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Accident Detection System (ADS) using GPS and GSM

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Abstract

Recently technological and population development, the usage of vehicles and rapidly increasing and at the same time the occurrence accident is also increased. Hence, the value of human life is ignored. No one can prevent the accident, but can save their life by expediting the ambulance to the hospital in time. A new vivid scheme called Accident Detection System (ADS) using Global Positioning System (GPS) and Global System for Mobile Communication (GSM) is introduced. The aim of our work is to find the vehicle accident location by means of sending a message using a system which is placed inside of vehicles system. The concept of this scheme is that (ADS) will send signal of data to the nearest rescue force main server automatically with the help of GSM module example hospital. So that the ambulance can reach the spot in time and human life can be saved and the accident location is identified sends the accident location immediately to the main server. The main server finds the nearest ambulance to the accident zone and sends the exact accident location to the emergency vehicles. The control unit monitors the ambulance and provides the shortest path to the ambulance according to the ambulance location and thus arriving at the hospital safely. The scheme is fully automated, thus it locates the accident spot accurately, provide the shortest path to reach the location and to the hospital in time.

Key Words: acceleration sensor; accident; detection; ADS; GSM; GPS

1.0 INTRODUCTION

According to the World Health Organization (WHO, 2013), approximately 1.24 million people die every year on the world road, and another 20 to 50 million sustain nonfatal injuries as a result of road traffic crashes. The common type of motor vehicle accidents are vehicle collision, rollover or overturning. Internal or external bleeding can be fatal and shock becomes more likely with passing time, hence the need for a quick response in the event of an accident. Therefore there is need of to develop a solution for near instant motor vehicle accident detection and reporting. Now a day, it became very difficult to know that an accident has occurred and to locate the position where it has happened. It's very difficult for the lives of victims until anyone noticed and informed it to the ambulance or to any hospital and if it occurs in remote areas there will be no hope to survive (Sandeep et, al, 2014). To overcome these, Global System for Mobile Communication (GSM) and Global Positioning System (GPS) technologies are used. The main goal of this research is to create a system which will detect vehicle accident in significantly less time and then sent a notification via GSM Modem to rescue team such as police, fire brigade and medical rescue services system with geographical coordinates and time when the vehicle accident occurred.

This research also can find the accident spot at any place and intimating the location to mobiles through the GSM and GPS networks. Besides that is to help authorities such as police and ambulance to get information about the accident and help them to get there in a short period.

The objective of this research is to alert the nearest driver about accident using alarm buzzer in the car vehicle, to give detail about accident location and reduce time for rescue force and police to reach the accident scene. It's also improve the technology on road system and safety for public when travelling.

2.0 LITERATURE REVIEW

At present, the number of vehicle accidents is increasing as a result of the increase in the vehicle and the attitude of some drivers who drive in a dangerous manner. However, the emergency system is very poor in sending the rescue team where there are some accidents that occur in an isolated place with no network coverage, not getting help quickly, which can result in some death. Therefore, a system to detect accidents should be implemented for any accidents that occur, can get help with less time from the rescue team, such as police, ambulance and fire brigade. The accident detection system will send information about the location of the accident automatically to the rescue team.

C.Prabha, R.Sunitha and R.Anitha (2014) had presented a paper title Automatic Vehicle Accident Detection and Messaging System Using GSM and GPS modem. This research was discussed about the automatic accident detection using GSM and GPS modem. This research also uses the vibration sensor to detect the accident and also Micro electro Mechanical System (MEMS) sensor which can detect the accident if the car rolls over. The sensors are used to detect the accident and give the signal ARM controller. Then, the microcontroller will send a signal to the GSM and GPS modem. Then, the GSM and GPS modem will then send a message and location of the accident to the police control room and rescue team. If the accident is a minor accident and no one injured, the driver can terminate the system by using a switch that provided in the car. This will help the rescue team to save their time. Besides that, there is one sensor that can use to detect the acceleration of the car. This sensor will help to provide information about speed of the car happen and it also can provide the information on how bad the accident was. (C.Prabha et, al,. 2014)

Pradhuymn Khaithan, Rishi Gaurav Bhatnagar, and Dr. T Jagdish (2010) had presented a paper title Automated Accident Detection and Prevention System (AADRS). This paper was discussed about accident detection using ADXL335 accelerometer sensor and combine with GSM module and Arduino Uno board. The other sensor that been used in this project are proximity sensor and impact sensor. The proximity sensor will use to set the safety distance between two cars when parking or at traffic light. The impact sensor will give signal when there are crash. This sensor will be place at the front, left side and right side of the car. The accelerometer sensor will be used to detect the speed of the car.

The signal from accelerometer sensor will be send to GSM module, and the message will be send automatically to the police and ambulance. From this research, the technology used can be improved by using the more accurate sensor and using Bluetooth for replacing GSM module. (PradhuymnKhaithan et, al,. 2010)

Md. Syedul Amin, Mohammad Arif Sobhan Bhuiyan, Mamun Bin IbneReaz and Salwa Sheikh Nasirhave (2013) presented a paper about GPS and Map Matching Based Vehicle Accident Detection System. This paper proposes to detect an accident from the GPS data which is recorded every 0.1 second. It is including data for speed and route (location). Form the GPS data, the accident detection system will send the speed and location using microcontroller to the rescue team. From these data, the present speed will be compared to the current speed to get the differences for every 0.1 second. The speed will then give the information about how bad the accident was. The location data from GPS will be used in the map matching algorithm to give the accurate location about the accident. Besides that, this system provides the manual button for driver to inform the rescue team about the accident. If the GPS data was corrupted, the manually signal will help the driver to get the emergency help quickly. (Md. Syedul Amin et, al, 2013)

Rajesh Kannan, Megalingam, Ramesh Nammily Nair and SaiManoj Prakhya (2010) had presented a paper title Wireless Vehicular Accident Detection and Reporting System. In this paper, they suggest a method to intelligently detect an accident at any place and any time and report the same to the nearby 'service provider'. Accident Detection and Reporting System (ADRS) which can be placed in any vehicle uses an accelerometer sensor to detect the accident. The sensor output is monitored and processed by the PIC16F877A microcontroller. The RF transmitter module which is interfaced with the microcontroller will transmit the accident information to the nearby Emergency Service Provider (ESP). This information is received by the RF receiver module at the 'service provider' control room in the locality. The RF transceiver module used has a range up to 100 meters under ideal conditions. The service provider can use this information to arrange for ambulance and also inform police and hospital. This system is suitable to be used in the prone areas. ADRS also implements an intelligent Accident Detection and Reporting Algorithm (ADRA) for the purpose. (Rajesh Kannan Megalingam et, al,. 2010)

Lih-Jen Kau and Chih-Sheng Chen (2015) had presented a paper title A Smart Phone-Based Pocket Fall Accident Detection, Positioning, and Rescue System. This paper was proposed with a novel algorithm as well as architecture for the fall accident detection and corresponding wide area rescue system based on a smart phone and the third generation (3G) networks. To realize the fall detection algorithm, the angles acquired by the electronic compass (compass) and the waveform sequence of the triaxial accelerometer on the smart phone are used as the system inputs. The acquired signals are then used to generate an ordered feature sequence and then examined in a sequential manner by the proposed cascade classifier for recognition purpose. Once the corresponding feature is verified by the classifier at current state, it can proceed to next state; otherwise, the system will reset to the initial state and wait for the appearance of another feature sequence.

Once a fall accident event is detected, the user's position can be acquired by the global positioning system (GPS) or the assisted GPS, and sent to the rescue center via the 3G communication network so that the user can get medical help immediately. (Lih-Jen Kau et, al,. 2015)

3.0 METHODOLOGY

This project involve two (2) part requirement which is hardware and software. Hardware requirement are GPS Module, GSM module, Microcontroller PIC16F877A, LCD Display, Accelerator sensor (ADXL335) & Power Supply. Software requirement are Proteus, Eagle, CCS Micro C Pro and PIC KIT 2.

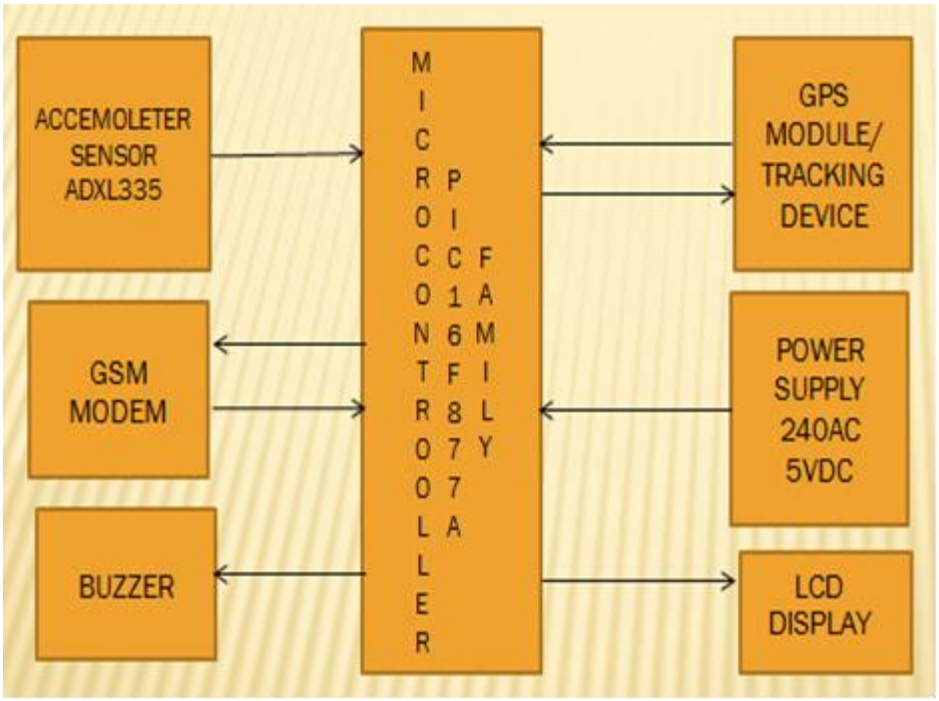

Figure 1: Block Diagram of ADS

Figure 1 shows the block diagram of Accident Detection System which contain accelerometer sensor, GSM modem, Buzzer, GPS Module Tracking Device, Power Supply and LCD display. This system was connected to the Microcontroller PIC16F877A to produce the output as needed.

For all circuit, the process was done by using Eagle Software to draw the circuit and printed circuit board. Then the process was continuing to UV printed and etching the circuit on PCB Board (see Figure 2).

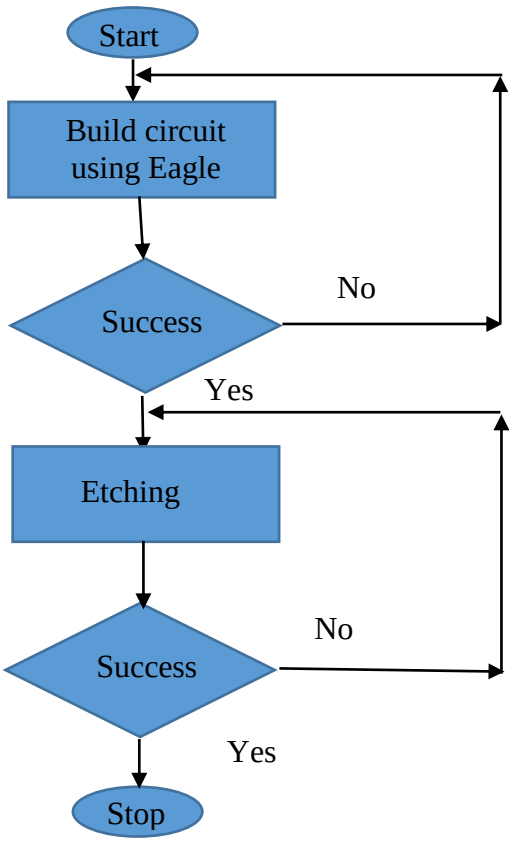

Figure 3.2: Flow chart for creating circuit using Eagle

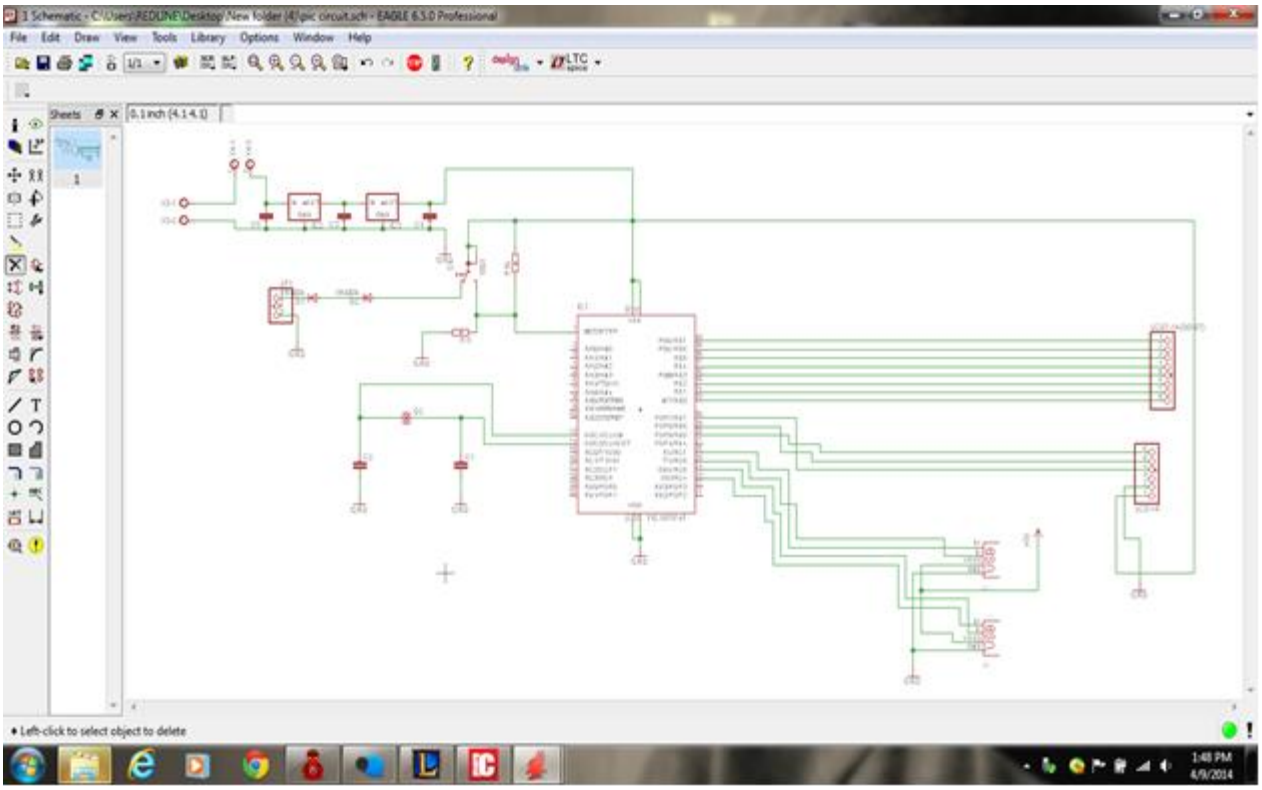

Figure 3: Circuit Design using Eagle Software

Figure 3 show the circuit design using Eagle Software. The steps of using this software are listed below.

a) Starting new project & Adding Components

First open eagle.scad then hover over FILE then NEW then clicks on schematic. Then, on the new popup window, the circuit was draw. To add a component click the add button. Then find the component. Click OK and click at the schematic sign of the component and it will be added.

b) Connecting Components

To connect the component, click the wire button. Then click on one part of the component to connect then click the other. If right click then the angle of the component and direction will change.

c) Converting Schematic to Boards

To convert the schematic to a board just press the board button. Then a window should pop up and all the components will be outside of the square. The yellow lines that are connecting your components means that is unrouted. There are 2 ways to rout the component. One way is by hand and the other way is using the auto route button. To rout by hand, click the rout button then click the two ends of the components. When the line that turns to red then it's on the top of the board. If the line is blue than it shows that the line is on the bottom of the board. There is also auto route button, which will help to auto route the entire component.

Next step in completing this system are printing the circuit in PCB board. The steps are as below:

a) Using UV Machine, the PCB was placed at the UV machine with the printed circuit (A4 paper) on top of the PCB board. This process took around 45 seconds to 60 seconds to print the circuit onto the PCB board.

b) Using developer, the circuit was placed inside the basin that contain some developer and the PCB was shake until the color of PCB turn to gold and the circuit line was turn to green. This is the etching process.

c) Then, the PCB was placed inside the water and then placed it in another machine that contains acid. This acid was used to make the PCB contain only the copper line that produce the circuit.

After etching process success, the process was continued to place the component and solder. Then, the circuit will be test, whether it can work or not. If the circuit was not working, the process of etching will be done again until the circuit was produce the exact output.

3.1 Circuit simulation

Other than circuit printed on PCB, this system was develop using Proteus software for simulation process. This simulation was done to make sure the system working before it been built as hardware. Proteus was used because it is easy to simulate and the programming inside microcontroller can be made inside Proteus without needed other software.

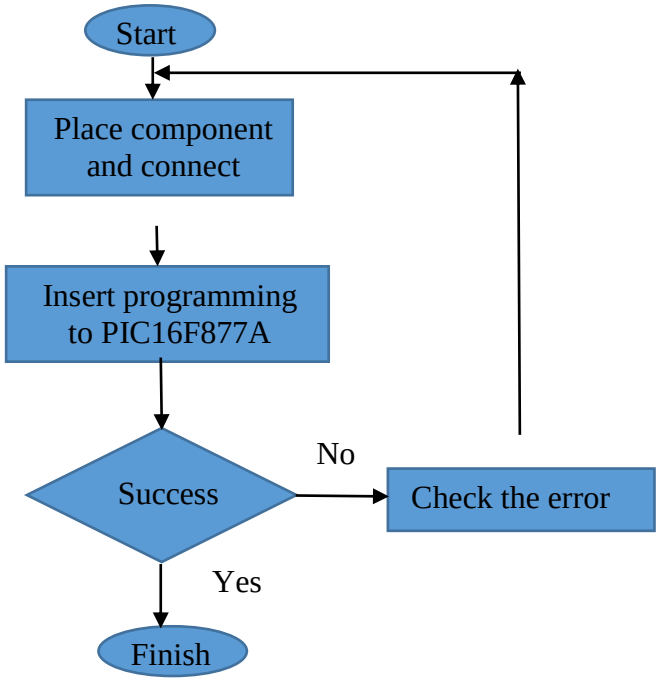

Figure 4: Flow chart using Proteus

Figure 4 show the flow chart of the simulation process using Proteus. This process starts with connecting component and microcontroller. After that, if the circuit was success, means no error, the process was continued by inserting the programming that was build using CCS Micro C Pro inside the microcontroller. Then, the process was done. Next, it will be run to see whether the circuit can be working or not. If there are errors in the circuit or the programming, the process will be done again.

4.0 RESULT & DISCUSSION

This project designed using accelerometer sensor in combination with a GPS Module, GSM module and PIC Microcontroller into a single system. It is a device that able to respond through action like car accident (vehicle collision, rollover or overturning) where this device can detect the action of the vehicle using acceleration sensor.

In this project PIC 18F877A processor is used as a main controller and impact/accelerometer sensors is ADXL335 as an input as shown in Figure 5. The impact sensors provide value for acceleration in 3 axis XYZ direction corresponding to any mechanical acceleration. When an accident occurs, ADXL335 detect vibration (impact) or acceleration of the vehicle and sends appropriate output signal to the PIC 16F877 microcontroller so that the location is identified using GPS.

Figure 5: Acceleration sensor ADXL335

For this project research, it used supply from the regulated power supply as shown in Figure 6. As the PIC16F877A requires 5 volts of supply, so a step down transformer of 240/12V is used to get the required AC output. To convert that AC supply to DC supply is done by using rectifier. DC output consists of ripples, to remove those ripples we use filter capacitors. To get output voltages of +5v & +12v we are using voltage regulators 7805 & 7812. Finally 5V is given to the PIC 16F77A for functioning.

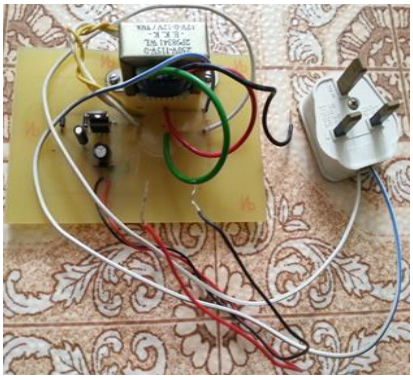

Figure 6: Regulated Power supply

The microcontroller continuously checks the status of the sensor (monitoring condition as shown in Figure 7 and determine impact (shocked) signal that meets a pre-set threshold. It also sends the accident occurrence signal to the communication transceiver component of the GPS devices. A motor vehicle crash impact is sensed as when the rates of deceleration exceed a certain pre-determined threshold value. In this project the pre-determine threshold value is 40. Figure 8 shows the result when impact sensor sensed the impact/shocked signal either in X-Axis or Y-Axis or both axis.

Figure 7: Detecting & monitoring the accident

Figure 8: Shock accident at X Axis & Y Axis

The results of this project research have classified 3 type of accident as shown in Table 1.

Table 1: Type of accident

Type of Vehicle Accident	Impact Sensor Detection
Collision	Detecting X Axis Shock
Rollover	Detecting Y Axis Shock
Overturning	Detecting X & Y Axis Shock

When accident occurs, GPS is activated and it gives the values of location in terms of Latitude and Longitude. GPS module always receives the information from satellites regarding the position of the place where the accident occurs. GPS Module able to locate a correct coordinate location after 1-5s delays time as shown in Figure 9. Microcontroller will receive the coordinate location from GPS Module of current accident if there existence any impact or sudden threshold change from the impact/accelerator sensor.

GSM modem is used to send information collected from GPS module along with other details to a specific mobile number. Typical information of coordinate receive at another display that been transmitted and receive by two of GSM Modem that communicate as host and client (transmitted as client and receiver as host server like police, rescue force, etc.) The vehicle is tracked for every five minutes using GPS and the position of the vehicle is also send to the mobile in terms of latitude and longitude. For example:
Accident occurred at location of

Latitude=1641.4095

Longitude=1725.3602

Figure 9: Location of accident is displayed

GPS positioning is done in the form of latitude and longitude along with the exact location of the place by making Google maps. Table 2 shows the data of various location of an accident when there is an existence of any impact or sudden threshold change from the impact/accelerator sensor.

Table 2: Latitudes and Longitudes

No	Location	Latitudes	Longitudes
1	Politeknik Ungku Omar (PUO), Jalan Raja Musa Mahadi, Ipoh Perak Malaysia	04°35’19.723”N	101°07’30.976”E
2	119, Persiaran Cempaka Sari 3, Taman Cempaka, 31400 Ipoh, Perak Malaysia	04°35’37.173”N	101°07’37.993”E
3	6, Persiaran Cempaka Sari 1. Taman Cempaka, 31400 Ipoh, Perak, Malaysia	04°35’60.17”N	101°07’51.83”E

The same above values as shown in Figure 9 are sent to the mobiles using GSM for which the mobile numbers are dumped in the program. At the same time those values are displayed on LCD display. Hence by using acceleration sensor place in vehicle, GPS accident location is detected and the information is sent to the mobile using GSM and as well as at LCD Display as shown in Figure 10.

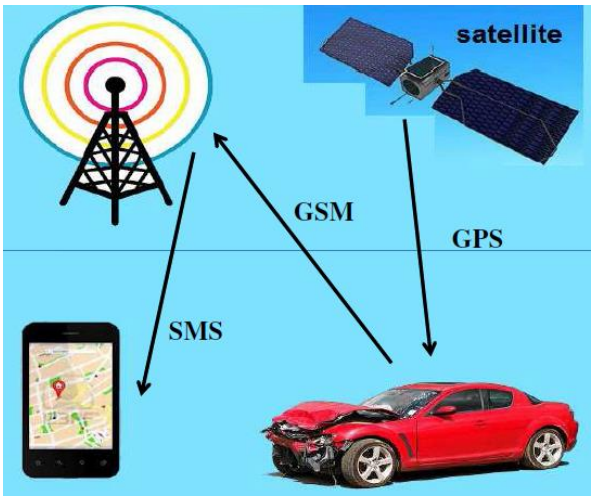

Figure 10: Accident Detection System (ADS)

5.0 CONCLUSION & RECOMMENDATION

As a conclusion, ADS project can alert highway user, rescue force, and police to response quickly if there is an accident that occurred by using buzzer. It will send warning and detail about the location of the accident scene to alert police and rescue force for them to react quickly to do their work and arrive at the accident scene on time. It also help accident victim that still have percentage of survival to be rescue immediately.

This system application can be used as low cost solution for automobile position and status, very useful in case of car theft situation, for monitoring adolescent drivers by their parents as well as in car tracking system applications. The proposed solution can be used in other types of application, where the information needed is requested rarely and at irregular period of time when requested.

The performance of accident detection needs to be upgrade by adding more features which are can detect the level of accident and combination with release of air bags. It helps not only in finding the location of vehicle but also it is helpful in saving the lives of victims by finding where an accident has happened. It can also be used in automotive and transport from lighter vehicles like cars, ambulances, fire engines etc. to heavier automotive like ship and aero planes for the purpose of accident detection. By releasing the airbags we can save the victims from major injuries. Finally this project has many advantages and hence it can be interfaced with Vehicle Airbag System such as when the sensors detect accident, the air bags get open quickly.

6.0 ACKNOWLEDGEMENT

With great pleasure we want to take this opportunity to express our heartfelt gratitude to all the people who helped in making this ADS Project Research work a grand success.

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