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Detection of GSM Based Accident Location, Vehicle Theft and Fuel Theft Using ARM Cortex M-3 Microcontroller

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***Abstract*—** In Today's world the amount of vehicle theft, fuel theft and accident of vehicles are increasing day by day. As per the survey made, each year more than a million vehicles are stolen in the U.S (one vehicle every 30 seconds). Vehicle theft occurs not only in metropolitan areas but also it can occur in seedy areas of town. To overcome this limitation, an automotive localization system using GPS and GSM services for the detection of accident location, fuel theft and vehicle theft using ARM Cortex M-3 is proposed. Here, the Vehicle tracking and locking system installed in the vehicle, to track the place and locking engine motor. The place of the vehicle identified using Global Positioning system (GPS) and Global system mobile communication (GSM). These systems constantly watch a moving Vehicle and report the status on demand. When the theft identified, the responsible person send SMS to the ARM Cortex M-3 controller, then controller issue the control signals to stop the engine motor. Authorized person need to send the password to controller to restart the vehicle and open the door which provides more secured, reliable and low cost. The proposed model shows better in its performance.

Keywords—Automation; GPS; GSM; fuel theft; ARM Cortex M-3.

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I. INTRODUCTION

Since from the last two decade, due to the high numbers of vehicles on road have increased, traffic hazards and accidents, putting more life at a risk. Every day there is news on road accidents reported in newspapers and on television. Most of the accidents are caused by reckless driving rather than faulty vehicles. Also the amount of vehicle theft is increasing day by day. Each year more than a million vehicles are stolen in the U S. The vehicle theft occurs not only in metropolitan areas but it can occur in seedy areas of town. In addition to this, the fuel theft is a major problem faced by the owners and drivers. It is local error that occurs in the vehicle transported, because fuel theft offers the unauthorized persons in a beneficiary part. Many times we have heard that petrol from bike or cars has been stolen. In this paper a simple, cost effective GSM based model is proposed for the detection of accident location, vehicle theft and fuel theft using ARM Cortex M-3 processor. The main objective of this paper is to reduce the operation of fuel theft, vehicle theft and helps to track the accident location using GSM and GPS. The proposed system produces a reliable security to the vehicles in terms of accident location updating, vehicle theft and fuel theft and sends a SMS to the owner of the vehicle through GSM modem. The rest of this paper is as follows: Section II deals with the related work on fuel theft, vehicle theft and accident location updating. Section III described the proposed methodology. Section IV gives the conclusion and future scope of the proposed model.

II. RELATED WORK

Usman Khalil et al., [1] described automatic road accident detection techniques. Here, GSM and GPS technologies, vehicular ad-hoc networks and mobile applications are the techniques are used in the system to send information messages to nearby emergency services about the accident location within a specified time. Norsuzila Y et al., [2] explained real time wireless accident tracker using mobile phone. The system uses PIC 16F microcontroller, piezoelectric sensors, GPS and GSM. When an accident occurs, the piezoelectric sensor detects and measures the severity of the force impacted on the vehicle and sends out a help message to central emergency server. Kim Nee Goh et al., [3] described automatic accident location detection system. The system includes accident locator device, accident management website and SMS system. Haversine algorithm was modified to enable better efficiency in searching the nearest hospital to the accident location. Syedul A et al., [4] described about GPS and map matching based vehicle accident detection system. This system detect an accident location from the map matched position of a vehicle by utilizing the GPS speed data and map matching algorithm and finally sends accident location to an alert service centre. B A Valli et al., [5] explained vehicle positioning system with accident detection using accelerometer sensor and android technology. The android and embedded technologies are used in this system. The embedded technology is used to detect the accident using accelerometer sensor and android technology is used to determine the name of that location. P Shrivatsava et al., [6] described vehicle to vehicle safety device. Basically the system is an electronic device that can be used at the time of emergency while driving a vehicle. It uses the concept of wireless communication i.e., Zigbee, GSM and sensors to detect a person who has met with an accident. Abhinav Saini et al., [7] introduced vehicle tracking based on region and feature matching. Here, the system uses image processing based vehicle tracking technique that does not require the background subtraction process for extracting the region of interest. M. M. Hossain et al., [8] designed a low cost anti- theft sensor for motorcycle security device. This work is based on detection of rotation of its handler. The device contains GPS-GPRS module, microcontroller and other components. Here, the system sends an accidental status to owner. Xiaolu Cheng et al., [9] explained RFID applications in vehicle networks and perform vehicle management in communities, detection of vehicle theft and speeding violation, and reminders of road conditions. Hui Song et al., [10] explained vehicle anti-theft system based on sensor network. Here, the sensors in the vehicle that are parked within the same parking area first form a sensor network, then

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monitoring and identify possible vehicle thefts by detecting unauthorized vehicle movement. M Geetha et al., [11] described anti-theft and tracking mechanism for vehicles using GSM and GPS. This mechanism alerts the owner or user of the vehicle with the message at the time of theft occurred. Moreover this mechanism helps to find the location of the theft vehicle by using GPS and GSM at any time and also this mechanism stores the message by the application in the mobile. Mohammad Salah Uddin et al., [12] described smart anti-theft vehicle tracking system based IOT. The GPS, GSM/GPRS and microcontrollers are used to enable users for monitoring the vehicles in a convenient manner. This system provides the access to check the movement and control vehicle remotely by using mobile applications. Mrinmoy Dey et al., [13] described anti-theft protection of vehicle by GSM and GPS with fingerprint verification. The system includes GPS and GPS along with a microcontroller installed in the vehicle. The use of GSM and GPS technologies allows the system to track the object and provides the most up to date information about on-going trips. Moreover fingerprint verification is done to ensure driving of the authorized person. P Jyothi et al., [14] explained the design and implementation of real time vehicle monitoring, tracking and controlling system. The system works on GPS and GSM technologies. The GPS is used to track the current location of a vehicle and GSM is used to send the alert message to the vehicle owner's mobile. S Mahamud et al., [15] introduced accident prevention and identification system based on arduino. The system makes use of GPS and GSM technologies and an accelerometer that will measure the velocity and the amount of the vehicle's tilting when it will get struck over something. Shruthi. K et al., [16] explained design of an anti-theft vehicle tracking system with a smart phone application. GPS and GSM technologies and a smart phone application are used for tracking of any movable asset. Using smart phone application the user can track the stolen vehicle. G Vijaya Raju et al., [17] described about vehicle theft control and accident location intimation through SMS. Here the password based security system is used to access the vehicle. GSM technology is used for accident intimation through SMS. Trupti K Wable et al., [18] described the GSM based digital fuel meter and fuel theft detection using PIC microcontroller. If fuel gets theft then SMS will send to owner of bike also buzzer makes noise so that owner of bike get awake. Anirudha Mule et al., [19] described about digital fuel meter and fuel theft detection. Here the designed system indicates the amount of fuel present in tank digitally. Whenever there is fuel theft, due to noise of burglar alarm people are aware of the fuel theft and also during fuel theft, a text message is delivered on mobile to the owner of the bike. Nandini H et al., [20] described about smart fuel theft detection using microcontroller ARM7. Here the system makes use of smart fuel theft detection with GSM alert and GPS tracking system. Using ARM7 controller, the real time position of vehicle and its fuel content is sent to owner's mobile in case of intrusion. Dinesh Kumar et al., [21] described the accident detection and reporting system. The GSM technology is used to intimate the vehicle position, Sensors such as vibration, alcohol and fire detectors detect signal in case of an accident occurrence and send a signal to the connected microcontroller. D Narendra Singh et al., [22] explained the real time vehicle theft identifies and control system based on Arm9. Here the designed security system for smart cars is used to prevent them from theft using advanced RISC machine (ARM) processor. Saloni shah et al., [23] described intelligent vehicle theft control using embedded system. Vehicle security enhancement and accident prevention system can be developed through tracking and locking, fuel theft, accident detection and prevention, driver fatigue, pollution control an speed limiting with efficient vehicle management system. Modugula R Reddy et al., [24] described accident detection depending on the vehicle position and vehicle theft parking, reporting system. Here, the concentration is towards accident detection and alert by sending message to android mobile. The android application that specifies the location name, accident location can be detected by using vehicle position on the road. Champa Bhagavathi et al., [25] described vehicle theft detection and prevention using GSM and GPS. The system provides two levels of security, password protection for the vehicle and remote ignition cut-off mechanism and also the system provides provision for vehicle tracking using GPS. Minakshi Kumari et al., [26] described vehicle theft intimation using GSM. Here it uses wireless technology for automobiles using GSM modem. Manisha Rinayat et al., [27] described GSM based vehicle fuel monitoring and theft detection system with SMS indication. If fuel gets theft then text message will send to owner of bike also buzzer makes noise so that owner of bike get awake. Mohammed A Junaid et al., [28] proposed design for fuel theft prevention in automobiles. A mechanism has been developed to prevent fuel theft, and this mechanism uses power supply from the vehicle and so far the fuel to come out of the fuel tank, vehicle must be in on condition. P Senthil Raja et al., [29] proposed detection of fuel theft in heavy vehicle. The system is implemented using vehicle area network and embedded design. The proposed system, owner of vehicle immediately receive a message when the fuel tank is opened by the operator or by a fuel traded and also the height of the fuel tank when opening and closing of the tank. P Geethabai et al., [30] proposed design and implementation of GSM based digital fuel meter and fuel theft detection using PIC microcontroller. The amount of fuel present in tank is displayed digitally. Whenever there is fuel theft occurs, a text message is delivered on mobile to the owner of the bike.

III. PROPOSED METHODLOGY

In the proposed work ARM Cortex M-3, GPS module and GSM module are plays very important role to track the vehicle. GPS module is used to display the coordinates of the vehicle position with help of GSM module. As shown in the figure 1, the proposed model built an intelligent security for the vehicle based on the ARM Cortex M-3, vehicle identification technology, GSM technology and GPS positioning system. This system puts into sleeping mode while the vehicle handled by the owner or authorized person otherwise goes to active mode, the mode of operation changed by in person or remotely. Fuel theft identification will be done in this system.

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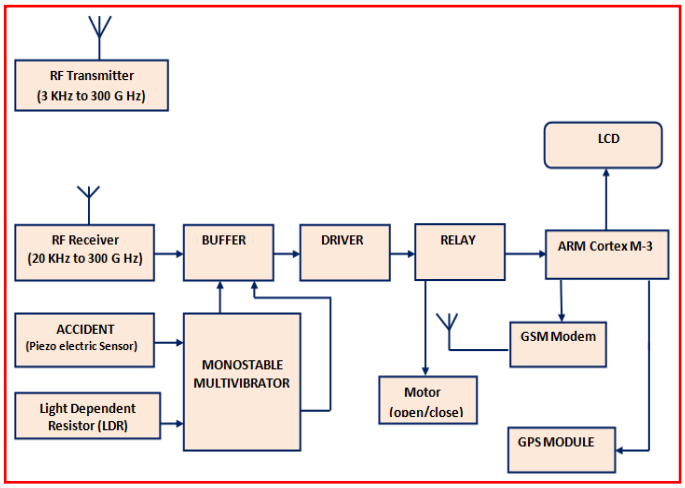


Fig. 1: Proposed Model

ARM CORTEX M-3:

The LPC1768 is ARM Cortex-M3 based microcontroller which is designed for a high level of integration and low power consumption. The ARM Cortex-M3 is a next generation core that offers enhanced debug features and a higher level of support block integration. The system LPC1768 operates at CPU frequencies of up to 100 M Hz.

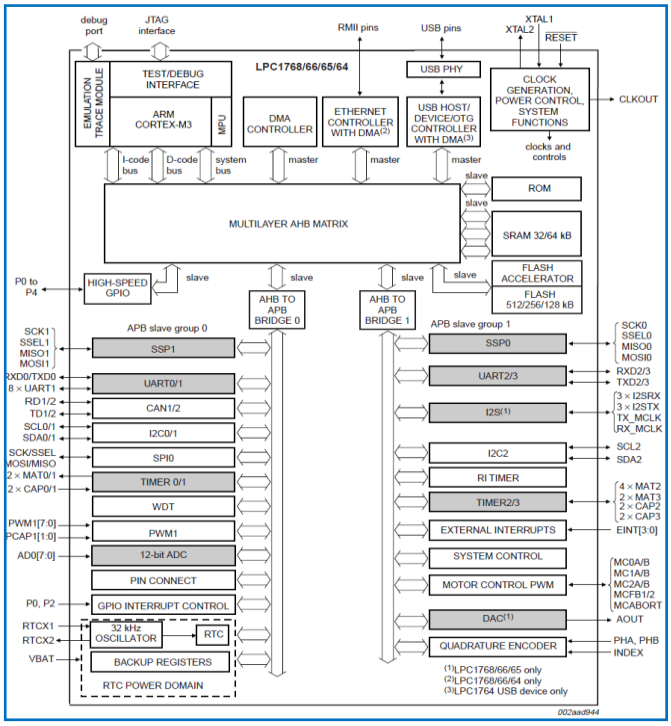


Fig. 2: Block diagram LPC 1768 ARM Cortex M-3

The ARM Cortex-M3 CPU consist a 3-stage pipeline and uses Harvard architecture with separate local instruction and data buses as well as a third bus for peripherals. The CPU of ARM Cortex M-3 also includes an internal pre-fetch unit that supports speculative branching. The peripheral of the LPC1768 includes up to 512 KB of flash memory, up to 64 KB of data memory, Ethernet MAC, USB Device/Host/OTG interface, 8-channel general purpose DMA controller, 4 UARTs, 2 CAN channels, 2 SSP controllers, SPI interface, 3 I2C-bus interfaces, 2-input plus 2-output I2S-bus interface, 8-channel 12-bit ADC, 10-bit DAC, motor control PWM, Quadrature Encoder interface, 4 general purpose timers, 6-output general purpose PWM, ultra-low power Real-Time Clock (RTC) with separate battery supply, and up to 70 general purpose I/O pins.

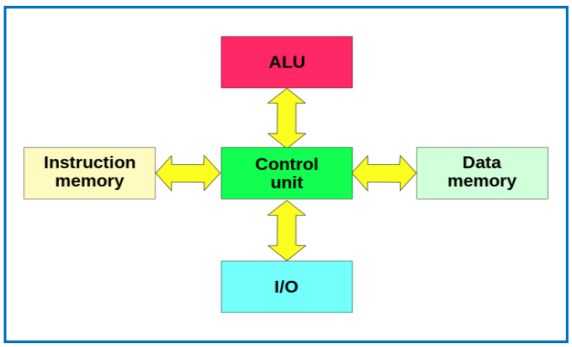


Fig. 3: Harvard Architecture

A. Power supply unit

This section needs two voltages viz., +12 V & +5 V, as working voltages. Hence specially designed power supply is constructed to get regulated power supplies.

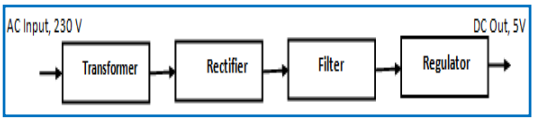


Fig. 4: +5V DC power supply for LPC 1768 ARM Cortex M-3

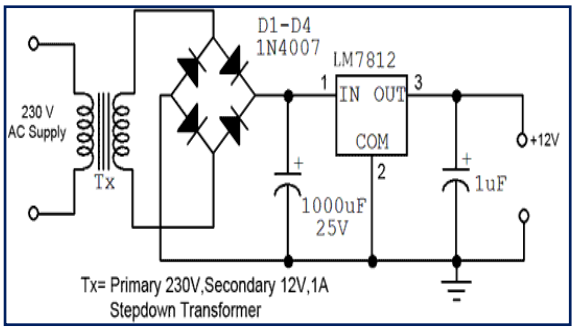
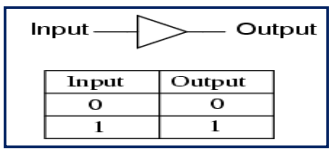


Fig. 5: Volts regulated power supply

B. Buffers

Buffers do not affect the logical state of a digital signal (i.e. a logic 1 input results in a logic 1 output whereas logic 0 input results in a logic 0 output). Buffers are normally used to provide extra current drive at the output but can also be used to regularize the logic present at an interface.



Input	Output
0	0
1	1

Fig. 6: Symbol and truth table of Buffer gate.

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C. Drivers

This section is used to drive the relay where the output is complement of input which is applied to the drive but current will be amplified.

D. Relays

It is an electromagnetic device which helps to drive the load connected across the relay and the o/p of relay can be connected to controller or load.

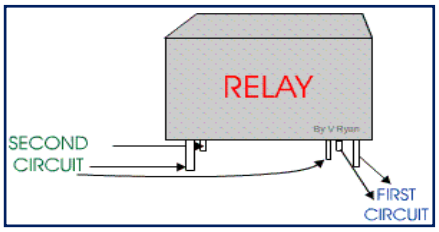

Fig. 7: How relay looks from outside

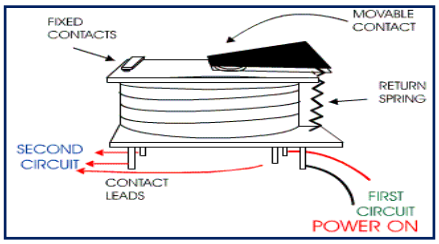

Fig. 8: Internal Structure of Relay

Fig. 9: Various commercial relays

E. Monostable Mulitivibrator

It has only one stable state and produce a single output pulse when it is triggered externally. It only return back to their first original and stable state after a period of time determined by the time constant of the RC coupled circuit.

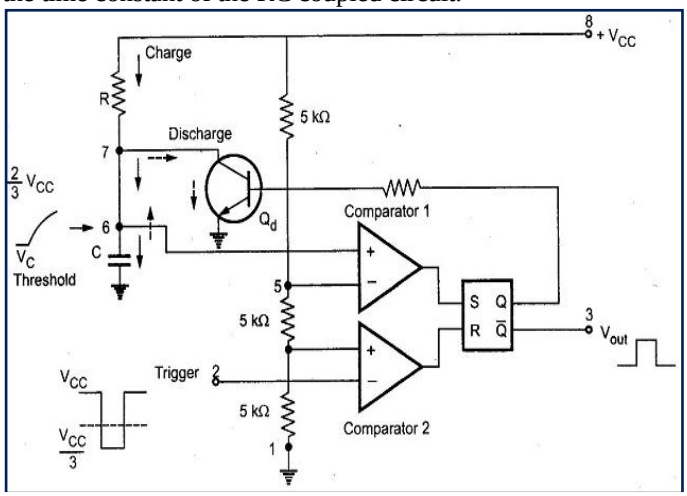

Fig. 10: Monostable multivibrator operation of 555 Timer.

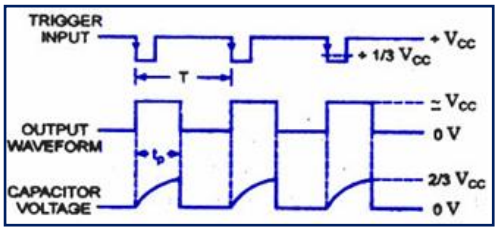

Fig. 11: Waveforms of Monostable multivibrator

F. ARM processor

ARM is computer processor based RISC architecture which requires fewer transistors than other typical processors which are noticed in some of the average computers. Hence the approach reduces costs, heat and power use. The low power consumption of ARM processors has made them very popular. The ARM architecture (32-bit) is the most widely used architecture in mobile devices, and most popular 32-bit one in embedded systems.

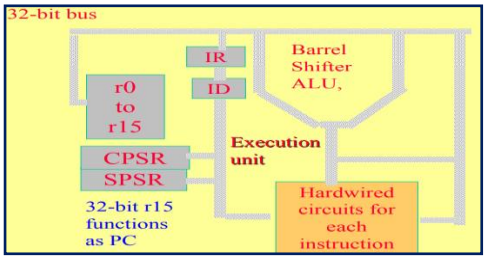

Fig. 12: ARM Architecture

G. RF transmitter

RF transmitters are electronic devices that create continuously varying electric current, encode sine waves, and broadcast radio waves. RF transmitters use oscillators to create sine waves, the simplest and smoothest form of continuously varying waves, which contain information such as audio and video. Modulators encode these sign wives and antennas broadcast them as radio signals.

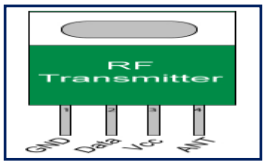

Fig. 13: Pin diagram of RF transmitter

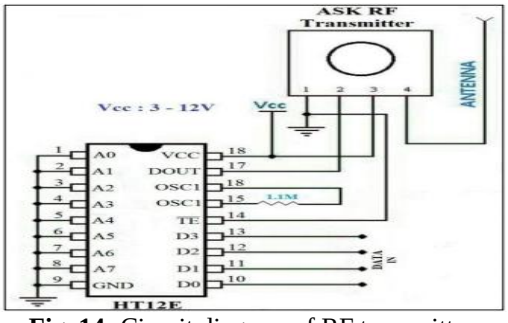

Fig. 14: Circuit diagram of RF transmitter

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H. RF receiver

RF receivers are electronic devices that separate radio signals from one another and convert specific signals into audio, video, or data formats. RF receivers use an antenna to receive transmitted radio signals and a tuner to separate a specific signal from all of the other signals that the antenna receives. Detectors or demodulators then extract information that was encoded before transmission. There are several ways to decode or modulate this information, including amplitude modulation (AM) and frequency modulation (FM). Radio techniques limit localized interference and noise.

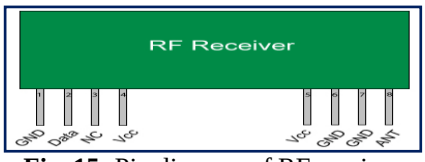

Fig. 15: Pin diagram of RF receiver

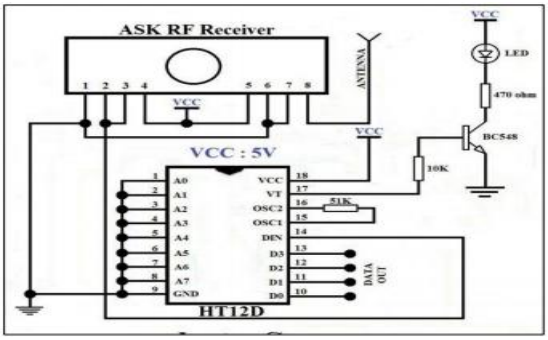

Fig. 16: Circuit diagram of RF receiver

I. GSM Module

The GSM module is used for Remote Control activities such as Gate Control, Temperature Control etc. GSM/GPRS module consists of a GSM/GPRS modem assembled together with power supply circuit and communication interfaces (like RS-232, USB) for computer. The MODEM is the soul of such modules which generate, transmit or decode data from a cellular network, for establishing communication between the cellular network and the computer. They use serial communication to interface with the user and need Hayes compatible AT (Attention) commands for communication with the computer (any microprocessor or microcontroller system).

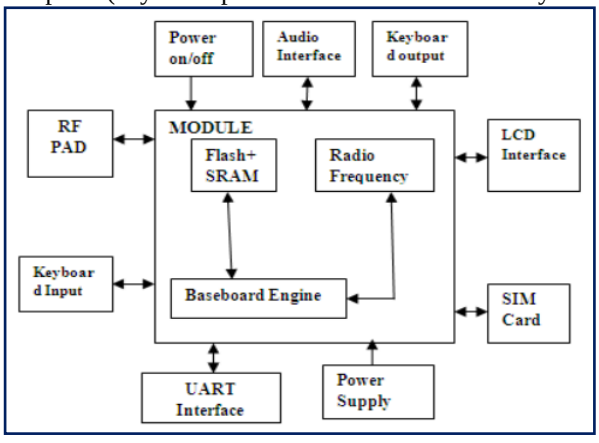

Fig. 17: GSM module structure

An RS-232 port was once a standard feature of a personal computer for connections to modems, printers, mice, data storage, un-interruptible power supplies, and other peripheral devices. However, the limited transmission speed, relatively large voltage swing, and large standard connectors motivated development of the universal serial bus which has displaced RS-232 from most of its peripheral interface roles. Many modern personal computers have no RS-232 ports and must use external converter to connect to older peripherals.

J. GPS Module

GPS is a satellite based system that can be used in navigation to locate the positions anywhere on the earth. GPS is designed & operated by U.S. Department of Defense (DOD).GPS consists of satellites, control & monitor stations and GPS receivers. GPS receivers take information which is transmitted from the satellites and uses triangulation to calculate a user's exact location. GPS is used in a variety of ways: - To determine the position of locations. - To navigate from one location to another. - To create digitized maps. - To determine distance between two points. The basis of GPS is a constellation of satellites that are continuously orbiting around the earth. These equipped with atomic clocks & transmit radio signals that contain their exact location, time and other information.

Fig. 18: Working of GPS

The radio signals which are transmitted from the satellites are monitored & corrected by control stations which are sent back to satellites using ground antenna. The radio signals from satellites are picked up by the GPS receiver. A GPS receiver needs only 3 satellites to plot a rough, 2D position, which will not be very accurate. Ideally, 4 or more satellites are needed to plot a 3D position, which is more accurate than 2D. There are three segments of GPS such as Space segments, Control segments and user segments. Here, in Space segment –The satellites orbiting around the earth. Control segment-The control & monitoring stations.

IV. RESULTS AND DISCUSSION

This proposed system will help us to detect the fuel theft, an unauthorized access of the vehicle and also detect the accident location. The GPS tracks and GSM alert based algorithm is

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designed and implemented with LPC1768 in an embedded system domain.

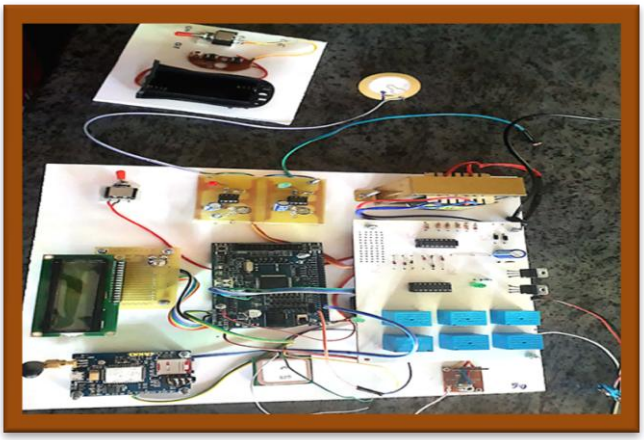

Fig. 19: GPS and GSM based accident location intimation, vehicle and fuel theft detection system.

The proposed vehicle accident detection system can track geographical information automatically and sends an alert SMS regarding accident to the user defined mobile numbers. Theft of vehicle is detected by using GPS and GSM technology. The system is put into sleeping mode while vehicle is handled by an authorized person. When the theft is identified, the system gets activated and the authorized person gets an SMS regarding Vehicle theft. When fuel theft occurs, LDR sensor gets activated, which is connected to ARM Cortex M-3 Controller and the text message is sent to the owner. Whenever there is occurrence of an accident, vibration sensor gets activated which is in turn connected to Monostable Multivibrator, and sends signal to ARM Cortex M-3 Controller. Hence the message displays on LCD. Accident location is determined by GSM and GPS modem as shown in figure 20.

Fig. 20: Accident detection displays on LCD

Fig. 21: Latitude and longitude details are sent to the owner.

Whenever an unauthorized person attempts to theft a vehicle, the signal is sent to ARM Cortex M-3 Controller and in turn message is displayed on LCD and the location of the vehicle is determined by GPS and GSM modem as shown in figure 22.

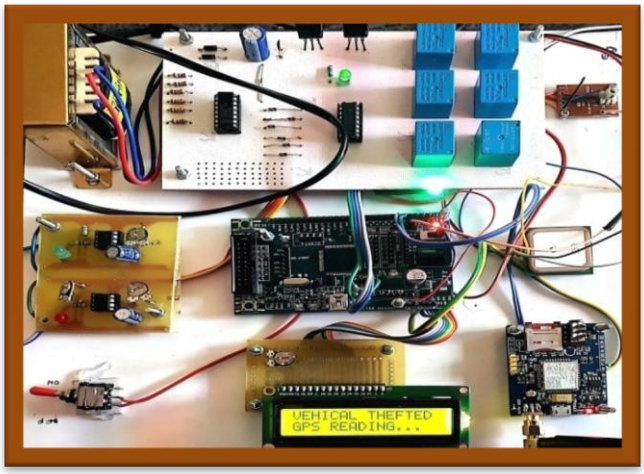

Fig. 22: Display of Vehicle theft detection

Fig. 23: Latitude and longitude details are sent to the owner.

If anyone attempts to theft fuel, LDR sensor gets activated which is connected to Monostable Multivibrator, hence the signal is sent to ARM Cortex M-3 Controller. The message is displayed on LCD and the location is determined by GPS and GSM as shown in figure 24.

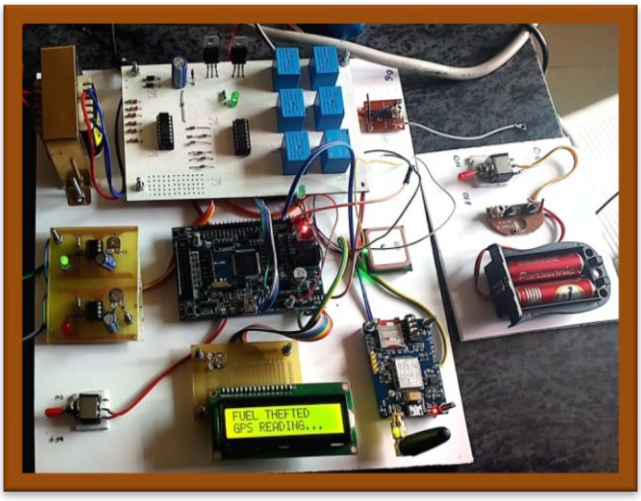

Fig. 24: Fuel theft detection

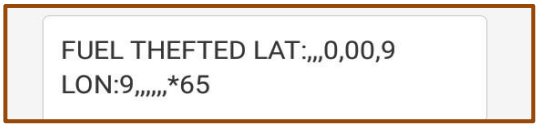

Fig. 25: Latitude and longitude details are sent to the owner.

V. CONCLUSION AND FUTURE SCOPE

In this paper, we have proposed a novel method of vehicle tracking and locking systems used to track the theft vehicle by using GPS and GSM technology. This system puts into the sleeping mode vehicle handled by the owner or authorized persons; otherwise goes to active mode. The mode of operations changed by persons or remotely. When the theft identified, the responsible people send SMS to the micro controller, then issue the control signals to stop the engine motor. After that all the doors locked. Further, it could be used as a valuable tool for real time traveler information, congestion monitoring, and system evaluation. The system can be used to quickly respond to the unexpected accidents which occur on highways or busy roads in cities. This can be done by arranging these systems in various ambulances which cover the entire city so that the nearest ambulance could be contacted for help. It can be extended for alcohol detection. The system will detect the driving person whether the person is drunk or not, if the person is taken alcohol, the vehicle will not start. By using these types of applications, up to some consistent accidents can be reduced and many life's can be saved.

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