi for further processing. As the vehicle starts the safety case will be in active mode. Thus whenever their occurs any kind of accidents takes place, at that moment itself the microcontroller trigger the Raspberry pi and a clear cut picture will be recorded and sent to the destination for rescue operation to carried out. These data's are sent to server with the help of Raspberry pi, which is single credit card sized minicomputer with the help of cloud computing. We can store the data in the server, so that we can access the data whenever it is necessary. These can be viewed from the web page. In case of network failure, these data's will be sent to the authorized android application in the form of twilio message.

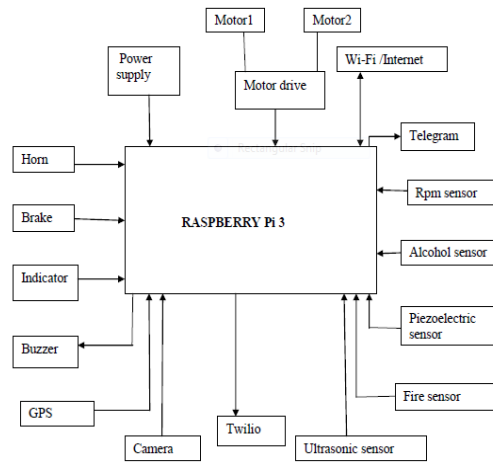


Fig 3.1 Block Diagram

4. COMPONENTS

Raspberry pi:

The Raspberry pi is a series of credit card-sized single-board computers developed in the United Kingdom by the Raspberry pi Foundation to promote the teaching of basic computer science in in schools and developing countries.

The Raspberry pi has a Broadcom BCM2835 system on a chip (SOC), which include an ARM1176JZF-S 700MHz processor, Video Core IV GPU and was originally shipped with 256 megabytes of RAM, later upgraded (Model B & Model B+) to 512MB. It does not include a built-in hard disk or solid-state drive, but it uses an SD card for booting and persistent storage, with the Model B+ using a Micro SD.. The Foundation provides Debian and Arch Linux ARM distributions for download. Tools are available for Python as the main programming language, with support for BBC BASIC (via the RISC OS image or the Brandy Basic clone for Linux), C, Java and Perl. The allure of the Raspberry Pi comes from a combination of the computer's small size and affordable price. Enthusiasts envision using the small form-factor PC as a cheap home theater PC (HTPC), or secondary low-power desktop. Institutions, like schools and businesses, could benefit from deploying a fleet of computers for a fraction of the cost of traditional desktop towers. The small size makes for an easy to-hide computer that sips power and can be mounted behind the display with an appropriate case. It could also be used in niche applications, like digital signature. The Raspberry Pi model available for purchase at the time of writing the Model B features HDMI and composite video outputs, two USB 2.0 ports, a 10/100Ethernet port, SD card slot, GPIO (General Purpose I/O Expansion Board) connector, and analog audio output (3.5mm headphone jack). The less expensive Model A strips out the Ethernet port and one of the USB ports but otherwise has the same hardware.



Fig 4.1 Raspberry Pi

Memory:

The raspberry pi model aboard is designed with 256MB of SDRAM and model B is designed with 51MB. Raspberry pi is a small size PC compare with other PCs. The normal PCs RAM memory is available in gigabytes. But in raspberry pi board, the RAM memory is available more than 256MB or 512MB

CPU (Central Processing Unit):

The Central processing unit is the brain of the raspberry pi board and that is responsible for carrying out the instructions of the computer through logical and mathematical operations. The raspberry pi uses ARM11 series processor, which has joined the ranks of the Samsung galaxy phone.

GPU (Graphics Processing Unit):

The GPU is a specialized chip in the raspberry pi board and that is designed to speed up the operation of image calculations. This board designed with a Broadcom video core IV and it supports OpenGL.

Ethernet Port:

The Ethernet port of the raspberry pi is the main gateway for communicating with additional devices. The raspberry pi Ethernet port is used to plug your home router to access the internet.

GPIO Pins:

The general purpose input & output pins are used in the raspberry pi to associate with the other electronic boards. These pins can accept input & output commands based on programming raspberry pi. The raspberry pi affords digital GPIO pins. These pins are used to connect other electronic components. For example, you can connect it to the temperature sensor to transmit digital data.

Power Source Connector:

The power source cable is a small switch, which is placed on side of the shield. The main purpose of the power source connector is to enable an external power source.

UART:

The Universal Asynchronous Receiver/ Transmitter is a serial input & output port. That can be used to transfer the serial data in the form of text and it is useful for converting the debugging code.

Display:

The connection options of the raspberry pi board are two types such as HDMI and Composite. Many LCD and HD TV monitors can be attached using an HDMI male cable and with a low-cost adaptor. The versions of HDMI are 1.3 and 1.4 are supported and 1.4 version cable is recommended. The O/Ps of the Raspberry Pi audio and video through HMDI, but does not support HDMI I/p.

Power Supply:

The input to the circuit is applied from the regulated power supply. The AC input i.e., 230V from the mains supply is step down by the transformer to 12V and is fed to a rectifier. The output obtained from the rectifier is a pulsating DC voltage. So in order to get a pure DC voltage, the output voltages from the rectifier is fed to a filter to remove any AC components present even after rectification. Now, this voltage is given to a voltage regulator to obtain a pure constant dc voltage.

Alcohol Sensor:

A semiconductor sensor for alcohol detection has very good sensitivity and faster response to alcohol. Suitable for detecting alcohol in breath, like a common breathalyzer. Provides an analog resistive output based on alcohol concentration. The drive circuit has one resistor. The resistance of the sensor reduces when alcohol increases. The sensor gives output as per the condition of the breath through the logic circuit which is send to the microprocessor Sensitive material of MQ-3 gas sensor is SnO₂, which with lower conductivity in clean air. MQ-3 gas sensor has high sensitivity to Alcohol, and has good resistance to disturb of gasoline, smoke and vapour. The sensor could be used to detect alcohol with different concentration; it is with low cost and suitable for different application.



Fig 4.2 Alcoholic Sensor

Piezoelectric Sensor:

A piezoelectric sensor is a device that uses the piezoelectric effect to measure pressure, acceleration, strain or force by converting them to an electrical charge. Piezoelectric sensors have proven to be versatile tools for the measurement of various processes. They are used for quality assurance, process control and for research and development in many different industries. Although the piezoelectric effect was discovered by Pierre Curie in 1880, it was only in the 1950s that the piezoelectric effect started to be used for industrial sensing applications.



Fig 4.3 Piezoelectric Sensor

GPS:

Global Positioning System was developed by the United States' Department of Defense. It uses between 24 and 32 Medium Earth Orbit satellites that transmit precise microwave signals. The Global Positioning System (GPS) is a space based satellite navigation system that provides location and time information in all weather, anywhere on or near the Earth, where there is an unobstructed

line of sight to four or more GPS satellites. The GPS satellites are maintained by the United State's Air Force and is freely accessible to anyone with a GPS receiver.

Wi-Fi Module:

Wi-Fi, also spelled Wi-Fi or Wi-Fi, is a popular technology that allows an electronic device to exchange data or connect to the internet wirelessly using radio waves. The Wi-Fi Alliance defines Wi-Fi as any "wireless local area network (WLAN) products that are based on the Institute of Electrical and Electronics Engineers' (IEEE) 802.11 standards". However, since most modern WLANs are based on these standards, the term "Wi-Fi" is used in general English as a synonym for "WLAN". Only Wi-Fi products that complete Wi-Fi Alliance interoperability certification testing successfully may use the "Wi-Fi CERTIFIED" trademark.



Fig 4.4 Wi-Fi Module

Camera:

A camera is an optical instrument for recording or capturing images, which may be stored locally, transmitted to another location, or both. The images may be individual still photographs or sequences of images constituting videos or movies. The camera is a remote sensing device as it senses subjects without physical contact. The word camera comes from camera obscura, which means "dark chamber" and is the Latin name of the original device for projecting an image of external reality onto a flat surface. The modern photographic camera evolved from the camera obscura. The functioning of the camera is very similar to the functioning of the human eye.



Figure 4.5 Camera

Buzzer:

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

Server:

The data send by Raspberry pi is stored on a server. The detailed information of person is registered through website on stored on server. The website can be accessible from anywhere.

5. PROGRAMMING LANGUAGE USED

PYTHON:

Python is a widely used high-level, general-purpose, interpreted, dynamic programming language. Its design philosophy emphasizes code readability, and its syntax allows programmers to express concepts in fewer lines of code than possible in languages such as C++ or Java. The language provides constructs intended to enable writing clear programs on both a small and large scale.

Python supports multiple programming paradigms, including object-oriented, imperative and functional programming or procedural styles. It features a dynamic type system and automatic memory management and has a large and comprehensive standard library. Python interpreters are available for many operating systems, allowing Python code to run on a wide variety of systems. Using third-party tools, such as Py2 exe or Pyinstaller, Python code can be packaged into stand-alone executable programs for some of the most popular operating systems, so Python-based software can be distributed to, and used on, those environments with no need to install a Python interpreter. C Python, the reference implementation of Python, is free and open-source software and has a community-based development model, as do nearly all of its variant implementations. C Python is managed by the non-profit Python Software Foundation.

6. ADVANTAGES

- Data logging and cloud computing: Measured values are stored in server with the help of raspberry pi. Most recent values are displayed on webpage.
- Data security: Data is encrypted while sending to increase the confidentiality. Also we use password system to avoid the unauthorized reception of data.

- Highly sensitive: System is very responsive to variations in the various parameters. This help to increase the accuracy of the data.
- Low cost and reliable circuit.
- Get clear cut about the accident
- Helpful for rescue operation.
- Increase and accurate reporting of road accidents.
- User friendly.

7. APPLICATIONS

- **Automatic Theft Lock:** At once if the vehicle seems to be theft, the owner just has to send an SMS to Police Control Room with vehicle number. Police authorities send signal to Vehicle through IoT so that vehicle will be stopped by cutting the ignition. The current location of the vehicle is send to Police control room through IoT.
- **Parking Problem elimination:** If any vehicle makes hindrance to ours, we can message to vehicle number in number plate with MOVE command. The module inside the vehicle receives the message and it gives indication message to user through IoT. User can move his vehicle which makes hindrance to others through commands over the mobile phone connected to IoT.
- **Data Store on Accident:** Generally, the black box will be used in airplanes to record the video of plane condition and update it to the control room. This information can be used to identify the problem simply by analyzing the video accurately. It is mainly useful to identify the cause accident if occurred. Same concept can be used in four wheelers to avoid accidents. Here the status of horn, indicator, brake and accelerometer of four wheeler is continuously monitored and stored by Raspberry Pi and data logger system. A camera is also interfaced to know about the people sitting inside the car also to know about the condition of the car before the accident has occurred.
- **Automatic Ambulance calling on Accident:** Once accident occurs the vehicular system itself message to ambulance service and police control room through IoT and GPS location is indicated.
- **Vehicle to Road Communication (V2R):** System automatically communicates with road side sign boards, and controls the speed in accordance with speed zones (Hospitals, Schools etc.)
- **Vehicle to Vehicle Communication (V2V):** Once the vehicle in front side is brake applied, the information is passed to vehicle at back side and it slow down automatically.
- **Automatic dimming of high beam in night time.**
- **Data Encryption:** Data encrypted using AES algorithm for secure communication through IoT for safety.
- **Accident Data Logger:** If any vehicle hits our vehicle and try to escape without stopping, memory device in ours will store the number of other vehicle, So that even when a vehicle tries to escape from the proximity before noticing will not be issue.

8. RESULTS AND DISCUSSION

This paper reviews the fundamental concepts of IoT. Further, the paper presents an infrastructure for the vehicle diagnosis, which consists of various technologies. The paper emphasizes on the system and software architecture and design which is essential to overall IoT and cloud based vehicle applications. It concludes with recommendations and extensibilities found for the solution in the vehicle related applications.

9. CONCLUSION AND FUTURESCOPE

Overall this device and system will be the changing factor in road safety and vehicle security. WHO has predicted that there will be about 1.9 million casualties by the year 2020. With the co-operation from both the vehicle owners and the Government, the implementation of such system can be possible. Thus we can reduce the impact of road accidents and crashes. In addition to it better data collection on accident will help to understand the status of vehicle. Emergency Crash Reporting System will support the rescue operations of the country. Also it include various other factors like parking problem elimination, vehicle to vehicle communication, automatic theft lock etc... Which provide high security for vehicle.

The cloud technology helps the server to update the accident related data on website. Many further improvements can be made in our system to make it better and easily adaptable such as adding more advanced sensors. To simplify the hardware and reduce wiring we can have used wireless sensors. Vehicle related will get as the mail.

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