REAL TIME TRACKING AND FUEL MONITORING OF TRUCK USING IoT

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Abstract

The need for efficient goods transportation system such as real time tracking, finding the accident location and reducing financial fuel loss of trucks is rapidly increased. To facilitate the need for efficient goods transportation system this paper describes solution for real time tracking and fuel monitoring which are considered as main problems that most of truck companies looking to resolve. The proposed system is implemented using IoT (Internet of Things) with single board computer (Raspberry Pi) which measures vital information of truck such as trucks current location, fuel level and fuel leakage in real time using various sensor modules. All gathered informations are uploaded into cloud platform (adafruit IO) for further analysis and monitoring purpose. In addition, this system also detects in case if truck involved in accident or not and send accident location information to authorized persons through email. The real
time information of truck is available in cloud for licensed users and authorized truck owner anytime anywhere. This complete system provides efficient real time tracking, fuel level and monitoring truck condition remotely based on Internet of Things (IoT) technology to deliver goods on time as well as protect the truck from theft.

**Key Words:** Internet of things (IoT), single board computer, real time tracking, cloud platform, Sensors, truck tracking, Raspberry Pi.

### 1 INTRODUCTION

In recent years, truck industry becomes an essential sector that decides the economic growth of any nation. Practically, every other industry solely relies on trucks for their goods delivery. Applications of commercial vehicle tracking solutions in the fields of goods transport, logistics, haulage and multi-drop delivery environments can include optimized truck utilization, operational enhancements and dynamically remote-managed trucks. So, the necessity of efficient goods transportation by using latest advancements in technologies is turn out to be more important [12]. Now a day, every modern vehicle has its own sensors and in vehicle communication module for sensing data accurately, processing and making decisions. The modern developments and changes in internet of things (IoT) and cloud computing have been providing a capable prospect to resolve the increasing modern vehicle transportation problems, for predicting the traffic congestion, finding the shortest route, and vehicle security and safety[8]. As a result, many investigators focus on intelligent transportation system (ITS) developed to improving driver’s safety, security, and convenience [5].

The need for efficient goods transportation system such as real time tracking, finding the accident location and reducing financial fuel loss of trucks is rapidly increased. Two major factors that leads to financial loss for truck owners are time and cost. Time is important for goods delivery, failing which may lead to financial loss to owner as well as customer. The truck owner needs to know the accurate arrival time and destination time of the particular truck to a particular station which allows effective management and scheduling of truck for next delivery. This can be overcome by using the real
time tracking vehicle system [13]. Second one is cost, in recent days fuel cost is raising constantly. Fuel cost is major impact on truck or any vehicle transportation. Fuel monitoring are main problems that most of truck companies looking to resolve. Remote monitoring and data collection systems are useful and effective tools to collect information from fuel storage tanks. The number of accidents is shooting upward daily along with the rising safety concerns while travelling. Many peoples life were lost every ever due to careless of drivers and others. Accident preventive mechanism prevents the possible situation that may lead to accident.

To facilitate the need for efficient goods transportation system, this paper describes solution for real time tracking and fuel monitoring which are considered as main problems to truck owners [7]. In addition to that, this paper describes a method to detect accident and alert the driver in case of truck nearing other vehicles very close or fuel leakage.

2 RELATED WORK

This research paper [1] provides a solution using GPS with Google Maps. The Cloud platform accumulates useful information about a vehicle. Even though this system provides a speed, driver’s condition, accurate positioning of the vehicle main drawback of this system is unable to detect the vehicle involved in accident or not and locating accident location and intimating to vehicle owners.

This paper [2] developed a bus tracking and monitoring the fuel and speed system to provide a facility for the management requirements by the administrator. The proposed system based on Arduino, GSM/GPS and map suit ASP. MVC which provide the actuated arrival time in addition to graphically showing the bus location on Google map. The design also enables the owner of the buses to monitor the bus instantaneously because the system administrator can easily maintained database information of buses and its fuel tank at any time of the service. One of the draw back in this system is not detecting the leakage of the fuel.

The paper titled, Design And Implementation Of Real Time Vehicle Monitoring, Tracking And Controlling System [3] propose a system providing safety and secure travelling to the traveller using wrong
path alert mechanism. The proposed system plays an important role in real time tracking and monitoring of vehicle by updating vehicle real time information to the owner mobile. Whenever driver drives vehicle on the wrong path or in case of vehicle’s accident situation occurs, the proposed system provides the vehicle’s current location, speed to the vehicle owner’s mobile. The limitation involved on this system is gathered information not stored in cloud for future analysis which is mainly required by truck owners. Also this system failed to detect whether the vehicle is involved in accident or not.

This research paper [4] developed a vehicle tracking system to track the exact location of a moving or stationary vehicle in real time. The system consists of hardware module as well as software module. The system provides positioning and navigational information in terms of number of parameters. Also if we want then information regarding the satellites which are being tracked by the system is also displayed. The developed system is compact, low cost and reliable but mainly lack with other features such as fuel level, accident detection, etc.

The proposed system makes an effort to address all the limitations of above described system.

3 SYSTEM ARCHITECTURE

The proposed system architecture for real time tracking and fuel monitoring using IoT is shown in figure 1. The final outcome of the proposed system is to monitor the truck status by sensing various values from sensor modules which are employed in truck using IoT cloud platform. The device employed in each truck consist of single board computer, GPS, fuel level sensor, gas sensor, vibration sensor, accelerometer sensor and ultrasonic sensor [14].
The single board computer R-Pi is directly interact with sensor modules to collects vital information about truck such as current location, fuel level, fuel leakage detection, accident detection and alert system when truck reaches near to other vehicle. The real time tracking of truck is achieved by GPS device which receives coordinates from satellites and send this information to R-Pi continuously [6]. The fuel level and fuel leakage on truck are being identified by fuel level sensor and gas sensor respectively. In case of truck got involved in accident, the system will be identified with the help of vibration and 3-axis accelerometer sensor. And notification about accident and its location information will be sent to truck owner through mail. By using ultrasonic sensor, the system alerts the driver under critical condition where truck reaches very near to other vehicle that may potentially lead to accident condition. All these information are gathered by single board computer on the truck and send it to cloud platform via GPRS network using the GSM module GSM/Wi-Fi connectivity in real time. Only the authorized truck owners can access these real time data’s on cloud environment anytime anywhere by using a web application. By monitoring the truck location, owner gets better idea on arrival time to the destination as well as status of their truck to manage and schedule goods delivery accordingly.
4 SYSTEM FLOW DIAGRAM

The flow diagram of the proposed system is shown in Figure-2.
Step 1: Import all necessary library functional files into R-Pi
Step 2: Initialize required GPIO port pins
Step 3: Read all sensor values and updated it in cloud continuously
Step 4(a): check accident occurred or not by reading values from vibration and 3-axis accelerometer sensor. If yes, send an email notification to authorized person. Step 4(b): Same way, if any fuel leakage or fuel level is low it send an email to authorized person.
Step 4(c): check whether truck nearing other vehicle or not using ultrasonic sensor. If yes, give an alarm to driver.

Figure 2 Flow diagram of the proposed system

5 SYSTEM IMPLEMENTATION

The proposed system is implemented on the base of single board computer R-pi which also acts as a gateway to fetch the real time data to the cloud platform. The main reason for choosing R-Pi 3 as base for entire system is because of its performance and variant
features. R-Pi 3 uses ARM8 architecture and Broadcom BCM2836 type Processor with core Architecture of 64 bit ARM Cortex - A53 and it supports the Frequency of 900MHZ and has 1 GB RAM, 40 GPIO Pins, One Ethernet Socket, Four USB ports, Video Output and Audio Output. It also has in-built WIFI/Bluetooth with Chip Antenna and consumes the power of 5V [15]. The Raspberry Pi uses Raspbian, Debian and Linux as primary operating systems. There are much third party software to work on. It supports various languages like Python, C/C++, Python, Ruby and Perl. Another reason to choose pi 3 is because it can support various communication protocols such as SPI, UART and I2C.

The important information are gathered from truck with the help of six sensor modules attached to R-Pi which are GY-521 3-axis accelerometer sensor, Fuel level sensor, HC-SR04 ultrasonic sensor, SW-420 Vibration sensor, MQ7 sensor and Neo-7M GPS module [9]. The cloud platform chosen for implementation is adafruit IO cloud which is an open source cloud platform. Also it provides flexibility to user to design their own dashboard for graphical visualization of gathered data. The schematic diagram of the proposed system is shown in figure-3.

![Schematic diagram of the proposed system](image)

The real time tracking of truck has been accomplished by interfacing GPS with R-Pi. The GPS collects the information about current location such as latitude and longitude and send it to adafruit IO maps and cloud computing platform [10]. Whenever a truck
involved in an accident, it will be detected by vibration and three axis accelerometer sensor. These sensors will be fixed on front and back side of vehicle. Whenever the accelerometer reaches abnormal value on anyone axis and detects larger value on vibration sensor the system presumes accident has occurred. The location of accident is captured by R-Pi using GPS and it will be updated on cloud maps. Meanwhile, authorized person receives mail regarding accident and its location instantly.

The Fuel level indication is achieved by interfacing fuel level sensor with R-Pi. Fuel level values are continuously sent to cloud platform to be monitor by owner. This also helps to identify the fuel theft happened or not by unauthorized person [11]. In case of fuel leakage, the system will detect using gas sensor and alert the driver immediately. The ultrasonic sensor continuously monitors the distance between the truck and other nearing vehicle. If the distance gap between the vehicle is very minimal it alerts the driver by buzzing alarm. This is mainly to prevent accident while truck driver under drowsy state. This complete system provides Real time truck location, fuel storage level and truck condition remotely based on Internet of Things (IoT) technology to protect the truck from theft and provide security to remote locations. The experimental setup of the proposed system is shown in Figure-3.

Figure 4 Experimental setup

The complete system is implemented using python programming language and its libraries. To support real time monitoring,
all gathered data from R-Pi are sent to Adafruit IO cloud. Adafruit IO is an open source cloud platform and it makes useful data send to cloud easy-way. A separate python code is included in the main program to send the all sensors data connectivity to cloud platform. The figure 4 shows the dashboard page of Adafruit IO cloud.

![Figure 5 dashboard page of Adafruit IO cloud](image-url)

Figure 5 dashboard page of Adafruit IO cloud

6 RESULT

Real time tracking and fuel monitoring using IoT android application is successfully implemented using R-Pi and gathered information are uploaded into adafruit IO cloud platform. The figure 6 illustrates the dashboard view Adafruit IO feeds of various sensor information received from R-Pi in real time. In feed menu it shows the different types of feeds connection group, their keys, last values if GPS sensor use the system is normal or any accident detection find in this column and recorded column the system last active time.
Figure 6 Real time sensor values on Adafruit IO cloud

Figure-7 indicating the current location of truck along with its longitude and latitude values on adafruit IO.

Figure 7 Current location of truck on Adafruit IO maps

Figure-8 shows truck fuel level in real time as a feeds in adafruit IO. The value 0 represents the condition of fuel level is low else it indicate as fuel level normal.
Figure-8 shows truck fuel level in real time

Figure-9 (a) (b) displays the values from 3-axis accelerometer and vibration sensor which is used to check the accident occurrence condition. These two sensors are used double check the condition of accident.

Figure 9 (a) Values of 3-axis accelerometer
Figure 9 (b) Values of vibration sensor

Figure-10 indicates the accident location of upon receiving abnormal values from both 3-axis accelerometer and vibration sensor.

Figure 10 Accident detected status shown on Adafruit map

Figure-11 shows email notification sends to truck owner after accident occurrence condition with with its longitude and latitude values.
Figure 11 email notification to truck owner

Figure 12 shows the condition gas leakage in a truck. Value 1 indicates gas leakage and 0 indicates no gas leakage.

Figure-12 Gas leakage condition on adafruit IO cloud feeds

Figure-13 shows the values of distance measured by ultrasonic sensor in cm between the truck and other vehicle. If the measured distance is greater than 400cm it displays "out of range" else it activates the buzzer connected at R-Pi GPIO pin 18 to alert the truck driver.
The proposed system was successfully implemented by using R-Pi and various sensor modules. Adafruit IO cloud platform was used to visualise the real-time values gathered from the truck and the same will be accessed by the truck owners.

7 CONCLUSION

The proposed system is successfully implemented using Raspberry Pi with various sensors such as vibration sensor, fuel level sensor, fuel leakage sensor, GPS sensor, accident detection sensor, and ultrasonic sensor. In Adafruit IO cloud is used to provide information about vehicle location, accident detection to the truck owner. The abnormal condition of vehicle information will send as an email notification to the truck owner. It was tested for various scenarios and the proposed system is responding precisely. The proposed system made easy for the truck owner to track real-time road traffic accidents and fuel monitoring are predictable and therefore preventable. By implementing these systems we are avoiding vehicle theft and fuel loss, which leads to profit for the truck owner. In future, data analytics will be done with the help of IoT cloud services.
References


