Design and Implementation of Fuel Oil Truck Monitoring System Using GPS, RFID, and Wireless

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Abstract. Based on the condition above, this research will be focusing on creating a monitoring system for a cargo tank truck using GPS (Global Positioning System), RFID (Radio Frequency Identification) and Wifi (Wireless LAN). This research is done in the laboratory of tech faculty majoring electronic of UNJ. The method that is going to use is the experiment method, which is designed and tested so that it will be implemented on the tool. There are GPS, ultrasonic sensor, micro controller Arduino Mega 2560, RFID reader, GSM1 modem and wifi module that are going to be implemented on fuel truck system, while on the server system, there will be computer and GSM2 modem. The input of microcontroller would be transferred latitude and longitude coordinate from the satellite through GPS, level data which coming from the ultrasonic sensor and the read tag RFID card system via RFID reader module. RFID tag card is used to identify the truck driver. The next step of this system is a micro controller that will process the data and send it to the server via wifi which will be saved in the database. The data sending through wifi module can be done as long as the wifi module and the computer is connected to wifi router network. The microcontroller could also send a location data of the fuel truck position by sending SMS to user’s hand phone through GSM1 if there is a request of sending location data from the user. Afterward, GSM1 modem will forward that message to GSM2 modem and the message could be saved. The program to monitor GPS data, fuel level and RFID in the server is using open source software, which is QT with C++ as its programming language. MySql is used as a database for data storage. The result of this research is that the server can monitor the truck tank location, fuel level, and truck driver's identity through wifi network or SMS. This system can also save those data into a database.

Keyword: GPS, Microcontroller, RFID, Wireless, SMS

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I. INTRODUCTION

Fuel distribution has a risk of deviation on its delivery. It can be seen when every time the government plan to increase the price of the fuel, the shortages of fuel’s availability happened in many areas. Although based on a report from Pertamina explained that every time the shortages of fuel occurs, the supply sent is always in the normal condition. From the case above shows that it is clear enough to see that there are some issues on its distribution. The cost deviation between subsidized fuel, the non-subsidized and the industry makes the fuel’s mafia who run the illegal business thrives.

All the time, the fuel's distribution from Pertamina to gas stations are using tankers which are managed by its business partner pointed by that company. The stealing of the subsidized fuel during its distribution to a gas station is normally done by reducing the supply, or it is well-known with the term of 'pee on the road', a sign by tanker's driver during his action of stealing.

The driver after loading the fuel, will not go directly to an intended gas station but will park his truck hidden somewhere. In that place, the driver and his partner remove some fuel to a prepared drum using a hose after they unseal the seal.

The gas station will definitely be having aggrieved with this action as the amount of supply they get is not an exact anymore. It is reported that in one month, the aggrieved of these gas stations have reached up to 3,600 liters or equal with 16.2 million.

The stealing action by these tankers’ driver happens almost every day and it already becomes a common secret. This fuel’s reduction can be avoided if there is a system to check whether the amount of fuel in a tanker coming from Pertamina is as the same as its amount or not when it is taken out in a gas station. Unfortunately, this process is relatively difficult to measure. Although there is an information checked on a fuel tank that shows the capacity of the amount of the fuel, but there is also an information saying that a tank is not a measuring tool.

There are some ways to approach this problem by measuring the height of fuel in a tank to guess the total amount of the fuel. But because the size of tanks is different, this approach will have its difficulty.

By using height sensor of the fuel, the different size of tanks will not go to be an issue anymore and the volume of the fuel in that tank can be measured. By using GPS, the road path of tankers could also be monitored. GPS (Global Positioning System) is a coordinated global system that able to point the coordinate position (latitude, longitude or the height) of an object on the earth.

The GPS will make sure that the tanker’s driver can’t steal the fuel in somewhere hidden any longer as his position is detected automatically by GPS. There are many tankers used to distribute the fuels safely to the gas stations, therefore the technology that able to identify each of them is needed. By using RFID (Radio Frequency Identification) technology, the identity of tanker’s driver can be known easily.

Sending data position of tankers, fuel’s volume and driver’s identity can be done by sending SMS or via wifi. Based on the facts mentioned above, this research will make a system that can monitor the tanker's position, fuels' height level in the tank and the identity of the driver through GPS, RFID, SMS, and wifi.

there is module of ultrasonic, microcontroller, GPS, RFID reader, GSM1 modem and wifi on the tanker's system, while computer and GSM2 modem are put on the server. The microcontroller is used as the system controller. The type of microcontroller used is Arduino Mega2560. Input used as a signal input to the micro controller are data coming from the ultrasonic sensor module, RFID, and GPS.

The ultrasonic sensor module is used to detect the height level of fuel in the tank. RFID reader module is to read the RFID tag card carried by tanker's driver. GPS Module is used to identify the position of the tanker by receiving latitude and longitude data from a satellite. GSM module is used to receive/sending SMS.

The microcontroller will keep sending those 3 data (level data, RFID, and GPS) through wifi module as long as wifi module and computer are connected to wifi router network. By request, a micro controller could also send the position location data of tankers to user's phone by sending it via SMS through GSM1 modem.

The process of that request is by sending SMS to GSM modem 1 so that the coordinate position data of the tankers can be located anywhere.

In the server system, a computer is used to display the visual coordinate data of tanker’s position, fuels level data and RFID tag real time card data also can save those data in the database for a while.
by sending them via wifi module or by SMS coming from GSM1 modem to GSM2 modem.

**Hardware**
Hardware used in this research consists of Arduino mega2560 module, ultrasonic sensor, RFID reader, GPS, GSM modem, TTL Logic Level Converter, Max232 module and wifi module. The Arduino module connection can be seen in table 1 while hardware design scheme can be seen in picture3. The use of TTL logic level converter module is as a bridge to convert the voltage of 3.3v to 5v from wifi module to Arduino, while Max232 module is used as a converter from TTL to RS232 so that the Arduino is able to communicate with GSM1 module.

**Software**
Software used for the monitoring system of tankers in computer server is QT Creator. QT program is an open source software that used in several operating systems (Linux, Windows, and Mac), where one of its frameworks is able to make an application using C++ programming. Database program used in this research is MySql, which is contained in Xampp program. Xampp program is a compilation of several programs Apache, MySql, PHP, and Pearl.

**II. RESULT AND STUDY**
Testing program done in this research consists of 3 parts which are program to send the data via Wifi, receiving/sending SMS and monitoring system and database

**Testing of Sending Data via Wifi**
Wifi program is tested to know whether microcontroller is able to send GPS data, RFID, and level data through Wifi network or not. The result of this program can be seen in picture 4. Three data are successfully sent to a computer server. GPS data that have been captured are only latitude and longitude with data format $GPGGA$, which are 0615.1297, S and 10700.2889, E. RFID tag data read is &fb&08&65&03 while number 51 is the result of level BBM reading through the ultrasonic sensor.

**Testing of Receiving and Sending data SMS via GSM Modem**
Receiving/sending SMS can be done by using AT-Command. Command used to send SMS is AT+CMGS=xxx while to receive SMS is AT+CMGR=xxx. XXX letters is a phone number used for the test. SMS result to user’s phone
SMS testing is done by sending the message “lokasi” to the phone number which put on GSM1 modem. Afterward, GSM1 modem will resend the message to user's number contain the address of coordinate data on Google Map. After SMS data is received in user's phone, the coordinate address of tanker's position should be copied first to web browser before Google Map look for that points. The search result of coordinate location via Google Map

**Testing of Monitoring system**
QT program is tested to know if a computer is able to monitor and to save GPS data, level data and RFID via wifi and SMS. The result of QT program for data monitoring can be seen on picture 7, while data storage result in the database.

**III. CONCLUSION**
1. The microcontroller used as a system controller is able to work perfectly to monitor the position of tankers, fuel’s level, and driver's identity.
2. Input signal used as a micro controller are latitude and longitude data coming from GPS, RFID tag card and level data coming from ultrasonic sensor module and the message received by GSM1.
3. Output signal used as a micro controller are GPS data sending, level data, and RFID to a computer server via wireless LAN module (wifi). Data sending through wifi module can be done as long as wifi module and computer are connected to wifi router network. In addition, the output signal of the microcontroller can also send a message to user’s phone and GSM2 modem via GSM1 modem with its message concludes the coordinate data of tanker’s location.
4. RFID technology can be used as an identifier of driver’s identity by reading RFID tag card with 4 cm of the maximum distance.
5. QT Program can be used to display GPS data, level data and RFID sending via Wifi module or GSM2 module on the server. This program can also be used to save data into the database using MySql.
6. The ultrasonic sensor module can be used to detect fuel's level based on the time difference of the emission and to receive the ultrasonic wave which is then processed by a micro controller as the measured level.

**REFERENCES**
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