

Design of Advance and Robust Vehicle Security System with Accident Monitoring

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Abstract: *This proposed work is an attempt to design and implement advanced and robust vehicle security system using GPS and GSM system to prevent robbery and to analyze the exact location of vehicle. The safety of the vehicle is very significant. This project is designed using GPS and GSM technology and accelerometer. The system contains GPS module, GSM modem, Infrared sensors, DTMF tone decoder, ARM 7 microcontroller, relay switch and accelerometer. GPS system tracks the location of vehicle, GSM system is used for duplex communication. The preventive measures like fuel supply cutoff, engine ignition cutoff electric shock system (installed on steering wheel) and paint spray system are installed in the vehicle which is controlled by user GSM Mobile. Traffic accidents are one of the leading causes of deaths. An important indicator of survival after an accident is the time between the accident and emergency medical personnel dispatched to the accident spot. By reducing the time between an accident occurrence and dispatch of the responders to the scene, mortality rates can be reduced, thereby we can save lives. In this project, the main application is early accident detection and its notification to the concerned emergency Centre. By using accelerometer accident notification can be achieved. Accelerometer can automatically detect traffic accident and immediately notify to central emergency centre, by using GPS co-ordinates we can reach to the location and rescue one's life. This complete system is designed taking into consideration low range vehicles to provide extreme security to their vehicles and life.*

Keywords: GPS Module, GSM Module, ARM 7 Microcontroller and accelerometer.

1. Introduction

Nowadays vehicle robbery cases are at greater risk, it has become mandatory to give a vehicle a better security with the main solid hostile to burglary gadget. Recent statistics of vehicle robbery cases are much higher than any other time, according to the report published by National Crime Records Bureau (NCRB), in the year 2011, 122,367 two wheeler vehicles were stolen in India and only 32,826 vehicles were recovered. Usually vehicles are stolen right off streets or apartment parking area. By the time the police are alerted which could be a few hours since the theft, the vehicles are made underground leaving almost no clues. Soon after robbery the vehicles are either dismantled or sold in neighboring states/districts at very low prices leaving the owner and police helpless to catch the thief. Same will be going on in rest of the world. To overcome this problem, a security system in the vehicle is implemented. Security system in the vehicle should be able to perform reasonably well even in unfavorable conditions to meet the required level of security. The cost of the security system should not be more, else the automobile manufacturers will not be able to implement such a system, as

it will increase the overall cost of the vehicle with a huge margin. The design of the security system should be similar with almost all of the brands and classes of vehicles then it helps reducing the manufacture cost. The overall power consumption should be less than the source of supply for the security system as the vehicle is built with the 12V battery. Vehicle focal locking framework guarantees the best ensure to secure your vehicle from various types of theft cases. . It is a vehicle security gadget that offers precise insurance to your vehicle. So this created framework utilizes an inserted framework focusing GSM technology. This created framework is installed in the vehicle. Whether one is owner of single vehicle or in excess of 10, Vehicle Tracking System is a solution for spot tracking and secures your valuable resources. It is very vital for accuracy and ongoing following and reporting of your vehicle, irrespective of its location. Combination of high-affective GPS units in vehicle following frameworks has powered these systems to work in different types of situations. This vehicle following framework found in clients vehicle as a burglary preventive action and salvage gadget. This framework developed for the four wheelers, vehicle tracking is generally utilized as a resource for naval force administrators for war administration capacities. The

applications include observing driving of a guardian with a teenager driver. Vehicle following frameworks installed in shopper vehicles as a burglary prevention and recovery system. In the situation that the burglary is recognized, the framework sends an SMS to the vehicle owner. After that vehicle owner places a call to GSM modem attached to the microcontroller and issue the important signs to stop the robbery like ignition off, paint spray on, fuel supply off and shock on the vehicle steering Keeping in mind these requirements we propose this new design of advanced and robust vehicle security system. The main aim of this research is to design and implement an advance vehicle security system that can prevent robbery and provide necessary information on accidents. This project involves a microcontroller particularly ARM 7 and a mobile handset for communication. Tracking of the stolen vehicle can be done with the help of internet services interfaced to it. Once the position of the stolen vehicle is found using the GPS, a location request is sent to the central processing system, by which commands can be given using remote functions. Remote controlled functions of the tracking system enable to perform many operations like stop ignition system, automatic position reporting based on distance or time. The Global System for Mobile communications (GSM) is one of the most commonly used standard for mobile phones across the globe. Many people use GSM service across the world. The use of the GSM standard makes international roaming common between mobile phone service providers, which help users to use their phones across the globe. I have read many research papers with regard to this topic. In all research papers the authors have clearly given detailed description about the working of the system together with advantages and disadvantages. The main purpose of this project is to design and implement accident notification phenomena using accelerometer, by the help of which we can reach accident location in less time and save victim's life. We have focused this paper for people who are involved in the technical background. Say for example, if the reader wants to understand the concepts of how the security system works in this project, he should have good knowledge about microcontrollers, sensors, GSM, GPS modules and accelerometer

2. Proposed Block Diagram

The advance vehicle security system (Fig.1) consists of GSM modem, GPS module, ARM7 microcontroller, infrared sensors, relay and accelerometer. The hardware design is split into two parts- GSM and GPS. The main circuit is subdivided into two circuits, one is for detection of thief motion using infrared sensors and other one is for DTMF tone decoding which is used for switching on/off the relay and last one is for accident detection using accelerometer. The block diagram (Fig-2) shows when robber makes an attempt to unlock the car, the infrared sensors located near the car door will sense the motion and will sent the signal to ARM 7microcontroller.The microcontroller which is interfaced to triggering circuit will send the triggering alarm to relay. The relay is interfaced to GSM mobile through earphone. The microcontroller will send triggering signal to GSM mobile and call will be placed to user giving information to him/her that somebody is trying to unlock the vehicle. The dial tone which generates from the telephone set or mobile handset is Dual Tone Multi-Frequency.

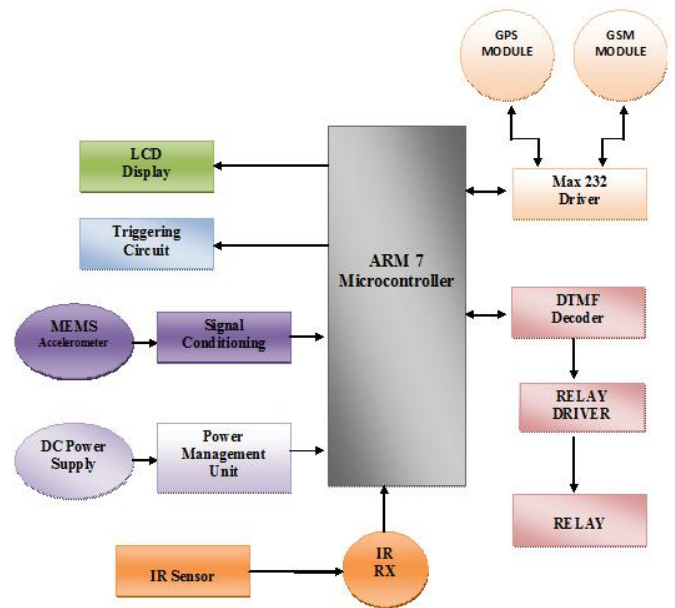


Fig-1 Shows Block Diagram Of The Proposed Project

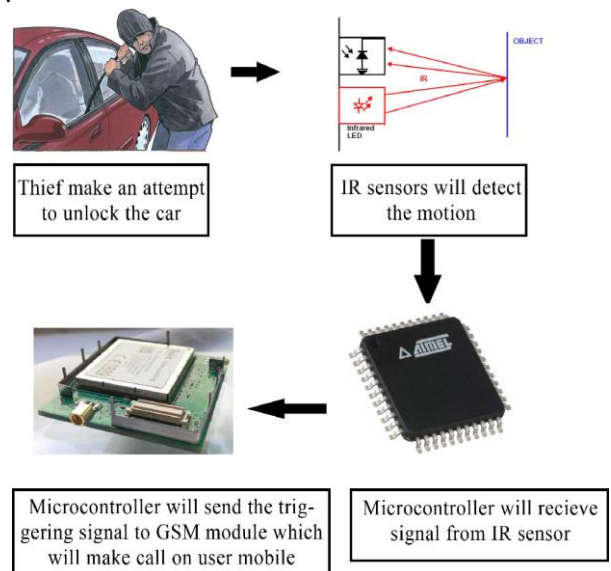


Fig-2 Shows Block Diagram For Detecting Thief Movement

The name was given due to the fact that the tone that we heard with the help of telephone is making up of two different frequency tones, hence the name is given as dual tone. The DTMF tone is a form of simplex communication between the dialer and the telephone exchange. A complete framework consists of tone generator and the tone decoder. Here we are using the IC MT8870DE, the main part to decode the input dial tone to 4 digital outputs. These output bits can be interfaced to a micro-controller for further use. For each keypad number pressed there is fixed range of values of frequency which gets decoded by DTMF decoder circuit. Depending on the system ignition cut-off, fuel supply cut-off, windscreen paint spray and electric shock mesh, the count of relays controlling them will be appended to the system. Here we are using four relays. The microcontroller is developed in such a manner that unique keypad number will be controlling relay which will in-turn

control these systems. The vehicle owner will send the DTMF tone to the GSM handset located in the vehicle. The DTMF tone will be decoded using IC MT8870DE which will be handling relays to activate security framework. For example numerical one on the mobile keypad is set for engine ignition cut-off, on pressing numerical 1 on the keypad of your mobile handset, the DTMF decoder will decode the keypad tone frequency and microcontroller will turn the relay on-off depending upon the software program burn in the microcontroller IC. The remaining part (Fig. 3) is for switching different framework like engine ignition, fuel supply, windscreen paint spray and electric shock mesh with the help of relay. The relays are controlled using GSM handset and DTMF tone decoder. DTMF tone detection and decoding is achieved by IC MT8870DE. This IC MT8870DE analyzes the dial tone from a phone line and decodes the tone pressed, Same we can see from block diagram (Fig. 2), after receiving the information that somebody is trying to unlock the car owner places a call to GSM handset placed in the vehicle appended to security system.

As soon as the call gets established between the owner and GSM handset located in the car, owner sends the signal by pressing the keypad (numerical value) from his mobile handset. Unique keypad number is assigned for controlling unique system. On pressing numerical 1 from owner mobile handset engine ignition will be cut-off, on pressing numerical 2 fuel supply system will be cutoff, on pressing numerical 3 electric shock system installed on steering wheel gets activated which will give shock to robber and on pressing numerical 4 windscreen paint spray system gets activated which prevents the thief from driving the vehicle.

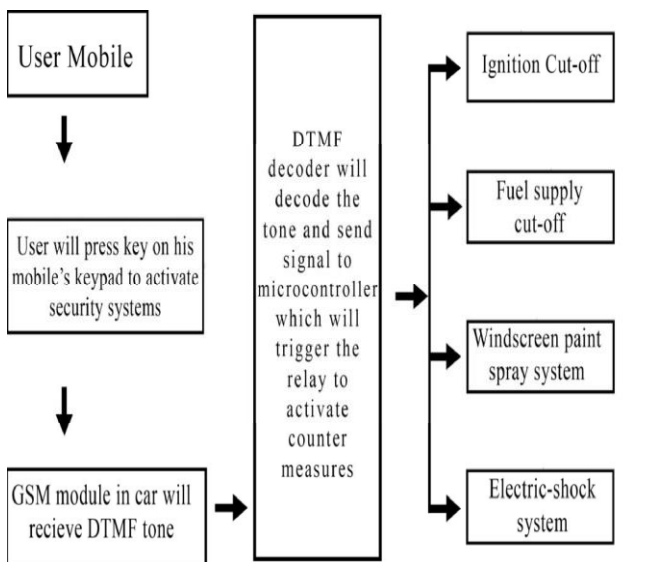


Fig-3 Shows Block diagram of DTMF Decoder

2.1 GPS Model

The Global Positioning System is a space-dependent satellite route network that gives area and time data in all climate situations, anyplace close to the Earth where there is an uninterrupted observable pathway to four or more GPS satellites. The system gives basic abilities to military, common and business clients as far and wide as possible. It is kept up by the U.S government and is open to all with a GPS receiver. A GPS system (Fig. 4) calculates its position by correctly timing

the signal sent via GPS satellites placed earth orbit. Each satellite consistently transmits messages which includes the exact time the message that was transmitted and satellite location at time of message transmission. The GPS framework utilizes the messages it receives to compute the transit time of each message and calculates the separation to each satellite using the speed of light. The GPS framework uses the messages it gets to calculate the transit time of every message and calculates the separation to each satellite with help of the velocity of light. Each of these separations and satellites' position characterizes a sphere. The receiver is on the surface of these spheres when the separations and the satellites positions are right. These separations and satellites locations are used to calculate the position of the receiver using the navigation mathematical sentence. This location is then displayed using online web application via Google maps or any offline tracking using GSM framework. Many GPS units show derived information like direction and speed, calculated from position alterations. In any typical GPS function, four or more satellites must be visible to acquire an exact output. Fig.4. Block diagram of GPS tracking system.

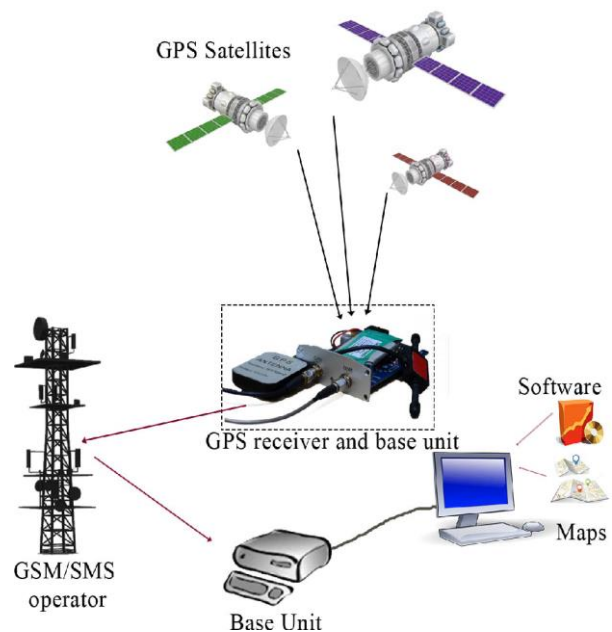


Fig-4 Shows GPS Block Diagram of GPS module

2.2 GSM Module

GSM module is used to build up communication between a processor and a GSM system. Global System for Mobile communication (GSM) is a technology used for mobile communication across the globe. Wireless MODEMs are the MODEM devices that produce, transmit or decode data from a mobile network, for establishing communication between the cellular network and the processor. These are manufactured for specific cellular network Wireless MODEMs like other MODEM devices utilize serial communication to link with microcontroller system compatible commands. GSM MODEM is a part of wireless MODEM devices that are designed for communication of a processor with the GSM cellular network. It needs a SIM abbreviated as Subscriber Identity Module card for mobile handsets to activate communication with the network. And they also have IMEI abbreviated as International Mobile Equipment Identity number similar to mobile handsets

for their unique identification. A GSM MODEM can many operations such as;

- Send, receive or delete SMS messages in a SIM.
- Read, add, remove, search phonebook data of the SIM.
- Receive, Make, or reject a voice call

A GSM module assembles a GSM modem with standard communication interfaces like RS-232 (Serial Port), so as to interface with a microcontroller based system easily. The power supply circuit is also made in the module which can be activated by using a compatible adaptor. The below figure (fig-5) show Block diagram of GSM module.

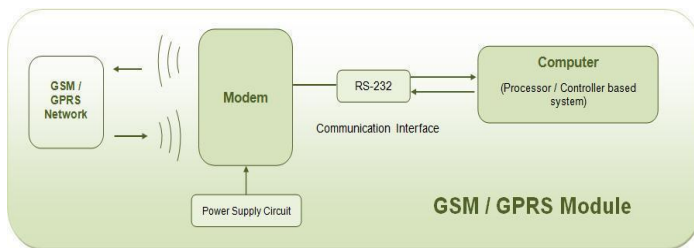


Fig-4 Shows GPS Block Diagram of GSM module

2.3 ARM 7 Microcontrollers

The ARM processor is a 32-bit RISC processor, (RISC) instruction set computer (ISA). ARM processors are microprocessors and which are widely used in many of the mobile phones sold every year. They are also utilized in personal digital assistants (PDA), hand-held gaming systems, calculators, and in computer hard drives. The micro-controller is a IC, which has a computer processor with many support functions, memory (both program RAM and storage), and Input/output built in to the device. These inbuilt functions reduce the need for external circuits and devices to be designed in the final applications. The first ARM processor was the Acorn Archimedes, released in 1987. Apple Computer became involved by helping to improvise the ARM technology in the late 1980s, with their effort resulting in the ARM6 technology system in 1992. Later on Acorn utilized the ARM6-based ARM 610 processor in their RISC PC computers in 1994. The latest invented ARM processor families includes ARM 11 and Cortex. ARM processors capable of 64-bit processing are currently in development. A microcontroller consists of a CPU tightly coupled with memory [RAM, ROM or EPROM], various I/O features like parallel ports, serial ports ,interrupt controller ,data requisition interface , ADC converter, DAC converter all being integrated in a single silicon chip. ARM7 is mostly used micro-controller from LPC2148 family in embedded system. This section is humble effort for explaining basic features of ARM-7. Below figure (Fig.6) show the pin diagram description. It is a family of instruction set for computer processors based on RISC (reduced instruction set computing) architecture invented by British company ARM. This approach reduces costs, heat and power use. LPC2148 is the widely used IC from ARM-7 family. It is made by Philips and it is pre-loaded with many

built in peripherals making it more efficient and a feasible option for the starters as well as high end application developers.

2.3.1 Features

- 8 to 40 kb of on-chip static RAM and 32 to 512 kb of on-chip flash program memory. 128 bit wide interface/accelerator which enables high speed 60 MHz operation.
- It has In-System/In-Application Programming (ISP/IAP) with on-chip boot-loader software. It has single flash sector/full chip erase system in 400 ms and programming speed of 256 bytes in 1ms.
- Embedded ICE RT and Embedded Trace interface gives real-time debugging with the on-chip high speed tracing of instruction execution and Real Monitor software
- USB 2.0 Full Speed compatible Device Controller and also 2 kb of endpoint RAM. In addition, the LPC21468 provides 8 kB of on-chip RAM accessible to USB by DMA

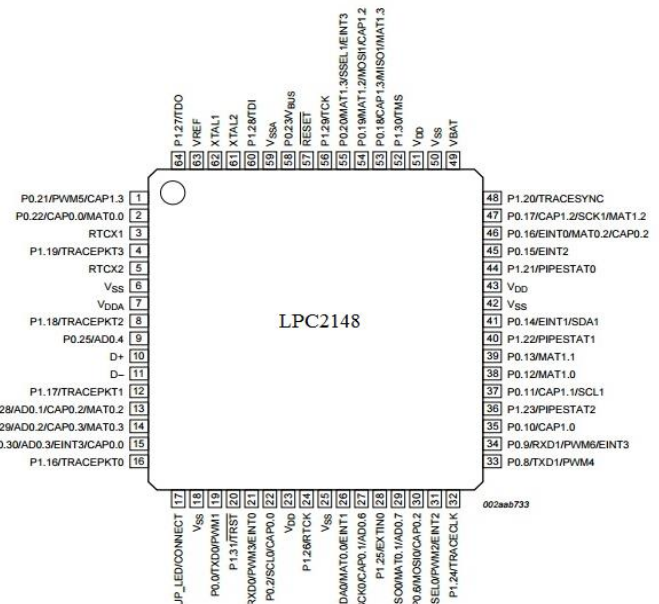


Fig.6 Shows Pin Diagram of LPC2148 Microcontroller

2.4 MEMS

The ADXL335 is a small, low power, thin, complete 3-axis accelerometer with signal conditioned voltage outputs. The device measures acceleration with a minimum full-scale range of ±3 g. It can also measure the static acceleration of gravity in tilt sensing applications, and also dynamic acceleration resulting from motion, shock or vibration.

2.4.1 Features and Benefits

- It has 3-axis sensing
- It has Small, low-profile package
- It has 4 mm × 4 mm × 1.45 mm LFCSP
- With Low power - 350 µA (typical)
- It has Single-supply operation (1.8 V to 3.6 V)

- It has excellent temperature stability
- It has BW adjustment with a single capacitor per axis

Relay = ULN2003
 Display = 2x16 LCD

2.5 Operation of Project

The overall function of this project is to provide security of vehicle with accident monitoring. When the power is switched on the microcontroller initializes and GSM modem is switched on and GPS will acquire the coordinates of the current location. To show the thief the IR sensor is interrupted by means of any object such as by hand movement. Microcontroller sends an alert message to owner mobile and also displays on the LCD. Message consists of attempt to unlock the car and also the exact coordinates of the vehicle. After receiving an alert message the owner makes a call to the mobile which is connected to the kit and mobile is kept in the auto answer mode. As soon as the call gets connected the owner turns off the vehicle ignition system by dialing numerical 1 on the keypad. Same procedure is repeated by dialing numerical 2 on the keypad for fuel supply off, again same procedure is repeated by dialing numerical 3 on the keypad for paint spray ON. Above procedure is repeated by dialing numerical 4 on the keypad for inducing electric shock on the steering of the vehicle. To reverse the operation numerical 5,6,7,8 is dialed on the keypad tone.

- To turn on the vehicle ignition system numerical 5 key is pressed on the keypad.
- To turn on fuel supply numerical 6 key is pressed on the keypad.
- To turn off paint spray numerical 7 key is pressed on the keypad.
- To turn off electric shock on the steering of the vehicle numerical 8 key is pressed on the keypad.

For accident notification and monitoring accelerometer is used in this project. Accelerometer is a device which detects the sudden motion or jerks and send signal to the microcontroller in the form of message. By giving jerk to the accelerometer the microcontroller sends the accident notification message to the owner mobile and also it sends coordinates of the accident location by the help of this owner can locate the vehicle position and rescue the life of person. In this way the project can help the delay in reaching the accident locations and also prevent theft of the vehicle.

2.6 Design Specifications

ARM 7 Microcontroller = LPC2148 Family, (3.0-3.6 V)
 DTMF decoder = IC MT8870DE
 GSM module = SIM900_AT
 GPS = 5V DC
 MEMS = ADXL335
 IR sensor = TSOP1738, 38 KHz

2.6.1 Power Supply

Voltage Regulator = LM317, 1.2V – 36V
 Rectifier type = Bridge
 Transformer = 0-12V AC, Step down
 Other components = LED

2.7 Circuit Diagram Description

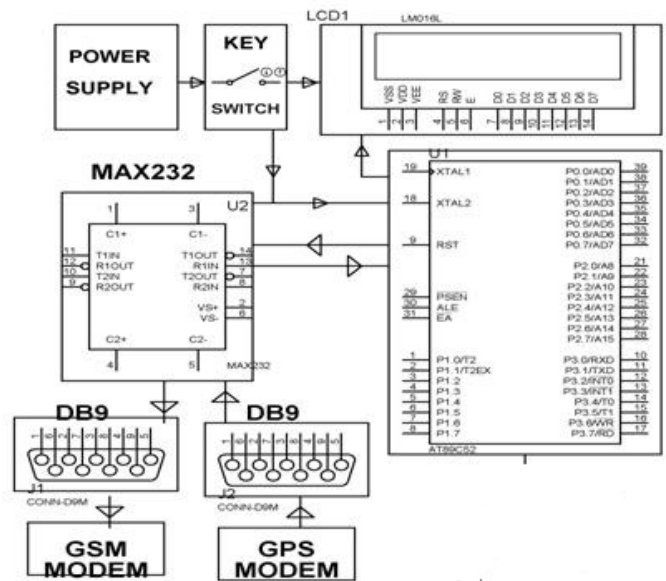


Fig.7 Shows Circuit Diagram

3. Flow Chart of Project

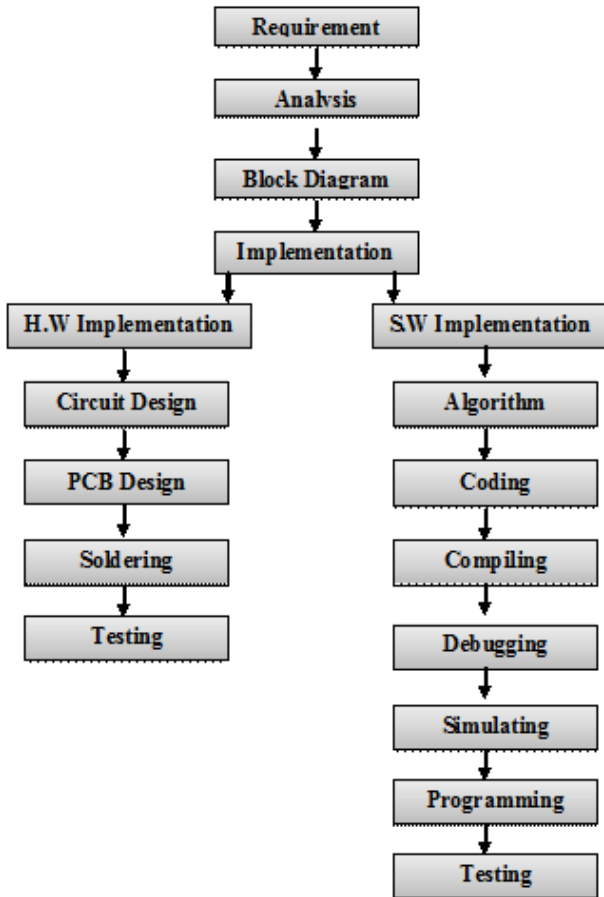


Fig.8 Shows Flow Chart Used To Design the Project

3.1 KEIL Compiler Software

Many companies provide the ARM7 assembler, some of them provide shareware version of their product on the Web, Kiel is one of them. We can download them from their Websites. However, the size of code for these shareware versions is limited and we have to consider which assembler is suitable for our application.

3.2 KEIL uVision4

Kiel uVision4 is an IDE (Integrated Development Environment) that helps you write, compile, and debug embedded programs. It encapsulates the following components:

- A project manager.
- A make facility.
- Tool configuration.
- Editor.
- A powerful debugger.
- To help you get started, several example programs

3.3 Pictorial View of Block diagram of physical devices

The below figure (Fig 9) shows the pictorial view of block diagram of actual physical devices.

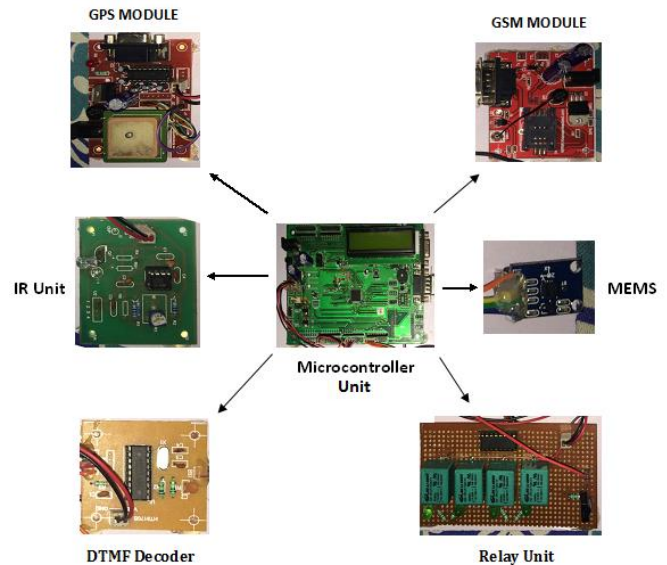


Fig.9 Shows Pictorial View of Actual Physical Devices

3.4 Applications

- This project helps in monitoring employee driving habits and activities.
- It helps to verify the employee time sheet.
- It helps in monitoring all your vehicles.
- It helps in timely delivery of the consignments
- This project also helps to monitor the vehicle speed and
- It also helps in tracking the movement of vehicles on the road

3.5 Advantages

- This project helps in fleet monitoring
- This project helps in vehicle scheduling
- It helps in route monitoring
- It helps in driver monitoring
- This project helps in accident analysis
- It also helps in geo-fencing and geo-coding
- This designed project is cost-effective
- It is reliable and
- This project has the capability of preventing robbery and providing accurate tracking system

3. Results

In the event that the system recognizes any theft, the framework sends an SMS to the vehicle owner. After that vehicle manager makes a call to the mobile appended to the controller, and issue the important signs to stop the robbery. The main aim of this project is to provide security of vehicle with accident monitoring. The IR sensor is interrupted by means of any object. Microcontroller sends an alert message to owner mobile and also displays on the LCD. The alert message can be seen in below figure (fig.10)

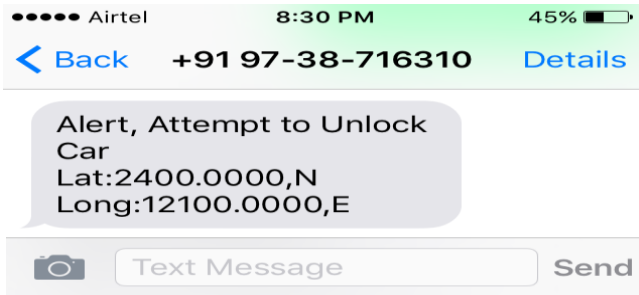


Fig.10 Shows Alert Message-1 on Mobile

After receiving an alert message, owner makes a call to mobile appended to the microcontroller, the mobile attached to the kit is kept in auto answer mode so that the call is answered automatically. Figure below shows the message on the LCD screen before the call attempt is made, (Fig.11)



Fig.11 Shows Message on LCD before action

As soon as the call gets established, owner takes necessary action by dialing numerical 1, numerical 2, numerical 3 and numerical 4 on the keypad. This can be seen in below figure (Fig.12)



Fig.12 Shows Message on LCD after action

The action can be reversed by dialing numerical 5, numerical 6, numerical 7 and numerical 8 on the keypad. Similarly by giving jerk to the accelerometer owner receives the accident alert message on his mobile as shown in below figure (Fig.13).

By receiving this alert message, owner can reach to the destination immediately with the help of GPS co-ordinates provided and save the victim's life. The overall developed circuit looks as shown in below figure (Fig.13)

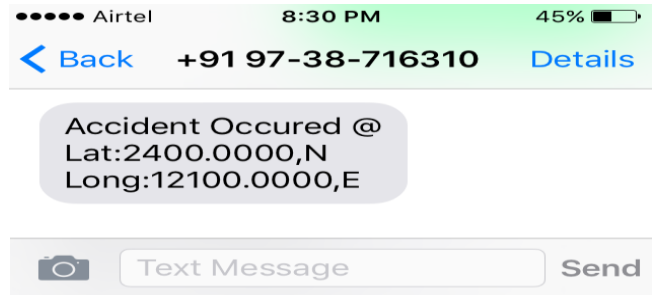


Fig.13 Shows Alert Message-2 on Mobile

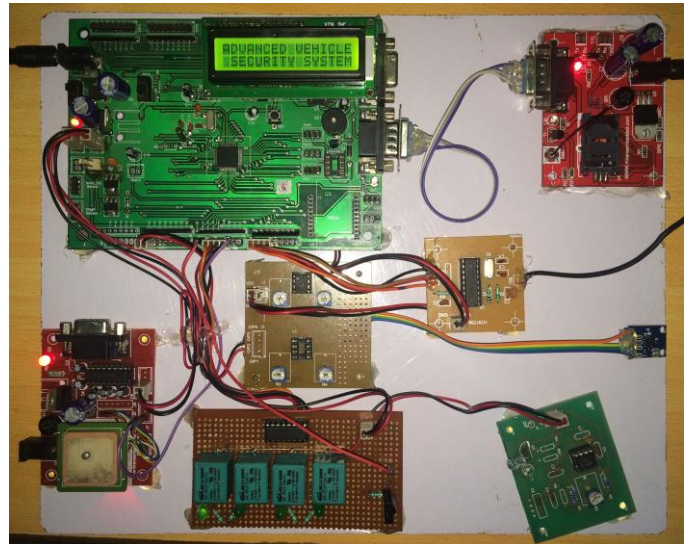


Fig.20 Shows Pictorial View of the Project

4. Conclusion and Future Scope

The design and development of advance and robust security system for vehicles is successfully completed using GPS and GSM system. This system is also having accident detection module. This advanced and robust security can be made affordable as if it can be used in low budget vehicles including two wheelers. This complete system is designed considering low range vehicles so as to provide them high security. The designed project is cost-effective, reliable and has the function of preventing robbery and providing accurate tracking system. In future we can add the bomb detection module and we can improve the efficiency of the design security system using LTE technology instead of GSM system. We can also reduce the size of the kit by using GPS and GSM on the same module. Accuracy of the GPS can be improved by increasing cost of the GPS.

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