© 2017 IJSRST | Volume 3 | Issue 1 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X
Themed Section: Science and Technology

Digital Fuel Measuring System with Distance to Zero and Fuel Fraud Indicator

Ch. Mani Kumar, Dr.R.B. Choudary
Sasi Institute of Technology and Engineering, Tadepalligudem, Andhra Pradesh, India

ABSTRACT

Most of the automobiles use analog fuel gauge or digital fuel indicator which indicates level of fuel available in tank. Here user is unable to correctly estimate kilometres s/he can travel with the remaining fuel due to inaccurate information. Some fuel filling stations fraudulently fill less fuel by tampering their meters. This necessitates an advanced digital measuring system incorporated in the vehicle itself. The modified digital fuel measuring system presented in this paper addresses two issues: 1) indicating kilometres the vehicle can travel with existing fuel in tank and 2) independently measuring the fuel filled in the filling station. These features empower the user.
Keywords: PIC micro controller with A/D converter, fuel indicator, fuel fraud indicator

I. INTRODUCTION

A fuel level detector is fixed in a fuel tank to measure the level of the fuel. Fuel gauges are available in a number of varieties and many of these gauges have flaws that can make the readings less accurate. Most of the automobiles use analog fuel level indicators which indicate fuel in three states: Empty, Half and Full. Thus, user does not get actual quantity of fuel available in fuel tank of the bike. Even if the existing gauge is more accurate, the user (one who rented the vehicle) may not be aware how large the tank is and will not be able to estimate distance s/he could travel.

Due to insufficient knowledge of fuel present in the tank, s/he may undergo trouble due to emptying of tank. This necessitates an advanced fuel measuring system that shows the exact quantity of fuel available digitally but not level of fuel. First generation digital fuel meters show fuel level with a bar or deflecting needle. But actual fuel present in fuel tank of the bike is not shown in digits. So, the user does not get an idea about the actual fuel available.

Most of the fuel filling stations are using digital dispensers which display the quantity and value of fuel added. But some bunk owners tamper their meters and fill less fuel. As no digital measuring system is present in the bike, the customer can't cross check the quantity of fuel filled.

Avinashkumar et al. (2014) developed a digital fuel indicator using PIC microcontroller which also indicates distance to zero [1]. They measured the changes in voltage at different fuel levels and computed distance to zero by considering a fixed mileage.

Jade et al. (2014) designed a fuel gauging system consisting of sensor, computer (ECU + CPU + modulator) and indicator [2]. A number of sensors are placed in separate places to receive information on measurable factors influencing mileage. ECU receives information from each individual sensor. The CPU collects data from ECU and processes it, then sends to modulator which modulates the signals and displays on the indicator. As more number of sensors were used, the system was expensive and suitable only for luxury vehicles. It is not suitable for low and medium class vehicles. Thus, it increases the cost of the luxury vehicle and failure of any sensor can stop working of the system.

Wable et al. (2016) developed a system using PIC 16F877A micro controller [3]. It shows the amount of fuel present in the fuel tank digitally, accurately up to 0.5 l. It also has a provision to send text message to owner of bike and alarms the owner by raising a buzzer. It also indicates current gear.

Nitesh and Lohit (2015) designed a digital fuel gauge which ensures the accurate level of fuel added during

fuel filling [4]. They fixed a pressure sensor below the fuel tank. This system also has seat belt warning system and records the relevant details about a vehicle such as engine temperature and detects alcohol content consumed by the driver with the help of alcohol sensor. Temperature and collision sensors were also provided to detect the accident.

Vijayapriya and Devi (2014) used a proximity sensor to determine the mileage of the vehicle (petrol consumption between the successive levels of Light Dependant Resistor, LDR arrangement) by calculating the number of rotations of the wheel [5]. They fitted a LDR arrangement by the side of the tank to determine the petrol level. They have also used a pH meter for measuring the quality of petrol. The meter fitted externally on the modified setup of tank determines the quantity of petrol in the tank.

Wang et al. (2009) proposed a novel image-based measuring system for measuring fuel level in tanks [6]. Many other researchers have worked on digital fuel measuring systems [7-11]. Some attempted to increase their usefulness by incorporating additional features.

The current paper proposes a digital fuel measuring system with distance to zero indicator and fraud detection in fuel filling stations. This paper is organized as follows. Section 2 introduces the materials and methods and results are given in section 3. Conclusions are presented in section 4.

II. METHODS AND MATERIAL

2.1 Components

Fuel Tank and Float

Cylindrical float was fixed at bottom lower part of the fuel tank of a 150cc motor cycle, Hero Honda Glamour (fuel tank with a capacity of 14 l).

Battery

12 V and 7 A battery was used.
A/D Converter
It converts analogue signal to digital signal.
Microcontroller
8 pin (DIL) version of the 12F675 and PIC16F877A was used.
LCD
2 line * 16-character LCD was used.

2.2 Working

The measuring system, shown in Fig. 1, uses a cylindrical float, A/D convertor, PIC microcontroller and LCD. The float was located inside the fuel tank and floats on fuel surface. An appropriate size of the circular float and location were chosen in accordance with the dimension of the fuel tank to obtain better measuring performance. Due to variation in the fuel level, change in resistance occurs in float circuit. The variation in resistance changes the voltage by very small amount. A digital converter receives analogue information and converts to digital form. The total setup was programmed in the microcontroller and the mileage (for Hero Honda Glamour) was considered as 50kmpl. LCD shows the exact quantity of fuel in the tank. This measuring system measures distance to zero with existing fuel in the tank and detects fuel fraud in fuel filling stations. The Schematic diagram is shown in Fig. 2.

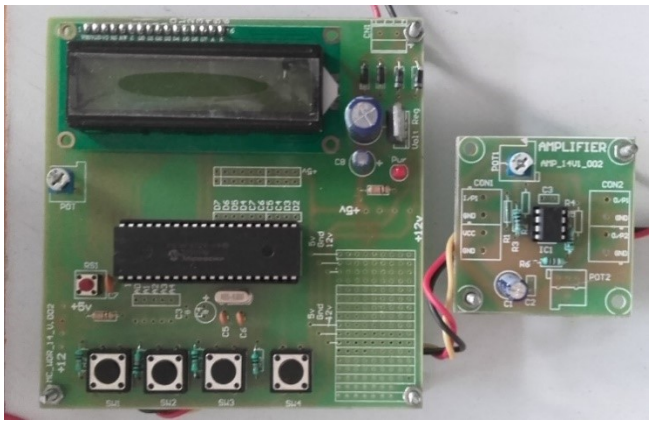

Figure 1. A view of fuel measuring system

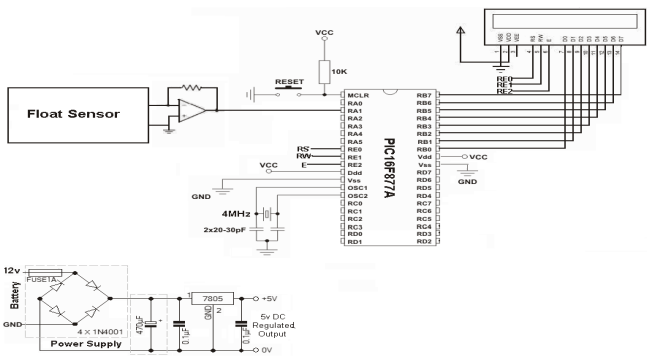

Figure 2. Schematic Diagram

When ignition key was turned on, the fuel indicator (Fig. 3) displays the quantity of fuel and the corresponding distance to zero on LCD.

Figure 3. Indication of fuel available and distance to zero when ignition is turned on

This device has two buttons. Before filling the fuel, press and hold the first button. The LED flashes "Measuring". Now release the first button and fill the tank. Once the tank is filled, press second button. The meter shows the quantity of fuel recently filled (Fig. 4).

Figure 4. Indication of recently filled fuel

2.3 Methods

First of all, the accuracy of the trip meter fitted on the bike was verified by making trial runs in the running track in the college ground. One litre petrol was poured in the tank 35 times using measuring jar and the readings were tabulated in Table 1. Error analysis was performed. It is well known that the actual mileage depends on speed and load of the vehicle besides many other factors. In order to determine the accurate value of distance to zero with corresponding fuel, trial runs were conducted with different loads (single, double and triple persons). Subsequently trials are made at these loads with different speeds. The results obtained are shown in Table 2.

In order to measure the likely fraud in petrol bunks, metered quantities of fuel was filled from a selected petrol bunk and the same was cross checked with our instrument. The petrol bunk readings and our instrument readings are shown in Table 3.

III. RESULTS AND DISCUSSION

Analysis of experimental data

The statistical values of the exponential data are calculated as shown below:

Mean (X)= 1/N

$$\sum_{i=1}^{N}(x1 + x2 + X3 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots Xn)$$

1/35(0.96+1.03+1.06+0.97+0.98+0.98+0.98+0.97+1.06 +1.02+1.04+0.99+1.07+1.01+1.05+1.02+1.00+0.99+0.9 6+0.98+0.99+1.04+1.06+1.04+1.06+1.02+0.99+0.98+1. 01+0.99+1.01+0.99+1.03) = 1.009l

Range = (Maximum – Minimum) = (1.06-0.96) = 0.1l

Avg. Deviation= $\frac{\Sigma\|\delta\|}{N}$= 0.949/35= 0.027 l

Standard Deviation (σ_x) = $\sqrt{(1/N-1)\sum_{i=1}^{N}(X \quad -x)^2}$

$\sqrt{(1/35-1)\sum_{i=1}^{N}(0.0346)}$ = 0.0319L

Variance ($\boldsymbol{\sigma^2}$) = $(0.0319)^2$ = 0.001L

Probable error = $\pm 0.6745\sigma_x = \pm 0.02$

Normal error distribution $\boldsymbol{P(x)} = \frac{1}{\sigma x\sqrt{2*3.14}} e^{-\delta^2/2\sigma^2}$ 1.96l.

With increase in load and decrease in speed, the mileage of the vehicle was found to decrease. So considering a fixed mileage leads to erroneous calculations. On the other hand, using elaborate sensors for detecting the current values of various input parameters and incorporating them in calculations will increase the cost of the equipment exponentially. So, it is proposed to develop a smart fuel measuring system which receives data from user regarding load, speed, etc. dynamically and calculates the distance to zero. An app will be developed through which the user can feed load, speed, road conditions, etc.

Table 1: Error analysis on Digital Fuel Meter (Trials 20-25)

S.No.	Fuel filled (l)	DDI Reading (l)	Error	% Error	Mean (X)	Deviation	Avg. Deviation	SD (σ_x)	Variance (σ^2)	Error Distribution $P(x)$
20	1	0.98	-0.02	-2	1.009	-0.02	0.000	0.004	2.47	0.98
21		0.99	-0.01	-1	1.009	-0.01	0.000	0.003	1.06	0.99
22		1.00	0.00	0	1.009	-0.00	0.000	0.001	2.38	1.00
23		0.99	-0.01	-1	1.009	-0.01	0.000	0.003	1.06	0.99
24		1.04	0.04	4	1.009	0.03	0.000	0.005	2.82	1.04
25		1.06	0.06	6	1.009	0.05	0.002	0.008	7.64	1.06

Table 2. Distance to zero at different speeds and loads

S.No.	Fuel in the tank (l)	Speed (km/h)	Actual distance travelled		
			With single rider	with two riders	With three riders
1	4.00	10.00	190.27	186.41	180.22
2	4.00	20.00	191.26	187.22	182.77
3	4.00	30.00	193.81	188.12	184.54
4	4.00	40.00	196.22	190.31	186.22
5	4.00	50.00	198.21	192.52	189.74
6	4.00	60.00	192.14	186.79.	181.19
7	4.00	70.00	189.24	181.29	176.56
8	4.00	80.00	185.22	179.14	171.36
9	4.00	90.00	184.19	175.31	167.33
10	4.00	100.00	180.32	171.33	160.24

Table 3: Fraud detection in fuel filling stations

S. No.	Fuel filled (l)	Digital fuel meter reading (l)	Fraud detected (ml)
1	1	1	0.00
2	2	1.92	0.08
3	3	2.89	0.11
4	4	3.97	0.03
5	5	4.94	0.06
6	6	5.96	0.04
7	7	6.93	0.07
8	8	7.86	0.14
9	9	8.91	0.09
10	10	9.94	0.06

IV. CONCLUSION

Digital fuel meter is developed for indicating distance to zero and fraud in fuel filling stations. This meter is more advantageous over analog meter. This meter continuously indicates distance to zero so that the rider would visit the nearest bunk before complete emptying of tank. Cheating by fuel filling station can be avoided as cross checking is possible. The mileage of the vehicle can be determined by consuming metered quantity of fuel.

V. REFERENCES

[1]. A. Avinashkumar, U. Singaravelan, T.V. Premkumar and K.Gnanaprakash, "Digital fuel level indicator in two-wheeler along with distance

to zero indicator", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), 11:80 84 Mar- Apr. 2014.

[2]. N.Jade, P.Shrimali, A.Patel, S.Gupta, "Modified type intelligent digital fuel indicator system", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684, p-ISSN: 2320-334X, PP 20-23

[3]. T.K. Wable, R.R. Shinde, "GSM based digital fuel meter and fuel theft detection using PIC microcontroller", International Journal of Advanced Research in Science, Engineering and Technology, Vol. 3, Issue 4, April 2016

[4]. K.Nitesh, B.N.Lohith, "Arduino based digital fuel gauge and vehicle monitoring system", Proceedings of 2nd ASAR International Conference, 2nd May-2015, Mysore, India, ISBN: 978-93-85465-06-2

[5]. V.S.Vijayapriya, R.Devi "Determination of adulteration and quantity of petrol in automobiles" International Journal of Students Research in Technology & Management Vol 2 (02), March-April 2014, ISSN 2321-2543, pp. 53-54

[6]. T.H. Wanga, M.C.Lua and C.C.Hsu, "Liquid-level measurement using a single digital camera", Measurement, 42(4): 2009, 604-610

[7]. G.Betta, A. Pietrosanto and A. Scaglione, "A digital liquid level transducer based on opticalfiber", IEEE Trans. Instrum. Meas., 45: 1996, 551-555

[8]. K.D. Dhande, S.R.Gogilwar, S.Yele and V. Gandhewar, "Fuel level measurement techniques: A systematic survey", International Journal of Research in Advent Technology, International Journal for Scientific Research & Development| Vol. 2, Issue 12, 2015 ISSN (online): 2321-0613

[9]. A.Kumar, S.K.Singh, "Digital fuel indicator in two wheelers", IJSRD - International Journal for Scientific Research & Development Vol. 2, Issue 12, 2015 ISSN (online): 2321-0613

[10]. K.A.Nitesh, B.N.Lohith, "Arduino based digital fuel gauge and vehicle monitoring system", Proceedings of 2nd ASAR International Conference, 2nd May-2015, Mysore, India, ISBN: 978-93-85465-06-2

[11]. D.Gupta, B.Kr.Singh and K.Panwar, "A prototyping model for fuel level detector and optimizer", African Journal of Basic & Applied Sciences 4 (6): 226-229, 2012 ISSN 2079-2034