FUEL MONITORING SYSTEM FOR FUEL MANAGEMENT

Mr.Senthil kumar.R[1],Ganapathi.M[2], Arunkumar.D[3], Goutham.G[4],Karthick.M[5],

[1]Associate Professor,
[2, 3, 4,5]UG Students
Department of Mechanical Engineering
Muthayammal Engineering College, Rasipuram, Namakkal, Tamilnadu, India.

Abstract

The focus of the work is in line towards the future development of automobile system, wherein vehicles will be operated with Global Positioning System. We developed a system to find the factor for fuel consuming with on-time reading in the monitor and also this system suggests the driver to use the fuel optimally by regulating the speed of vehicle. Two separate petrol engines are used for the analyses. One engine is placed with two-wheeler and another with a four-wheeler. This work of Fuel Monitoring System is an initial step for better fuel management and also becomes the scope of our work. The data collection with sensors and also by implementing the micro controller is done at different speed range and also with different load condition. Based on the inference from the collected data suggestions are made for better utilization of the fuel. Equation has been developed between the economic factor and its influencing factors like load and speed. In future we hope that this engine performance monitoring will be highly helpful for automation.

Key words: **Fuel consumption, sensors, Micro controller, Monitor.**

1 INTROUCTION

Mr.Aher S.S et.al., [1]made an attempt to make fuel monitoring and vehicle tracking system by implementing a microcontroller. MSP430F149 microcontroller is employed for the system. Also GPS technology is utilized to track the vehicle. Yen-Jen Chen et.,al [2] developed a fuel consumption monitoring using FMS, which has front end Vehicle Tracking System (VTS) and the back end Management Server (MS). VTS was established and installed into the vehicles, based on several well-known technologies, such as Mobile Telecommunications Technology of GPRS or 3G, Global Positioning System (GPS), and On-Board Diagnostics II (OBD-II). In addition,
VTS was also connected with the Vehicle Electronic Control Unit (VECU) through the OBD-II inter-face.Nitesh.K.A [3] et.,al came out with the design and implementation of digital fuel gauge which measures the accurate level of fuel adding,
by fixing the pressure sensor below the
Fuel tank, at any point of time it will continuously measures the level of fuel with the help of processor and displays the value in the digital numeric form in the display unit. Hence, the measured values and location of fuel added is sent to the owner mobile through GPS and GSM and vehicle owner is aware of the fuel consumption through SMS services. In 2014 Nitin Jade et.al., [5] developed "modified type intelligent digital fuel indicator system" and achieved an accuracy level of 95% -98% in measuring the fuel digitally. In January 2014 Vinay Divakar [6] developed "Fuel gauge sensing technologies for automotive applications" and achieved a smart fuel gauge system. In April 2013 Jaimon chacko Varghese et.al., [7] developed "Low cost intelligent real time fuel mileage indicator for motorbikes" and measured the probable distance that can be travelled by the vehicle corresponding to the amount of fuel in the fuel tank can also be estimated. In 2012 Deep gupta et. Al., [8] Brajesh Kr. Singh and Kuldeep panwar of H.M.R. institute of technology and management developed "A prototyping model for fuel level detector and

optimizer" and achieved the measurement of fuel so the accuracy level was 96.36% -98%.

2 PROBLEM IDENTIFICATION

2.1 Scheduled fuel filling

Even a regular vehicle user, do not know as when to fill the fuel for the vehicle as and because one use to fill it by weekly or daily basis. And now particularly for a new person it becomes a difficult task to identify the level of fuel. So it becomes a customary problem for a long traveller. Here an experimental work has been carried out to suggest a equation to predict the time of filling based on the 'distance basis'.

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2.2 Fuel Theft

Almost all of the public have their own vehicle. Now-a-days fuel theft is happening in the parking and vehicle security becomes a challenging thing. In practice by today no record of data is being maintained for fuel filled and its consumption value. To overcome this challenging problem a fuel monitoring system is being implemented. This task is being carried out by the use of embedded system based on Global System along with mobile communication technology. A system has been developed in which if fuel theft occurs, the system reports automatically via GSM module by sending SMS message to owner/driver of the vehicle.

2.3 Automation of transport documentary

Presently transport documentary such as writing the amount of fuel filled and how much fuel left after the trip is registered in written form. It is a manual work and also a day to day process wherein it becomes a fatigue work for the owner. Moreover, this has to be done by continuous monitoring and also it will take time for managing of document, also it takes space and need maintenance too. So a need for automation of this work is needed for simple and easy maintenance by converting the manual work into digital.

2.4 Economic use of fuel

While driving with normal speed the driver knows the amount of fuel remaining but he doesn't know how much distance can be travelled with the remaining fuel. By implementing the fuel consumption system it will provide the driver with the information about things like the time to fill the vehicle with fuel and also provide with an idea about the estimated distance to which the vehicle can travel with the available amount of fuel.

3 METHODOLOGIES ADOPTED

In future autonomous car will replace the self-driving to a major extend, which is going to be a great revolution in the automobile industry. In this autonomous work, driver will be replaced with a computer system, the vehicle has to be equipped with many facilities which includes things like engine monitoring, GPS, Road safety system. In this project work is being carried out in the area of engine monitoring. The engine monitoring system is a cumbersome process and it depends on Engine condition and the value of fuel consumption. Again the engine performance is constrained by many factors like speed of the vehicle, load, engine temperature, exhaust system, carburettor and air-fuel mixture etc.

Fuel Consumption challenges: The challenges of successful monitoring involve efficient and specific design, and a commitment to the implementation of the monitoring project, from data collection to reporting results. Fleet tracing is used to identify, maintain and locate the vehicle with the help of GPS technology.

Currently there is no on-time monitoring for fuel consumption in vehicle. At present, we have facilities like showing the amount of fuel present in the tank and the speed of the vehicle and driver don't know how much distance can be travelled with the fuel present. They are just assuming the consumption of how much fuel present and

the distance travelled by the vehicle. This will reduce the efficiency and performance.

Fuel monitoring or fuel management:

Fuel monitoring refers to the monitoring of fuel consumption, theft, refilling of fuel tankers etc. A fuel management system is essential in the market owing to the increasing cases of corruption in fuel transportation. This system can also provide great relief for the people who wish to monitor the fuel consumption in their company's fleet and to check any fuel theft by their drivers.

Need for FMS system: The need for the Fuel management system is the rising of fuel costs. It challenges the fleet operators to maintain the movement of vehicles and monitor the driver behaviour to avoid delaying traffic conditions. Implementing real time vehicle tracking is essential for comprehensive operational control, remote driver security and fuel savings.

4 METHODOLOGY

Initially the problems are collected from the peoples and the target set towards the automation in the vehicle. The solution can be done with the electronic device. The device designing is the second process.

To selecting the components for the particular requirement .The selected components are arranged with the particular place with the interfacing of microcontroller.

The devices are alternatives for the standard devices so the new devices must calibrate with the standard device. The testing can be doing for the calibration. After that the testing is processed.

5COMPONENTS

- Proximity sensor- for speed measurement
- Ultrasonic sensor-for fuel level sensing:
- Arduino- used as microcontroller
- Crystal Display- Monitor

Fig.2. Developed kit enclosed in a cover

Proximity sensor: The sensor act as a switch which works with the principle of whenever the material crosses the sensor it will go to on condition and while the metal is eliminated the reverse will occur. The counting by the microcontroller switching considered and provided. Repetition in switching time can be calculated by the ECU and then it is converted to the RPM.

SPECIFICATION:

SD1002–1004 Speed and Direction Sensor

- Separate Digital Outputs for Speed and Direction High-Speed Capability Operate From 5 to 24Vdc.
- Reverse Battery Protection to -24Vdc
- Wide Operating and Storage Temperate Ranges.

Ultrasonic sensor: ultrasonic sensor is used for the level sensing. That is fixed at the top of the fuel container which at empty stage gives the height of the container. The volume of the container is already known.

The fuel level of the container is to be calculated by making a simple graph between height v_s volume by applying differentiation equations. The sensor gives the reading of fuel level according to the height of the fuel which is in respect to empty stage.

Microcontroller (**Arduino):** Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments.

Features of the Arduino UNO:

- Microcontroller: ATmega328
- Operating Voltage: 5V
- Input Voltage (recommended): 7-12V
- Input Voltage (limits): 6-20V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 6
- DC Current per I/O Pin: 40 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB of which 0.5 KB used by boot loader
- SRAM: 2 KB (ATmega328)
- EEPROM: 1 KB (ATmega328)
- Clock Speed: 16 MHz

6ASSEMBLY AND EXPERIMENT

To make the device being planned for the design that can be shows the physical model of the testing element. In this planning diagram have the Engine and fuel level indicator and speed measuring device and the microcontroller. The CAD diagram is shown in the fig. 1.

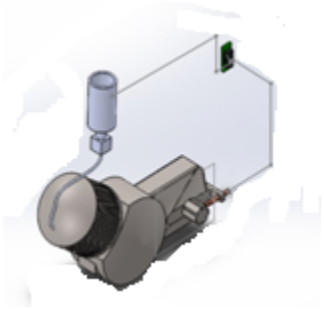


Fig. 1: Orthogonal view of developed set up with components

Fig. 2: Assembled view of developed set up with components

The speed sensor is attached with the wheel with safety grill of the vehicle's rear wheel. The proximity sensor has to detecting the magnetic pulse of the metal. So the metal is mounting with the wheel rim by using special joint. The kit can be make the circumference with the shape of the wheel rim. The proximity sensor which is mounted at the grill of the rear wheel with the position at tangential to the metal and it is placed at the line of the circumference.

The readings are noted which includes speed, load (on-load, and off-load condition), amount of fuel present. For this the measuring devices have to be fitted in the vehicle at appropriate position.

In the microcontroller it is assigned with two algorithms.

- Algorithm A – runs as measuring device.
- Algorithm B- runs as device.

For measuring readings it follows Algorithm A which has individual commands for measuring speed and fuel level sensing.

To measure speed, Magnetic proximity sensor work as a counter. It counts the number of rotations of wheel. i.e. number of rotations that is sensed by the sensor. This counting interacts with the time and then it converted into revolution per minute (RPM).

$$\text{RPM}=\frac{\textbf{NUMBER OF PULSE GENERATED BY SENSOR}}{\boldsymbol{ONEMINUTE}}$$

To find the speed of the vehicle,

$$\mathbf{V= r*w}$$

$$\mathbf{V=}\frac{\boldsymbol{2\pi N}}{\boldsymbol{60}}\ \mathbf{m/s}$$

Finally the speed results come in the display as km/hr.

Fig. 3: Assembled view of developed set up fitted in the vehicle

To measure the fuel level ultrasonic sensor is used. It is operating with sound frequency. This sensor is fitted at the top of the tank. The fuel level is sensed with respect to the height of the fuel level in the tank. The ultrasonic sensor has a transmitter and a receiver. The transmitter sends an echo pulse at a certain time. This pulse reflects back towards the receiver and it collects the pulse. The interface calculates the time duration between the transmission of pulse and receiving. This time duration for the pulse detection is the factor for finding the fuel level, because liquids also reflect the echo pulse and it doesn't observe or attract these pulses.

$$\text{Distance} = \frac{\boldsymbol{TIME\ X\ SPEED\ OF\ ECHO\ PULSE}}{\mathbf{2}}$$

7 EXPERIMENTATION

This is the region where we experimented. In this experiment has following two categories such as

- **NO LOAD TEST**
- **ON LOAD TEST**

No load test: In this test, vehicle is in standing condition. Then we start the vehicle and run it for a specific time period. At this we are collecting the readings of RPM and fuel level by the sensor we fitted at various speed. The no-load test is done with 15 minute fuel consumption. Initially a certain amount of fuel is poured in the device fitted tank. For every fifteen minutes the vehicle is operated at different speed limit and we are taking the amount of fuel remained in the tank and it has to be noted along with the speed. The readings are noted in a data sheet.

By solving the above values to get consumption factor respect to total economy of vehicle

$$\textbf{Economy factor=}\frac{\boldsymbol{milage\ at\ different\ speed(according\ by\ reading)}}{\boldsymbol{maximum\ milage\ of\ engine(assume\frac{70km}{h})}}$$

SPEED LIMIT (Km/h)	0-10	10-20	20-30	30-40	40-50
ECONOMY FACTOR (ON LOAD)	0.84	0.87	0.92	0.95	0.97
ECONOMY FACTOR (NO LOAD)	0.86	0.89	0.94	0.97	0.99

On load test: In this test, we are running the vehicle with load as single person which is taken as live-time reading. At this we are collecting the data such as speed and Fuel remaining in the tank. The vehicle with an average speed for a particular distance. After

driving the remaining fuel is noted. The process is repeated for different speeds for certain distance noted values are written in the data sheet.

The calculated readings are noted in a data sheet. By using these data we are making a calculation and converted into algorithm. This algorithm is called as Fuel economy algorithm. Already we calculated the fuel level algorithm and speed algorithm. These three algorithms are interconnected with each other and it is converted to Algorithm-B. This final algorithm B is uploaded in the microcontroller. A crystal display is connected with the microcontroller. Finally, frame work is done for attaching the device to the proper location of vehicle.

Calculation for applying the factor with the device,

$$\frac{KA}{1000} = \frac{D}{R}$$

K=Economy factor

A=Maximum economy of the engine (Take 70Km/litre)

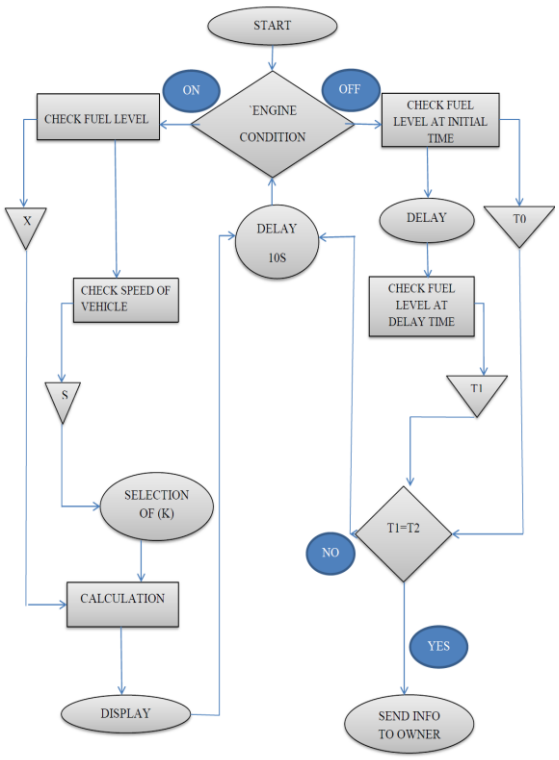
D=Remaining distance can be run (Required value)

R=Remaining fuel in the tank

8 ALGORITHM

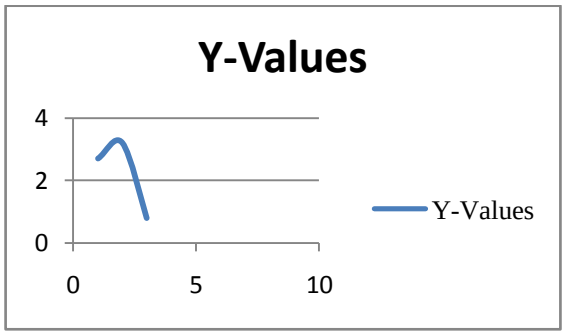
When engine is at on condition, two things will be checked. One is fuel level and the other one is speed of the vehicle. While checking readings and economic factor is calculated. By using these two calculations the output will be attained.

When engine is at off condition fuel level is checked twice at certain interval of time. If there is any difference with the fuels, we may know that fuel leaking or fuel theft is happened.



9 RESULT

The result of the analysis is to find the economy factor and apply the factor with respect to speed of vehicle and two kinds of loads, the results are tabulated and difference can be indicated by the graph.



10 SCOPE OF FURTHER WORK

In future development the data are stored with the big data so it can be easily accessible for every user, so the artificial intelligent can operate every vehicle without the human support. The work can be extended in this aspect.

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