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IoT based fuel level monitoring and fuel theft detection system

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Abstract

The project aims how the level of fuel can be monitored from a distant place and in case of theft can be detected easily from that place. For this, a level sensor will be needed which continuously will take the readings of the level of fuel at the tank (vehicle tank or any reservoir) and this level sensor will be connected to a microcontroller input.

The IoT implementation part is the level of the fuel can be continuously monitored by displaying it on a website using an ESP8266 NodeMCU.

Now to fulfil the second part i.e. to make it a fuel theft detection system there would be a threshold value of decreasing rate of the fuel level height. If the decreasing rate of fuel is greater than the threshold level an alarm will be sent to its owner in case of a vehicle tank or a buzzer will be on in case of industrial reservoir.

Keywords: IoT, Fuel, NodeMCU, Ultrasonic Sensor

Introduction

Nowadays the price of fuel is become a headache for daily life thus the number of fuel thieves are also increased day by day. Many times the case of stealing fuel illegally from the fuel tank of the bike are caught on street CCTV cameras. Because of this the fuel track drivers also feel a lack of safety during long way transmission and security at petrol pumps are must needed. Sometimes the vehicles are also harmed at the time of the crime. It's not a very easy task to stop this type of crime by applying any rules. This can be done only if the thieves can be caught at the time of the crime.

Methodology

At first, the level of the fuel is measured using an ultrasonic sensor. The level is displayed on an LCD screen for manual reading checking and the level thus measured is also displayed on a webpage using an ESP8266 NodeMCU.

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Now as the level of the fuel is continuously measured then the rate of decreasing of the level height of the fluid can also be detected. Now if the fluid level height decreasing rate when a vehicle is driven is not same like when the fuel is being stolen. The decreasing rate of fuel level height fluid while stealing must be higher. And in case of fuel track due to the motion of the track, the level height of the fuel can sometimes be higher or sometime be lower than the original. But there must be a threshold value of the rate of change of level height of fuel. If the rate is higher it can be taken as the fuel is stolen. So there must be a threshold value of the decreasing rate of fluid level height. Micro-controller can be programmed in a way if the changing rate of fluid level height is higher than the threshold value a buzzer connected with the microcontroller is on.

Block diagram

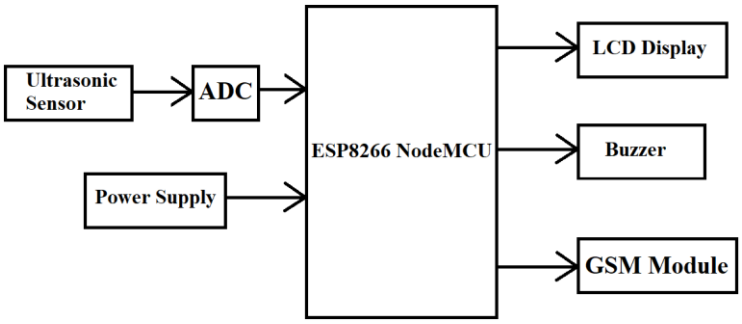

Figure 1: Block diagram of IOT based fuel level monitoring and fuel theft detection system

Working principle

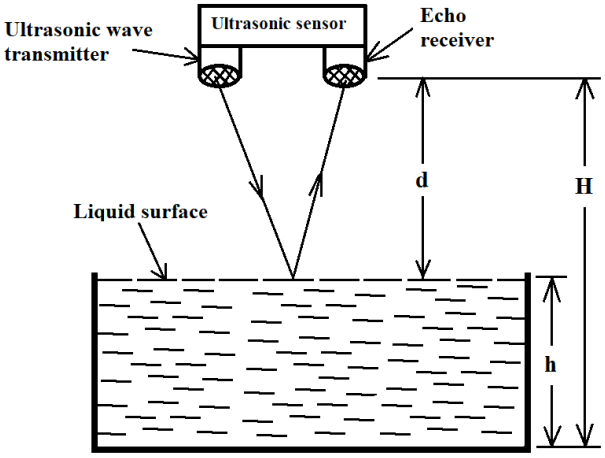

Figure 2: Working principle of ultrasonic sensor-based level measurement system

An ultrasonic wave transmitter is used in the ultrasonic sensor to send ultrasonic wave. Now after reflecting the reflected wave signal is received by the echo receiver of the

ultrasonic sensor. If the ultrasonic sensor is placed at a height of' from the fuel surface then the distance travelled by the ultrasonic wave from the transmitter to the receiver is = 2d. Now if the time to travel the distance is 't' sec then in S.I. unit

$$2 \times d = t \times 340 \qquad \text{_____ (i)}$$

[The speed of ultrasonic wave in air is 340 m/s]

$$\text{Or, } d = (1/2) \times t \times 340 \qquad \text{_____ (ii)}$$

Now if the distance of ultrasonic sensor from the bottom surface of fuel container is 'H' then the level of fuel 'h' can be determined as,

$$h = H - d \qquad \text{_____ (iii)}$$

This value of 'h' is continuously monitored by displaying it on a website using an ESP8266 NodeMCU.

Let at time 't1' and 't2' the level heights are 'h1' and 'h2'the rate of change in level can be given as

$$r = (h1 - h2) / (t1 - t2) \qquad \text{_____ (iv)}$$

Now when the fuel is stolen, the value of 'r' is high than at any other time. So a threshold value can be set if a the value of 'r' goes higher than that value a buzzer will be on and a message will be sent with the help of a GSM modem connected with the micro-controller.

In case of fuel track as the level never remains fixed due to motion of the track equation (iv) is become

$$r = |(h1 - h2)| / (t1 - t2) \qquad \text{_____ (v)}$$

While the track is to be emptied the system can be stopped manually.

Advantages

1. From a distant place, the level of fuel can be monitored.
2. If the fuel tank has any leakage that will also be detected.
3. As from a distant place the level of fuel can be monitored this is very useful for the chair-person of a fuel pump to know that if his property on the way is safe or not.
4. If continuous monitoring is not possible then and if in case of deletion of the message (sent in case of thief detection) then comparing the levels of fuel in the tank of fuel track before transportation and at the destination, it can be confirmed that if there is any imbalance or not.
5. Very easy to use.

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Disadvantages

1. Always continuous monitoring is not possible. As the conclusion is taken from the level of the fuel thus if after stealing different fluid of the same volume and the same colour is filled inside the tank it's very difficult to detect. When it will be detected it might be already late to take action.
2. Now if the thief is smart then keeping an opaque object below the ultrasonic sensor at the level of the fluid can clear the whole tank. However, this can be avoided by keeping the ultrasonic wave transmitter at the lower surface of the tank and placing the echo receiver at the upper surface of the tank just on the transmitter.

References

1. G. Bedi, G. K. Venayagamoorthy, R. Singh, R. R. Brooks and K. Wang, "Review of Internet of Things (IoT) in Electric Power and Energy Systems," in IEEE Internet of Things Journal, vol. 5, no. 2, pp. 847-870, April 2018.
2. S. Bera, S. Misra and A. V. Vasilakos, "Software-Defined Networking for Internet of Things: A Survey," in IEEE Internet of Things Journal, vol. 4, no. 6, pp. 1994-2008, Dec. 2017.
3. Naomi Somer Lepcha, Tshering Sangmo Sherpa, Jitendra Singh Tamang, "GSM Based Fuel Theft Detector Using Microcontroller", International Journal of Advance Electrical and Electronics Engineering (IJAEEE), ISSN (Print): 2278-8948, Volume-4 Issue-3, 2015
4. www.ibm.com