A Novel Approach To Make Vehicle Autonomous And Secure

Muhammad Shahroz Abbas, Muhammad Zubair Tariq

Abstract— Technology has revolutionized the transportation system. However, life was never as fanatic and insecure as today's world as we are living in. The need to have a safe journey, remain always updated and alert has increased many folds. Modern vehicles having the latest technology are giving reliability and safety to the people. However, unfortunately, the number of causalities in a road accident and vehicle theft is increasing rapidly. Mysterious vehicle stealing, accidents, and late rescue create a tenser situation and enormously increasing accident mortality rate extremely on unpopulated areas. To overcome all these matters fully automatic system is present which automatically detects the accidents as well as theft activity and sends the alert SMS with location coordinates to emergency services or concerned persons. The proposed technology is consists of both software and hardware. The modules in hardware part are Vibration sensor Accelerometer, Temperature sensor, Smoke sensor, Bluetooth and GPS/GSM module which are controlled by Arduino UNO R3 and placed in vehicle whereas the software part is the Mobile Application that is installed on user's mobile, use to get vehicle's location and sends alert SMS by getting signal from Arduino. The experimental results reveal that the presented system functions well as intended.

Keywords— Accident Detection, Fire Detection, Arduino, Vibration Sensor, Accelerometer, Heat Sensor, Smoke Sensor, GPS/GSM module Bluetooth Device, Android Application

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1 INTRODUCTION

The world is quickly revolutionizing the way of life; our Survival just depends on quickly adapting the changing norms of technology. Similarly, advancements in technology are becoming the cause of disasters and crime whereas "Disaster" is referred to a sudden event, such as an accident or a natural catastrophe that causes great damage or loss of life [1]. Scientists are in a continuous struggle to facilitate mankind and intend to provide them safe and reliable products. They suggest "Automation" is only the solution to make the journey secure as well as it is the way to make us updated and alert about any criminal activity or accident. Developing countries like Pakistan hundreds of cases of vehicle theft and accidents are being reported on a daily basis [2]. The mortality rate in accidents and vehicle theft activity is directly proportional to the late rescue on the spot of the incident. To keeping in view all these issues a multipurpose embedded system is proposed that can become the savior of precious human life and property. The proposed system can automatically inform the emergency services or concerned person with precise location through Short Message Service (SMS) if an accident or any unusual activity happens to the vehicle like if a vehicle gets the fire or someone forcefully tries to open the car. Emergency horn fitted into the car shell be activate and sends the alert message when any criminal activity happens. Moreover, parents can keep an eye on their children and gets the location of the vehicle anywhere anytime all over the globe by using the mobile application.

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2 LITERATURE REVIEW

Continues straggle and commitment is the key to making a successful product. None of the products in this world is the final one, advancement in technology is a basic factor for its reliability. In this emerging world, there are a lot of systems that have been proposed for accident detection, location finder, and theft activity detector. However, the majority of the system has limited functionality or performs operation manually. Therefore, keeping in view some pros and cons an autonomous system is proposed to get better results. Some systems are

M. S. Abbas. [3] Presented An Automatic Accident Detection System: A Hybrid Solution. The proposed system has the capabilities to automatically detect an accident and quickly inform to the emergency services or concerned family member with precise location through Short Message Service (SMS). However, it has limited functionalities like it cannot detect Fire and any criminal activity happening to the vehicle.

Sane et al. [4] presented a Real-Time Vehicle Accident Detection and Tracking using GPS and GSM. This system works manually and works by pushing the button and the contact number on which alert message has to be sent is hardcoded, it will not change. After having an accident the system will ask the driver either he/she wants to send SMS or not. If the driver

presses the button, the microcontroller understands that the accident is not serious so it will not send SMS. In other cases, if a collision has been detected and the button has not been pressed in the given time, the microcontroller will get the co-ordinates of the current location and will transmit the alert SMS to the family of the driver through fitted GPS and GSM modules.

Kaladeviet al. [5] proposed an Android Smartphone based solution to automatically identify the accident and generate an alert with the location of the spot. In this solution, a heartbeat sensor is integrated with a Smartphone. Since there is a defined standard of a normal human heartbeat rate (60 to 100 beats per minute BPM). If there is any variation in heartbeat rate relevant to the given range the system sends an alert SMS to the pre-selected contact along with the location of the spot. Actually, in our opinion, instead of accident detection, it can be used as a health indicator.

SoSMart application [6] detects accidents automatically using the internal sensors and accelerometer of the smartphone. After accident detection it sends an alert notification with location to pre-selected contact, so the contacted one can send rescue services as soon as possible. However, it uses the mobile's accelerometer to detect accidents that are usually used to get values of the X-axis and Y-axis. While the journey it can be possible that a child plays with the mobile and as soon as he/she tilt or shake the mobile the alert message will be transmitted to the other family member. Therefore, it's not a reliable product.

Ben Asante [7] proposed Vehicle Fire Outbreak Detection Communication System. This project is suitable for the detec-tion of fire outbreaks in an environment where excessive heat is generated such as in vehicles and also in heavy industrial environments (where a lot of heat is generated by the working machinery). However, it is limited to locations where the band of frequency for GSM (Global System for Mobile telecommu-nication) SIM900 module is used. This project neither detects the road accident nor theft activity.

Samir proposed Anti-theft Security System for Vehicles. Sup-pose, a thief tries to steal the car, and tamper with it, then im-mediately a text message will be dropped on our phone, as well in the app. As soon as we receive the text message, we can go to the android application and click on the accelerator, gear and brake buttons, given in the app to stop working it.

Anupriyaet al. [8] proposed a Smart Accident Notification and Collision Avoidance System. The mortality rate of human lives is tried to decrease through this system that is a good step to-wards human living. In this system, major four units are work-ing simultaneously for the detection of the accidents and alert the concerned persons. The first one is the main front unit called the vehicle unit. It includes the sensors, ZIGBEE, and microcontroller along with GPS to sense the collisions. The main function of this unit is to send the location of the spot of the accident towards the ZIGBEE which will give further in-

structions. Actually, the GPS sends the latitude and longitude to the main server if the accident takes place. Secondly, the main brain of the system takes the position which is called the control unit. The control unit keeps all the records about the nearby hospitals in his database for the patients of the acci-dents. It notifies about the accidents and locations through GPS and ZIGBEE. To support the rescue operation, after get-ting the notification and the location of the incident where a collision has occurred. The ambulance unit is responsible for performing the rescue operation. The ambulance unit also consists of an LM35 temperature sensor and IR based obstacle sensor. LM35 sensor is used for getting the temperature of the patient and the obstacle sensor is used to measure the pulse rate of the patient.

Keeping in view it is prudent to say that most of the existing products are incomplete and demands complete automation. Therefore, this system has been proposed, which can become the savior of mankind.
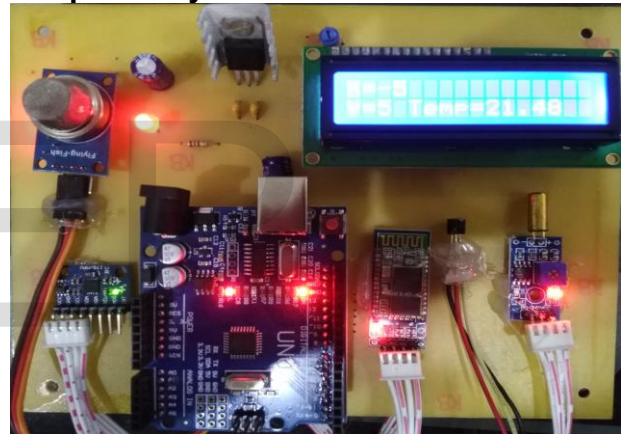
2 Proposed System

Figure 1. Proposed System

2.1 Hardware Component

The hardware component consists of several modules. The following are the main modules:

2.1.1 Arduino Board

Arduino is an open-source platform used for build-ing electronics products. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on the computer, used to write and upload computer code to the physical board. In this work, Arduino UNO Rev3 [9] is used. It can be programmed using C or C++ language [9].

2.1.2 Accelerometer/Tilt Sensor

In a moving vehicle, a crash not only occurs when there is a collision with another vehicle but it may al-

so occur when there is no proper balance in right and left sides of the vehicle. Sometimes a vehicle may move on the footpaths due to which major accidents occur. Since when a vehicle loses its balance, then the angle of the vehicle definitely changes both horizontally and vertically and the chances of an accident are high. The accelerometer gives the angle of the X-axis and Y-axis of the moving vehicle to detect an accident [10].

2.1.3 Vibration Sensor

The vibration sensor works on the vibrating technique. Most of the vehicle crash detection systems use this module. In the proposed system, whenever the vibration sensor detects any fluctuation of jerk it notifies to the Arduino that a problem has occurred [11].

2.1.4 Heat Sensor

LM35 is a precession Integrated circuit Temperature sensor, whose output voltage varies, based on the temperature around it. It is a small and cheap IC that can be used to measure temperature anywhere between -55°C to 150°C. It can easily be interfaced with any Microcontroller that has ADC function or any development platform like Arduino [12].

2.1.5 Smoke Sensor

The MQ-6 Gas sensor is used in the system that can detect or measure gases like LPG and butane. The MQ-6 sensor module comes with a Digital Pin which makes this sensor operate even without a microcontroller and that comes in handy when you are only trying to detect one particular gas. When it comes to measuring the gas in ppm the analog pin has to be used, the analog pin also TTL driven and works on 5V and hence can be used with most common microcontrollers [13].

2.1.6 Bluetooth Module

In the proposed system, the Bluetooth module is used for the communication between hardware and software components. In this work, HC-06 module is used because it gives a good performance in data transmission [14].

2.1.7 GPS/GSM Module

SIM808 module is used. It is based on the latest GSM/GPS module SIM808 from SIMCOM, supports GSM/GPRS Quad-Band network and combines GPS technology for satellite navigation. It has high GPS receive sensitivity with 22 tracking and 66 acquisition receiver channels. Besides, it also supports A-GPS that available for indoor localization. The module is controlled by AT command via UART and supports 3.3V and 5V logical level [15].

2.2 Software Component

The software component is a Mobile application that is installed on the user's mobile. The mobile application has several functionalities; firstly when it gets signals from the Arduino then it sends an SMS to the concerned person with the precise location of the incident, secondly, it is used to get current location of the vehicle and turn off the horn by sending signals to the Arduino using SMS. Microsoft Visual Studio Community 2017 [16] is used for the application. To create the front end, XAML with predefined visual studios feature is used, whereas C# is used to handle the back-end using Xamarin cross-platform which is also a very efficient and latest cross-platform in application development [17],[18].

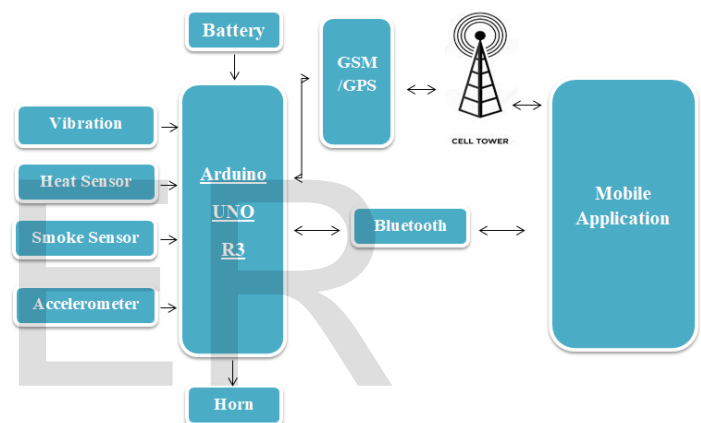## 3 SYSTEM CONFIGURATIONS AND WORKING

Figure 2. Block Diagram

The reliability of any system cannot be determined without its testing using different case studies under varied conditions. In order to evaluate the performance of the proposed system, the hardware component is deployed into the vehicle whereas the mobile application is installed on the driver's mobile. Both hardware modules and the user's mobile are connected with the Bluetooth module.

After making the connection using Bluetooth, enter the drive name and contact numbers to whom we want to send the alert message. Fig. 2 shows the working flow of the proposed system. As soon as the system detects any theft activity, accident or vehicle get the fire the microcontroller will send the alert signal to the mobile application through Bluetooth and after getting the location coordinates mobile application will transmit the alert message to emergency service or any concerned person. In other cases, GSM/GPS module and Horn will be activated when mobile will not in the range to send the SMS and someone forcefully try to open the vehicle or vehicle catches the fire at midnight.
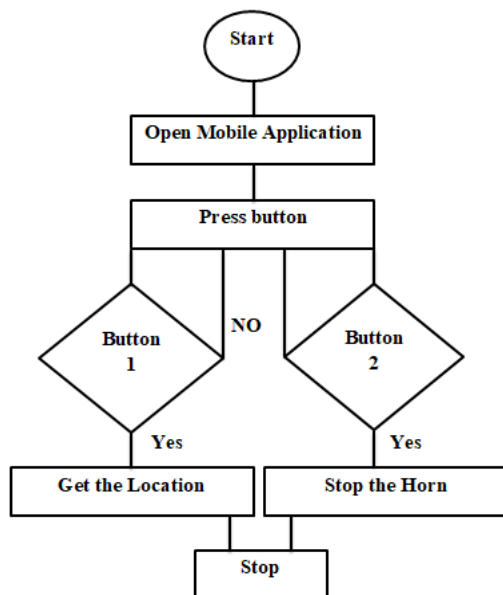
Beside all the working GPS/GSM module and mobile application also use to get the vehicle current location for safety purpose and to turn off the Horn.

3.1 Working flow-chart of hardware module.
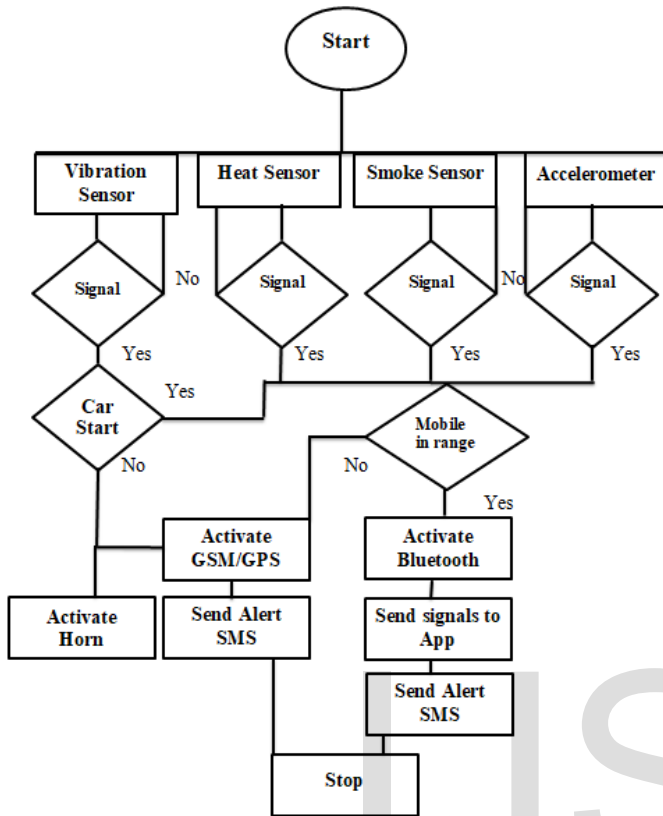
Figure 3. Flow-chart 1

3.2 Working flow-chart of Mobile application.

Figure 4. Flow-chart 2

4. ADVANTAGES

The proposed automatic accident detection and security alet system can become the savior of life for every one. It can play a vital role to protect our properties reduce the death rate in accidents. The proposed system is very user-friendly that even a non-technical person can use it easily. In short, the main benefits of this system are low cost, secure and easy to use.

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