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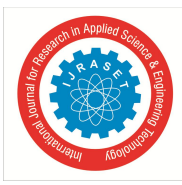
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# Fuel Allocation and Lockout System

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**Abstract**— Fuel theft from vehicles is one of the major problems, the world is facing today. The reason for fuel theft is steady increase in the price. Hence fuel theft is a major concern for everyone, especially the logistics and fuel transport companies. These companies are facing significant losses due fuel theft from their fleet of vehicles which usually include heavy vehicles like trucks, lorries etc. There are several solutions which are used by these companies to prevent or minimize fuel theft which include monitoring cameras, additional security, GPS tracking of vehicles etc. We have come up with this project to prevent fuel theft, especially in fuel transport vehicles. Our proposed system detects any change in fuel level of a fuel tank using ultrasonic sensor and with the integration of GSM module, the message regarding the change in fuel level and the location of the vehicle (detected using GPS) is sent to the owner or the management. The additional feature of our project is, we can lock the fuel tank remotely if needed by the owner.

**Keywords**— Fuel theft, GSM, GPS, location, ultrasonic sensor & lockout system.

## I. INTRODUCTION

One of the major problems that has come to light now a days is fuel theft according to a survey there is a drastic increase in fuel light right from the increase in price fuel and due to lockdown imposed and due to increase in unemployment. Fuel theft is mostly seen in fuel transport department as they carry thousands of litres for greater distances, as they are travelling long distances drivers will have a break at that time more theft is happening ,not only at the time of break but also while the vehicle is moving if the outlet is backside of the vehicle theft is happening at night times theft is more ,now a days as everything is being digitized , so that we can deal with real time easily but unlike analog meters, digital meters in vehicles show the level of fuel in the form of points but when if fuel is leaked or theft we do not know the exact amount of fuel being taken which is a major concern ,due to this theft is being unnoticed in major concerns.

Not only at the time of theft, but also when filling the tank the petrol pump owner also may cheat due to the inaccurate reading of the digital meter vehicle fuel theft is the main problem of car and bike owners, the owners may not know about the theft but the next time when they drive they will face a problem, in the case of an emergency fuel plays a major role so this problem has to come up with a solution.

In case of fuel tanks there can be flaws such as ,when the driver goes to fill the tank he gets the receipt of how many litres have been filled, date and time but in reality the driver does not know how many litres have been filled, there may be mismatch in the numbers another flaw maybe caused by the pump station filler another flaw maybe the involvement of the company staff to falsify the information ,so all the factors must be kept in record by the company which takes a lot of time and work to note all the details. So therefore to overcome all these problems we have to know the exact amount of fuel in the tank of the vehicle this could take out all the doubts and helps to save time, in this project we will be letting directly the owner to know the amount of fuel present moreover the proposed method of ours will also let know the exact location of the vehicle at any time whenever there is an outlet to know is the outlet happening legally or illegally.

Fuel transportations may happen through a lot of ways ,but only the ones travelling in the highways will have security at the toll gates but the ones travelling in sideways will face problem for thieves .oil price also have been increasing a lot to make it a cash many people are committing such crime ,to keep our fuel from being theft we also need a thing to stop the flow whenever there is an illegal flow ,therefore we introduced a lockout system which can prevent the flow of fuel no matter how hard the thieves try to take. With the help of this project, we will be able to know the amount of fuel being taken or theft.

## II. LITERATURE SURVEY

According to the paper published in IJSRST by the students of ECE studying at BITS College, they have developed a system to prevent fuel theft using a prototype containing the components LCD Screen, Flow sensor and Wi-Fi Module. The main component that controls everything is the Arduino UNO (ATmega328P Microcontroller). After recording the fuel flow through the value using the flow sensor, using the Internet the hourly fuel data is sent to the server of authority and they can lock out the valve of fuel outlet in the vehicle avoiding further fuel theft.



Jitendra Tamang at Sikkim Manipal Institute of Science and Technology developed a system for avoiding fuel theft by adding one more functionality to the above-mentioned literature survey that is GSM. Instead of using Internet, the cell towers can be used to send the messages SMS. Sometimes Internet will not always be available. So, GSM will allow the authority to receive message regarding fuel allocation and hence considering it they can perform the lockout of the fuel vehicle. Also, instead of sensing the fuel flow, this project uses IR sensor for detecting the fuel level.

Adam Riekert and few other authors from University of Waikato, New Zealand developed a sophisticated system containing both the functionality of above two literature surveys that is updating data of fuel information to the server using Internet and also sending SMS messages to the owner of the fuel company. In addition to these two they have used RFID tags for vehicle Identification for additional security leaving no loopholes for fuel theft. They are again to possible ways in which these RFID tags used in the working of the project. One way is a little less secured way where manually the tags are distributed across the drivers of fuel vehicle or to the authorized personnel. This type of system is called Fuel Shield. Another way is where the tags fitted to the vehicle, this type of system is called Blue Tank.

The next literature survey is GPS Fleet tracking software by Verizon connect which can be used in the fuel allocation and lockout system project for knowing the location also where the fuel valve is opened or where the fuel level is decreased. Depending on the location the Authorized personnel can find out whether the fuel is theft or is it a place where fuel is to be delivered then by using the functionality added by other literature survey reviews, we can attain a sustainable system that can us completely avoid any possibility of Fuel Theft.

These are some of the Literature surveys we reviewed before considering the project we are going to develop. The future scope of above reports and papers helped us develop our project in a proficient manner. We included the functionality of both the GSM and GPS in our project which was not done before bringing out a new output that can implemented in real life for circumventing any future fuel larceny.

### III. PROPOSED SYSTEM

After analysing several methods which are presently in use preventing fuel theft, we have come up with the following idea. Placing the ultrasonic sensor to monitor the fuel levels inside the fuel tank, so we can keep the record of the fuel level. This ultrasonic sensor only manages to sense the level of fuel present in the tank and cannot be proposed as a perfect fuel theft prevention method.

Hence, we have used GSM module to convey the fuel theft information to the fleet company or the owner.

- The GSM module is connected to the owner's communication system.
- The GSM module sends the info regarding fuel theft and the location of the fuel theft.
- The GSM module sends the info in the form of a SMS

To make the system much more effective, we have introduced a GPS module in the system.

- GPS module is placed inside the vehicle or fuel tank.
- It senses the location of the fuel tank.
- In case of fuel theft, this location is sent to the owner using GSM module.

We have also used a lockout system, to change the project from merely a fuel theft detection to lockout system. This system consists of setup through which the owner of the vehicle or company management can lockout the fuel tank in case of any fuel theft attempt and prevent much more loss.

### IV. HARDWARE COMPONENTS AND SOFTWARE

The proposed system is built using the following hardware components and Software tools.

#### A. Arduino UNO

Arduino UNO is a microcontroller which processes the data and controls the system. The programming for Arduino UNO is done in embedded C in Arduino IDE.

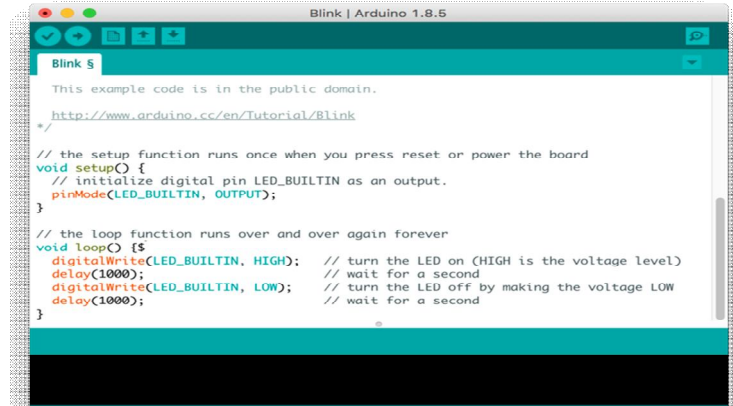


Fig. 1 A screenshot of Arduino IDE

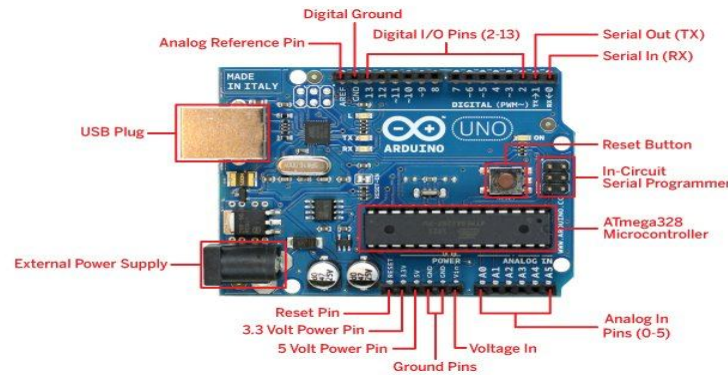


Fig. 2 Arduino UNO pin description

### B. GPS Module

We would be using a GPS receiver module to receive the GPS signal. The GPS (Global Positioning System) is an inter-network of satellites which is used in monitoring the location and other location information in all weather conditions. This GPS can be accessed by anyone using a GPS receiver module. GPS was developed by the United States government.

It was initially developed in 1973 by the USA government using 24 satellites to overcome the problems faced by the previous navigation systems.

The three parts of GPS are:

- Space segment
- Control segment
- User segment

The first two segments are controlled by the US Airforce while the third one (User Segment) can be accessed by anyone using a GPS receiver.

GPS tracking systems are widely used to locate the precise location of the vehicles, devices, or people perfectly. GPS tracking system consists of a GPS receiver to receive the signals from satellites. The GPS tracking system also calculates the direction in which a vehicle is going and the speed with which it is going. GPS tracking system can also store this data in its central database to improve future user experience and make the GPS using experience smooth.

GPS tracking systems can be classified into 2 types. A passive GPS tracking system which stores the data and logs regarding the journey in its internal storage or database. Another one is active GPS tracking system which can be much useful to the fleet vehicles as it involves real time tracking and the data is sent immediately to the company or the owner. The company or owner can track the live location of the fleet vehicles. Figures and tables must be centred in the column. Large figures and tables may

span across both columns. Any table or figure that takes up more than 1 column width must be positioned either at the top or at the bottom of the page.

### C. Transformer

Transformer is an electrical device which is used to transfer electric power from one circuit to other circuit without any change in frequency. This is mainly used to transfer AC electricity voltage from one level to another level. Transformers do not work with DC current. Transformers are classified into 2 types: Step-up transformer and Step-down transformer. Step up transformer is used to raise the voltage level of the AC current while step-down transformer is used to decrease the voltage level of AC current. Step-down transformer is widely used because, many times, the high AC voltage from mains need to be stepped down before reaching the electronic devices as they require very low voltage. Rectifier circuits are also used along with the step-down transformer for decreasing the voltage level and smoothening the supply to household devices.



Fig. 3 Electrical Transformer

### D. GSM Module

GSM module is also known as GPRS module is used to communicate between the mobile device and circuit we are performing on. The main component in this module is modem, it plays a major role in communication as it transmits and picks up the signal. GSM means global system for mobile communication, and it is a digital cellular communication system. It was created to set some standard protocols for 2G communication systems used in mobile devices, but it now has become the global standard, these standards are used in over 219 countries. It is made to offer quality services and features to customers which are not available in analog communication. Not only the digital transmission it also provides like global roaming in other GSM networks.



Fig. 4 GSM Module

Tables must be numbered using uppercase Roman numerals. Table captions must be centred and in 8 pt Regular font with Small Caps. Every word in a table caption must be capitalized except for short minor words as listed in Section III-B. Captions with table numbers must be placed before their associated tables, as shown in Table 1.

### E. Ultrasonic Sensor

Ultrasonic sensor works on the principle of the echo or simply works on the effect known as Doppler shift. These sensors generate a high frequency signal and transmit in the direction where the object is and receives the echo from the object, after this the sensor calculates the time taken by the echo to reach the sensor to determine the distance between the object and the sensor. This technology can be used in many applications like calculating the speed of the sound, these produce sound waves by converting the electrical energy to sound energy at the rate of 20khz, this is done with the help of the transducer.



Fig. 5 Ultrasonic sensor

**F. 12V DC Motor Pump**

In this project we use a 12v dc water motor to pump out the fuel from the tank as this is the prototype, we use water instead of fuel. When the switch is on with the help of the motor, it draws the water from the tank to outside, rather than using a tap we use motor here because it has the advantage of locking system.

It takes the command from GSM module, when the GSM sends out a low power signal the lockout system happens in the motor after that no matter how many times the push button is pressed the water does not come out. The DC motor gets the supply directly from center tapped transformer in the way we use diodes and capacitors to rectify the ac signal.

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Fig. 5 12V DC motor pump

**V. METHODOLOGY**

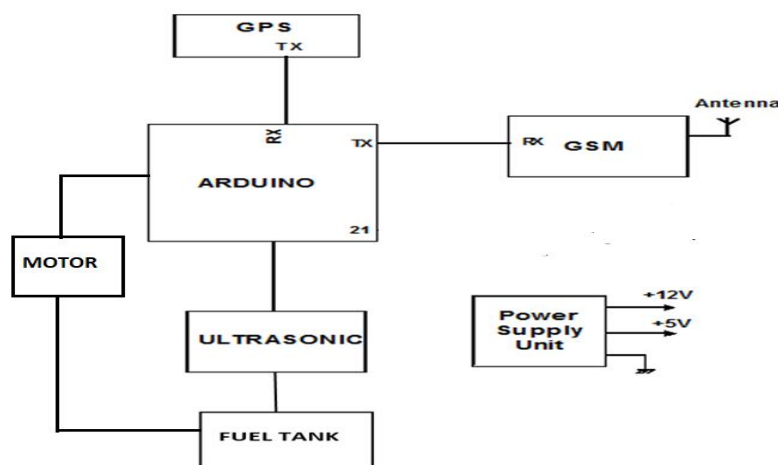


Fig. 6 Block diagram

In the above block diagram, we can see that several components are connected to the Arduino UNO which have various functionalities.

In detail, the block diagram of the project is analyzed as below:

- The ultrasonic sensor is connected to Arduino which is used to sense the level of fuel present in the fuel tank.
- GPS receiver module which is connected to Arduino tracks the location of the device constantly.
- A pump motor is connected to the Arduino and fuel tank which is used for the outflow of fuel from the tank when required.
- GSM module is triggered when there is a fuel level decrease sensed by ultrasonic sensor and communicates the message to the owner. The message contains the location of the vehicle and controls to lockout fuel tank using motor.
- This GSM module setup can take the order from the owner to activate the lockout system which turns off the motor pump and stops the pumping of fuel from tank to outside.
- A power supply is used to power the entire setup including Arduino and several other components. The power supply consists of transformer, rectifier circuit and other components which is used to ensure the safe and low-level DC supply to the components present in the project.

## VI. WORKING

In this project our main aim is to notify the owner whenever there is a theft happening and also let the owner to stop the theft by using a method known as lockout system, so to let the owner enjoy these qualities we are using different modules like GSM, GPS and also an ultrasonic sensor to measure the level of the fuel in the tank, the main component of the lockout system is DC 12V motor pump, with the help of output from the relay unit the motor knows whether to stop the flow or allow it.

After connecting all the components as per the circuit diagram, the whole control of the system lies in the Arduino code that is typed in C language, in that code we can control the level of ultrasonic to measure the level of fuel in tank.

GSM module also works based on the Arduino code; the message it has to send the registered mobile also lies in the code. We can change the mobile number to which message can be sent also resides in the Arduino code. With the help of GPS module GSM acquires the accurate location of the tank and sends the location along with the message.

We get the power supply from switch board, from which we get 230 AC volts, from this by using two center tapped transformers we send the reduced voltage to rectifier circuit. In rectifier circuit there are diodes through which rectification happens, but the rectified voltage has large ripples in it, to reduce the ripples in it we use a large capacitor, then after we use to limiting voltage IC'S IC 7812, IC7805 which limits the voltages to 12V, 5V from these voltages we connect them to sensor button, relay, GPS, GSM modules and Arduino.

Arduino takes 12V, Ultrasonic sensor takes 5V, the GPS, GSM modules takes 5V. After checking all the connections and giving correct power supplies to each component ON the power supply switch.

After getting the message from the GSM module, the owner sends a return message @GPS to the GSM module, Arduino reads the message and informs the GSM, GSM makes the Relay to OFF mode and sends the owner another message mentioning the tank is blocked or lockout has happened. Once the Relay is in OFF state the motor gets into OFF state therefore there will be no flow of water to outside, the owner along with the message gets the location included in it. Now no matter how many times the pushbutton is pressed the motor will never get into ON state because that is the lockout system.

To again use the motor the only way is to reset the Arduino, then only Arduino dismisses the lockout system once again all the actions can be performed. The level Ultrasonic sensor has to measure and the message the GSM has to send all can be changed in the Arduino code.

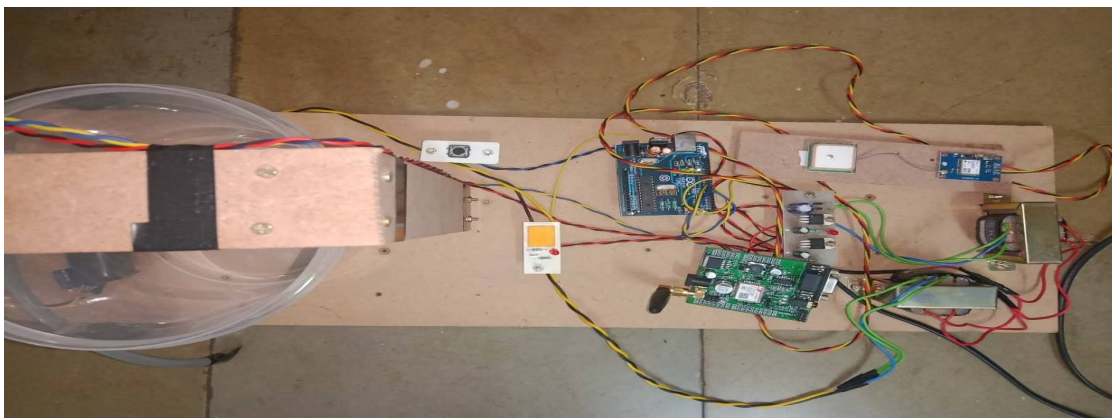


Fig. 7 Active setup of the project

## VII. RESULTS

Whenever we try to pump out the fuel from fuel tank using the motor pump, ultrasonic sensor was triggered, and GSM module sends information regarding the location (which was tracked using the GPS module) to the user's mobile. Then after if the user sends the return message to the GSM module lockout system happens.

We have tested all the possible scenarios of fuel theft in fuel tank, and our project worked successfully in every scenario. Lockout system too worked accurately and perfectly in every situation. Thus, this system can be implemented at macro scale in real life situations.

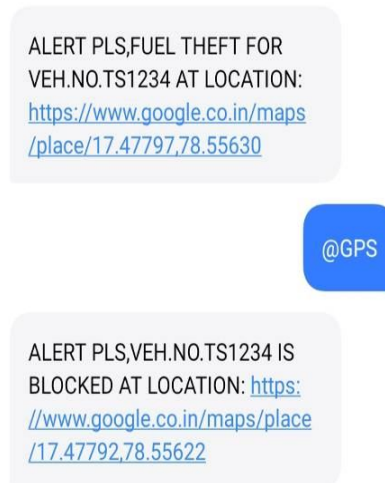


Fig. 8 SMS of theft detection sent to mobilephone

## VIII. CONCLUSION AND FUTURE ENHANCEMENTS

The system designed is a fully secure fuel theft detector and lockout of the system is done based on the message received from the authority. The GSM and GPS module used are thus required for sending the message wirelessly and location of the fuel vehicle, respectively. The ultrasonic sensor used senses the amount of fuel present in the fuel tank. The system is simple and cost effective for implementation and hence can be introduced into commercial markets with some more features and robust build.

In the future we can make changes to the project by adding a wi-fi module to upload the data hourly to the server, to store the statistics of fuel usage for further improvement of the system. We can also introduce a password based lockout system for fuel tanks which will make the process simpler.

## IX. ACKNOWLEDGEMENTS

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