International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-3, January 2020

Fleet Monitoring System using GSM, GPS and Web Server with Drunken Driving Alerts

Ashish Patwari, Godasi Kavya, Meghana Reddy P

Abstract*: This paper explains the design and implementation of an on-demand vehicle tracking and alcohol activity detection system using microcontroller and suitable peripherals. Correct information about a vehicle's location is extremely important in managing fleet, logistics and cab services. Unfortunately, operators or owners of such services find a tough time to perfectly spot their trucks or vehicles owing to irresponsible, reluctant, untruthful and unlawful drivers. We propose a system based on Global System for Mobile Communication (GSM), Global Positioning System (GPS), PIC microcontroller, alcohol sensor etc., which can provide the whereabouts of the vehicle in the form of an SMS to the owner's mobile phone. A working prototype of the proposed system was created and tested successfully. Such systems will be of great utility to cab and fleet operators in developing countries such as India etc.

***Keywords*: Alcohol activity detection, MQ-3 sensor, On-demand vehicle tracking, PIC microcontroller, Vehicle location update.**

I. INTRODUCTION

Transportation has become a part and parcel of man's life. Presently, this sector is witnessing rapid strides in the form of electric vehicles, bio-fuel vehicles and an attempt to bring in driverless vehicles. However, the downside in developing countries such as India is that the roads are in a bad condition and are rarely repaired. This causes many accidents that often lead to the death of dozens of people.

Most of these deaths occur mainly due to three reasons apart from bad roads which include a) Drunken drivers b) Drowsy drivers and c) Over speeding however drunken driving is one of the leading causes of road accidents. Despite several efforts taken by different organizations all around the world by conducting various programs to aware people against careless driving, yet accidents occur very often. Our paper mainly focuses on measures to combat accidents occurring due to drunk and drive. Many such accidents can be avoided if precautionary measures are taken on time.

Revised Manuscript Received on January 30, 2020.
***** Correspondence Author
Ashish Patwari*, School of Electronics Engineering, Vellore Institute of Technology, Vellore, India. Email: ashish.p@vit.ac.in
Kavya Godasi, B. Tech ECE Alumni, Vellore Institute of Technology, Vellore, India. Email: gkavya2008@gmail.com
Meghana Reddy P, B. Tech ECE Alumni, Vellore Institute of Technology, Vellore, India. Email: meghana13.p@gmail.com

One such measure is to know the drunken state of the driver prior to the start of vehicle. In this paper we are implementing the same. For the ignition to turn on the driver must go through a mandatory alcohol test. If the alcohol content exceeds a certain limit, then the ignition turns off and an alert message is sent to the registered user. If there is no alcohol content, then the ignition turns on normally. So, if a person wants to start the vehicle, he should undergo this test. With this we can prevent the accidents occurring due to drink and drive to some extent.

The American Department of Defense (DoD) developed a very useful and popular technology called the Global Positioning System (GPS) mainly for military use. Later, it was made available for public use. Lately, it has become an important part of a vehicle system. It is being used for tracking and navigation purpose. It provides speed, accurate time and location coordinates. Another widely used technology is Global System for Mobile communications (GSM).

Now-a-days, GPS technology has well penetrated into the civilian sector and is widely being used by the citizens. GPS receivers are accurate, reliable and affordable.

We propose a vehicle mounted system that provides accurate location of the vehicle on-demand. At the user end, the operator just uses a Global System for Mobile Communications (GSM)-enabled mobile phone to send a message (pre-defined format) to track the vehicle. The vehicle mounted device consists of a GSM Subscriber Identity Module (SIM) that receives the message. The microcontroller then pulls the live location from the Global Positioning System (GPS) module and sends back a message to a predefined phone number (in this case, the operator's cell phone). An additional component of this device is an alcohol sensor which can help (i) trigger an alarm, (ii) disable the vehicle ignition and (iii) send an alert message to the operator's cell phone upon detecting high levels of alcohol consumption by the driver. Here we include a feature for updating the vehicle's location as well as the drunk state of the driver on the server. This feature acts as a savior when there is no GSM network at the user's end. The registered user can still know the location of the vehicle by accessing the web server.

The rest of the paper is organized as follows. Section II describes existing methodologies. Section III describes the proposed method.

Section IV describes the hardware components used in the proposed design. Section V describes the results. Section VI gives a few future directions and concludes the paper.

II. EXISTING METHODS

Many researchers have carried out their studies on vehicle tracking systems. Due to the advancements in technology, inexpensive navigation systems are widely available.

Most of the modern designs for vehicle tracking employ two well-known technologies, namely, the Global Positioning System (GPS) and the Global System for Mobile Communications (GSM). Most vehicle tracking systems consist of a device which is fitted inside the vehicle to be tracked. The main function of a GPS modem is to sense the current location of the vehicle in terms of the latitude and longitude coordinates whereas the primary function of the GSM modem is to act as a bi-directional communication system which can exchange the information to and from the user in the form of Short Messaging Services (SMS). At the core of all such vehicle tracking systems, there is a Micro controller which is interfaced to all the peripherals and performs the controlling tasks required for the correct operation of the system.

Authors in [1] proposed a system based on the Intel Galileo platform for vehicle location and theft tracking. A system using GPS, GSM and General Packet Radio Service (GPRS) at the vehicle end and a smart phone at the user end has been designed in [2]. A Raspberry Pi based vehicle monitoring and tracking system that can monitor a vehicle's course from location A to B along with a provision for LPG gas leakage detection using MQ6 sensor was proposed in [3]. In [4], a real-time automobile tracking system via Google Earth was presented which included a transmitting embedded module to interface in-vehicle GPS and GSM devices in order determine and send automobile location. In [5], a system was designed to monitor the position and velocity of mobiles in a cellular radio network using field strength data of surrounding base stations and a linear recursive model of mobility after applying Kalman filter for smoothening. A car position tracking system using GPS and GSM modems along with a sensor to monitor the fuel levels in the fuel tank (to avoid fuel theft by drivers) was successfully implemented in [6].

A real time system that is useful for cab companies and fleet managers was proposed in [7], using fingerprint scanner for driver authentication, a panic button and a web cam for passenger safety and vehicle tracking. A vehicle tracking device using Arduino Uno that can give the location coordinates based on a SMS request and provide a link to Google maps was demonstrated in [8]. In this system the user just sends one message to the GSM modem on vehicle and the GSM modem will send back the current location of the vehicle in the form of hyper link and user has to click on a link and that link redirects to Google maps and shows the current location of the vehicle in the map [8]. Authors in [9] were able to send appropriate vocal and text warning messages when a vehicle exceeds the permitted speed limit at a certain location using GPRS and remote server. Authors in [10] proposed an ignition system which operates on the blood alcohol content (BAC) from human breaths.

An IoT based system to monitor parameters such as fuel level, live location of vehicle, over-speeding etc., has been implemented in [11]. A smart universal vehicle tracker with ability to detect drunken driving was proposed in [12]. A comprehensive vehicle tracking system using Node MCU and Blynk mobile app was demonstrated in [13].

Based on the above literature, an improved real-time vehicle tracking using GPS/GSM with Wi-Fi module and alcohol sensor has been proposed in this paper. The alcohol sensor provides safety against drunk and drive accidents. Though the authors in [12] presented a similar system using PIC16F, the on-board module did not have a Wi-Fi modem and hence there was no possibility of implementing a web server. Hence, the design here is elegant and an improved version compared to existing systems.

III. PROPOSED METHOD AND METHODOLOGY

The proposed method is as shown in Fig.1. The flowchart for the operation of the proposed system is given in Fig. 2.

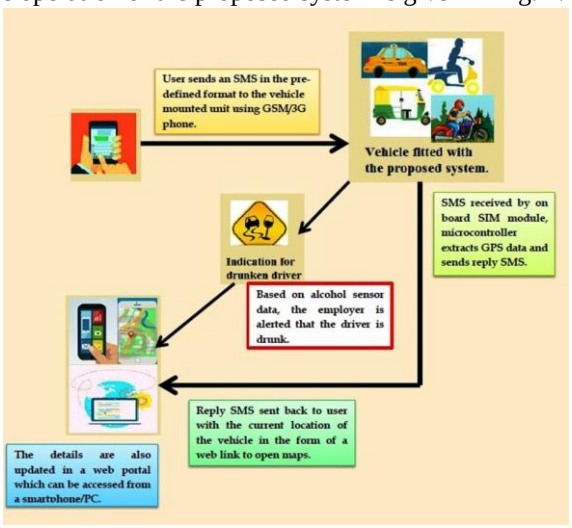

Fig. 1. Outline of the proposed system operation.

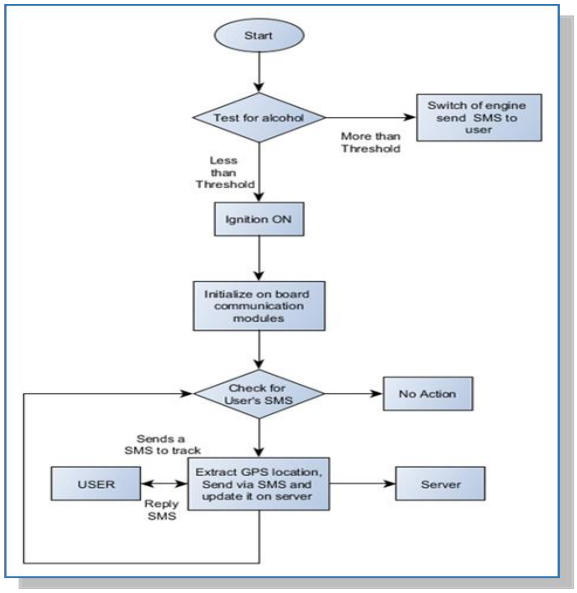

Fig. 2 Flowchart showing the system operation.

The indication for alcohol consumption (drunken driver) is automated i.e., whenever the alcohol sensor detects that the amount of alcohol is very high, the ignition is switched off, an SMS is sent to the owner of the cab stating the driver's state and the car's location. On the other hand, whenever the owner is interested to know the location of the vehicle, he/she has to send an SMS in a pre-defined format to the vehicle mounted device. The device then sends back a reply SMS with a weblink indicating its current coordinates.

IV. HARDWARE DESIGN

This section describes the hardware components used in this proposed system. Fig. 3 shows the hardware block diagram of the proposed system. Table I gives the list of key hardware components, their model numbers and a brief description about them.

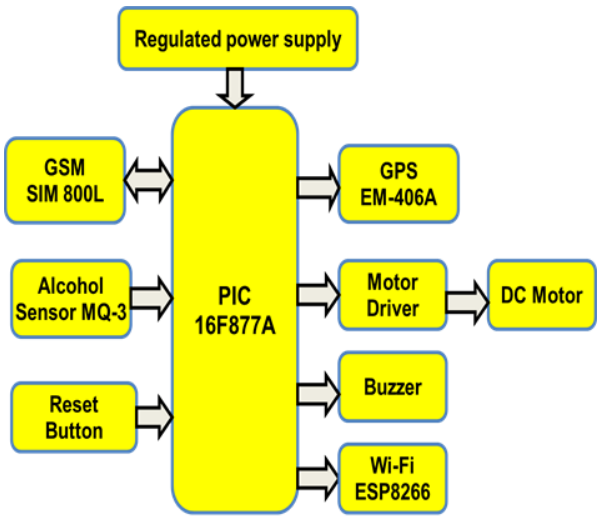

Fig. 3. Hardware Block Diagram of the Proposed System

Table I Key Hardware Components

HARDWARE MODULE	SPECIFICATIONS		
	DESCRIPTION	MODEL NUMBER	IMAGE
Alcohol sensor	Sensing range of 0.04 mg/L to 4 mg/L, operates at temperatures from -10°C to 50°C and consumes less than	MQ-3	
GSM modem	Quad-band, Send and receive GPRS data (TCP/IP, HTTP, etc.), AT command interface with "auto baud" detection	SIM 800L	
GPS modem	NMEA format, 6 pin cable. indicator LED, 5V power, ~40mA current draw,-159 dB sensitivity	EM-406A	
Wi-Fi modem	802.11b/g/n, Wi-Fi Direct (P2P), soft-AP, Integrated TCP/IP protocol stack	ESP8266	

The PIC microcontroller PIC16f877a is one of the most used microcontrollers in the industry. This controller is very convenient to use. One of the main features is that it can be written-erased as many times as possible because it uses FLASH memory technology. Out of the total number of 40 pins, there are 33 pins for input and output.

It is used in remote sensors, security and safety devices, tracking systems and home automation. The cost of this controller is low, and its handling is also easy. Operating frequency is 0-20 MHz and power supply voltage are 2.0-5.5V. The connections used for the proposed system are given in Table II.

Table II Pin numbers on PIC to connect peripherals

Components	Port number
GPS(EM-406A)	A0
Wi-Fi (ESP8266)	A1
Buzzer	E2
Alcohol Sensor	C2
DC Motor	C3
GSM(SIM800L)	B1

V. RESULTS AND DISCUSSION

A fully functional prototype of the proposed idea was built and tested for functionality. The system works well as per the initial design requirements. It is scalable in the sense that multiple such units can be installed and operated. The cost of the system is Rs. 5000 [$70].

The system works as per the desired specifications. Fig.4 shows the hardware set-up. All the modules are powered on.

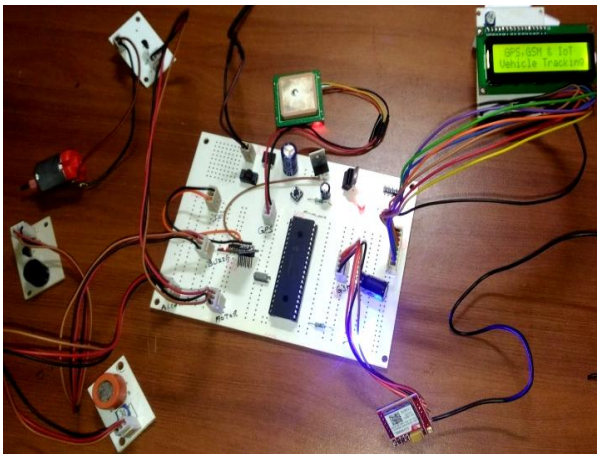

Fig. 4. Prototype of the proposed system

Fig. 5 shows that the ignition of the system (DC motor) is turned-off when alcohol activity is detected and alert SMS is sent to user along with location as shown in Fig. 6.

The information about the vehicle's location and alcohol activity of the driver is also updated on the webpage as shown in Fig. 7, by making use of the on-board Wi-Fi module. The GPS coordinates of the vehicle are obtained in the form of a weblink which opens a Google map with a pin on the vehicle's current location as shown in Fig. 8. It can be seen that the working prototype of the proposed system was designed and all the functional aspects were verified.

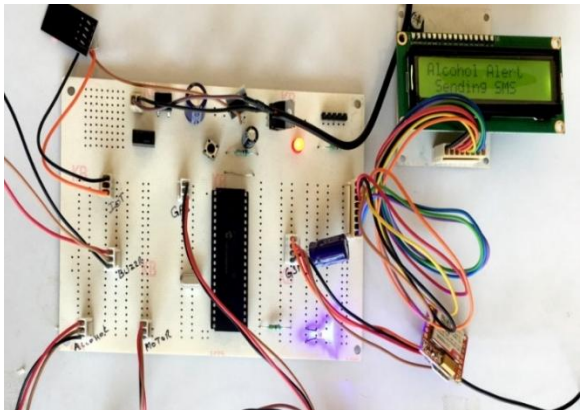

Fig. 5. Alcohol detected, ignition off.

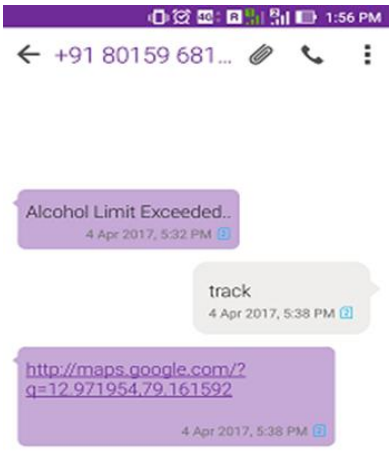

Fig. 6. Alcohol Alert SMS sent to User and on request message (track) from User, location is sent.

Fig. 7. Updated information on the webpage.

Fig. 8. Vehicle Location in Google Maps

VI. CONCLUSION AND FUTURE SCOPE

We conclude that the system for on-demand vehicle location updates and alcohol detection was successfully implemented using GPS, GSM and Web server. It provides accuracy, correctness, ease of use and reliability within a reasonable cost.

The prototype can be converted into a commercial product after optimizing the power consumption, form factor, cost and packaging.

The design can be extended to have an on-board Real-Time Clock (RTC). The RTC can be programmed to send an automatic location update about the vehicle's location to the owner's mobile phone at a specified time of the day (say, every day at midnight). A timer can be programmed by using the PIC microcontroller, to disable the vehicle ignition for a pre-determined duration (say 1 hour) upon detecting high levels of alcohol consumption. The vehicle restarts only after the specified duration. The design can be scaled-up where all the vehicles of a cab company are fitted with these devices and the vehicles can communicate through GSM modules. Possibilities of Vehicle-to-Vehicle (V2V), Vehicle-to-infrastructure (V2I) and Internet of Vehicles (IoV) could also be explored.

REFERENCES

1. O. A. Mohamad, R. T. Hameed, and N. Ţăpuş, "Design and implementation of real time tracking system based on Arduino Intel Galileo," in *2016 8th International Conference on Electronics, Computers and Artificial Intelligence (ECAI)*, 2016, pp. 1–6.
2. S. Lee, G. Tewolde, and J. Kwon, "Design and implementation of vehicle tracking system using GPS/GSM/GPRS technology and smartphone application," in *2014 IEEE World Forum on Internet of Things (WF-IoT)*, 2014, pp. 353–358.
3. P. A. Shinde and Y. B. Mane, "Advanced vehicle monitoring and tracking system based on Raspberry Pi," in *2015 IEEE 9th International Conference on Intelligent Systems and Control (ISCO)*, 2015, pp. 1–6.

4. Mohammad A. Al-Khedher "Hybrid GPS-GSM Localization of Automobile Tracking System" in *International Journal of Computer Science & Information Technology (IJCSIT) Vol 3, No 6, Dec 2011*
5. Martin Hellebrandt and Rudolf Mathar "Location Tracking of Mobiles in Cellular Radio Networks" in *IEEE Transactions on Vehicular Technology, Vol. 48, No. 5, September 1999.*
6. M. Anisah, A. Taqwa, A. Amperawan, E. Evelina, and S. Rasyad, "Global Positioning System And Global System For Mobile Communication Modem Application As Car Position And Fuel Monitoring System," *J. Teknol.*, vol. 77, no. 22, Dec. 2015.
7. V. R. C. Gowda and K. Gopalakrishna, "Real time vehicle fleet management and security system," in *2015 IEEE Recent Advances in Intelligent Computational Systems (RAICS)*, 2015, pp. 417–421.
8. F. B. B. Alzahri and M. Sabudin, "Vehicle Tracking Device," in *2016 International Conference On Advanced Informatics: Concepts, Theory And Application (ICAICTA)*, 2016, pp. 1–6.
9. Majid A. Al-Taee,Omar B. Khader,Nabeel A. Al-Saber "Remote Monitoring of Vehicle Diagnostics and Location Using a Smart Box with Global Positioning System and General Packet Radio Service" in *2007 IEEE/ACS International Conference on Computer Systems and Applications (2007)*
10. M.H Mohamad, Mohd Amin Bin Hasanuddin, Mohd Hafizzie Bin Ramli "Vehicle Accident Prevention System Embedded with Alcohol Detector " in *International Journal of Review in Electronics & Communication Engineering (IJRECE).*
11. R. A. Deshmukh and M. N. Warade, "A Novel IoT based Approach to Report, Monitor and Secure Vehicles," International Journal of Innovative Technology and Exploring Engineering (IJITEE), vol. 8, no. 6, p. 4, Apr 2019.
12. N. Shankar and B. Indurani, "Smart Vehicle Monitoring with Accident Detection and Prevention System," International Journal of Innovative Technology and Exploring Engineering (IJITEE), vol. 8, no. 2, p. 3, Dec 2018.
13. B.V.S. Padmaja, K. Venkata Ratnam, K. Syam Sai, "IoT based Implementation of Vehicle Monitoring and Tracking system usingNode MCU", International Journal of Innovative Technology and Exploring Engineering (IJITEE), vol. 8, no. 6, p. 4, Apr 2019.

AUTHORS PROFILE

Ashish Patwari received the B.Tech degree in ECE from JNTU Hyderabad, India, in 2007. He received the M.Tech degree in VLSI and Embedded Systems from IIIT Hyderabad, India, in 2009. Currently, he is working as an Assistant Professor in the Department of Communication Engineering, School of Electronics Engineering, Vellore Institute of Technology, Vellore, Tamil Nadu. He received his Ph.D. degree in 2019 from Vellore Institute of Technology, Vellore.

Kavya Godasi has finished her B.Tech ECE degree from Vellore Institute of Technology, Vellore in 2017. Currently she is working as a systems engineer in telecom domain at Tata Consultancy Services (TCS), Hyderabad.

Meghana Reddy P has finished her B.Tech ECE degree from Vellore Institute of Technology, Vellore in 2017. She also received her master's from New Jersey Institute of Technology, USA. Currently, she is working as an engineering intern at GEP worldwide, New Jersey.