Design and Development of Smart Fuel Management System

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Abstract- A voltmeter's core principle underpins the mechanical fuel functioning as a whole (voltage-measuring analogue meter). A potentiometer is all that is needed to detect voltage across the fuel gauge. However, the quantity of fuel available must somehow affect the resistance of the resistor. For this, a lever arm and slider with a floats at one side runs over a strips of resistor at other side within the gasoline tank. Changes in fuel level cause the floating to move vertically in relation to the resistor, resulting in a shift in voltage supply to the gauge. Finally, the indicating needle on the gauge shifts to the correct place in response. As a result, in the taxi industry, where drivers are forced to make do with limited resources, this initiative would be revolutionary. Moreover, it aids in the reduction of pollution. The smart fuel management technology might reduce gasoline usage by 10% to a maximum of 20%, according to our estimates.

I. INTRODUCTION

Managing one's budget has become increasingly difficult for the average person due to rising costs of fossil fuels such gasoline and diesel. Variations in driving style and road conditions also affect fuel economy, making budgeting for these costs more difficult. Although it promises an effective answer to the above-mentioned issues, this initiative is a double-edged sword.

By integrating software and sensors into vehicles, our initiative aims to bring about a shift in traditional fuel management systems, combining vehicle performance with congested traffic, road surfaces and driving behaviours. It aims to simplify the process of budgeting for fuel expenses. An analogue voltmeter serves as the basis for mechanical fuel operation (voltage-measuring analogue meter). Energy across it in a variable resistor is all that is needed for a gasoline gauge. As a result, a resistor that changes in terms of the amount of gasoline being used must exist. One lever arm and one slider runs across a piece of resistor inside the fuel tank to do this. Float movement causes the other side of the lever to slide over a resistor, resulting in a voltage change at the gauge. Finally, the gauge's indication needle adjusts to the correct position in response to this information. The taxi sector, which relies on low-wage workers, would undergo a seismic shift if this initiative were to be implemented. Moreover, it aids in the reduction of pollution. In our calculations, we believe the sophisticated fuel management system can assist reduce fuel use by 10% to 20%.

II. METHODOLOGY

The gasoline tank's fuel level is monitored by a fuel gauge, which is located on the tank and connected to the microcontroller. The fuel gauge indicates the variation in fuel quantity as the gasoline quantity varies. Electrical signals are generated from the mechanical signals and delivered to the microcontroller. An inputs to the system, it is one of the three types of input. In order to accurately measure the amount of fuel that enters the combustion chamber, a flow sensor is installed between the tank and the engine. As an input, an electrical signal is provided to the controller (Arduino uno) as just a measure of the fuel flow. Calculating an automobile's mileage requires using this precise fuel flow measurement. A speed sensors is used to determine the speed of an automobile. Electrical impulses are sent from the speed sensor to the microcontroller in order to compute the vehicle's speed. In this case, the input voltages are the gasoline level, flow, and speed. Wi-Fi is used to communicate these input signals from the

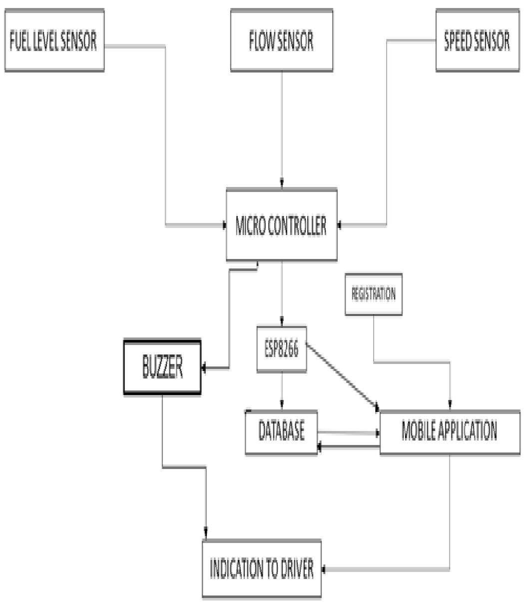

Figure.1: Block Diagram of Fuel Management System

microcontroller to the application database (ESP). In the programme, Google Firebase serves as a database. The Wi-Fi module connects the hardware prototype to the software. Applications' software is pre-loaded with all of the necessary formulas to generate accurate results. Everything that's required for an application database has been sent. The software picks up on the variables and performs computations in accordance with the formations programmed into it. Using the user's GPS, the application can also be used. The entire number of kilometers the vehicle should drive must be entered by the user. Because of this, the total number of inputs is Because of this, the total number of inputs is

1. Distance to travel

2. There is enough fuel in the tank.

3. The amount of gas used.

4. The rate of speed at which a vehicle travels.

Using all of these variables, the final results can be computed. When the speed of the vehicle changes, the calculations are also changed. As a result, the suggested speed and the amount of fuel required to go to the final location can be determined. According to the formulas and algorithms provided, these computations are carried out. The app displays the results of the calculations.

A. Fuel Level Sensing

In automobiles, a fuel level sensor (FLS) is used to indicate the amount of fuel the vehicle has left in the tank. There are numerous methods for determining the amount of fuel in a tank, including resistive film, discrete resistors, capacitive sensors, and ultrasonic ones. Resistive-based sensors are the most commonly employed for this purpose. These sensors are mechanically linked to a flow that rises or falls according to the level of fuel. As the water moves, so does the sensor's resistance. Typically, the fuel gauge display circuit consists of coils for the dispensing needle's action, and this sensor is part of that circuit. The needle's position changes in relation to the current flowing through the coil as the resistance of the fuel sensor changes. Figure shows a typical resistor-based FLS. Sliding contacts within sensor elements are a drawback of a resistive contact-based sensor, causing wear and tear on the sensor. The sense of well-being is diminished as a result of the accumulation of dirt and grime.

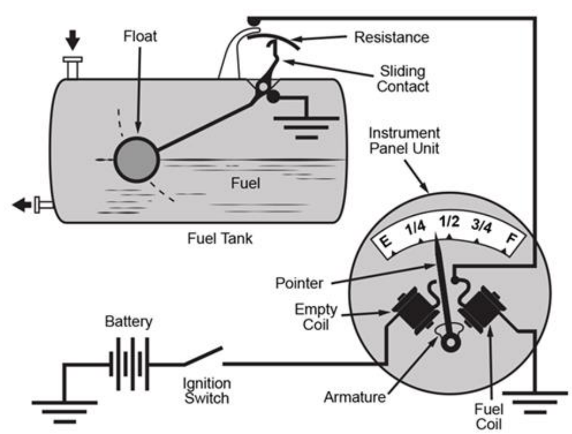

Figure.2: Typical Fuel Level Sensing Arrangement

B. Non-Contact Hall-Sensor-Based FLS

The magnetic field passing through the Is will be sensed by the Is's sensors. Diametric sensors must be installed so that their rotational movement is in direct correlation with the float's movement for fuel detecting applications. In addition, the sensor must be installed in close proximity to the motor to ensure proper operation. Retrofitting is easier with this method than with other non-contact sensor technologies. In order to prevent degrading inside the gasoline, the engine could be sealed. The sensor operation will not be affected even if the gasoline is contaminated. A variety of Hall Sensor ICs for FLS applications are available from Allegro, ranging in accuracy and linearity to output interface and cost.

C. Linear Analog HES for Digital FLS

An analogue output voltage proportional to magnetic field is provided by the programmable linear Hall-effect sensor 1377. The 1377 offers a ratio metric output voltage range of 4.5 to 5.5 V for input supply voltage. To power the 1377, connect it to the 5 V supply of the interfacing D's cluster. Figure below depicts a linear analogue Hall-effect sensor-based digital FLS. The 1377 has two-point magnetic field programming to adjust the OFFSET and sensitivity of the sensor. Users can now account for magnet, coil and manufacturing air gap tolerances.

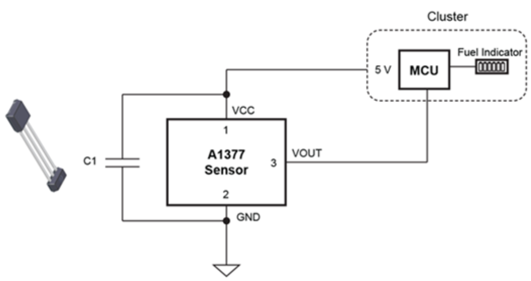

Figure.3: Linear Analog Hall-Effect Sensor-Based Digital FLS Using A137

The speed calculations are illustrated below, As we all know

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

Let us assume time(t) as 10 seconds, We are calculating and updating process parameters every 10 secondsLet us assume f = output from flow sensor (litre/sec)f x t = litres consumed by vehicle.

The following formula is used to calculate fuel consumption in litres / 100kms, the most commonly used measure of fuel consumption.

(Litres used X 100) ÷ distance = Litres per 100km. (L/100)Distance is calculated from speed sensor The below is a graph between L/100 and mileage(in miles per gallon) of BMW 740i car given by the manufacturer.

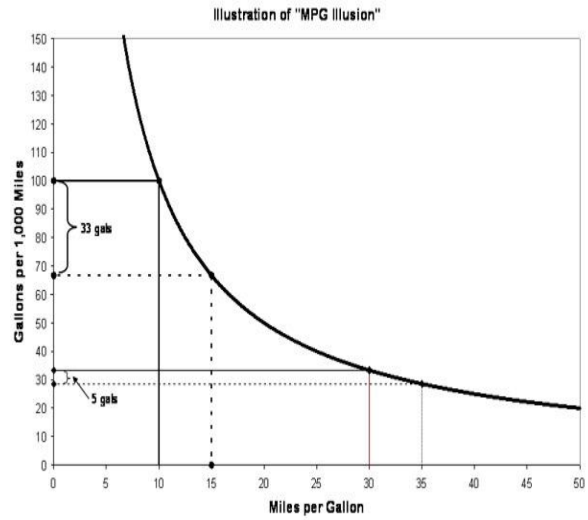

Figure.4: Illustration of Mileage

Using interpolation, any intermediate miles per gallon can be calculated

@ L/100 = 70, miles per gallon = 15
@ L/100 = 100, miles per gallon = 10
For L/100 = 80 , miles per gallon = (80-100)/(70-100) = (x-10)/(10-15)

Where x is the required intermediate mileage

If x<y, alarm is given to the driver, else there is no alarm

Where y= Output of fuel level sensor * Standard mileage of car.

III. RESULTS AND DISCUSSIONS

Our prototype shows how much fuel the engine uses at various speeds and in varied road conditions. We've created an Android app to make things a lot more user-friendly and straightforward. The following are the outcomes of our research. The amount of fuel utilised varies depending on the vehicle's speed. No two trips take the same amount of fuel. Monitoring the fuel tank level on a real time basis and generating pre-journey notifications Estimating traffic flow and the performance of vehicles.

The output voltage is shown as a linear function of float angle in the image below. The output voltage is proportional to the float angle movement over a range of 50 degrees. The A1377 linear sensors and magnet are shown on the gasoline sensor assembly in this figure.

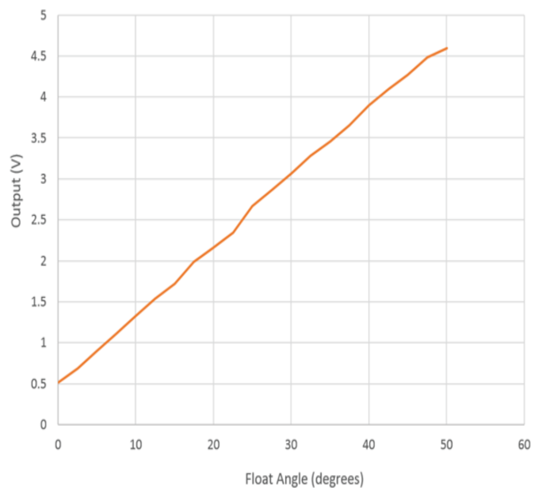

Figure.5: Float Angle vs. Output Voltage

IV. CONCLUSION

All things considered, our project's primary goal is to improve fuel management. Variations in driving patterns and other characteristics have been linked to changes in gasoline flow rate, which in turn affects fuel consumption and the cost of moving about. Our prototype demonstrates that even while driving the same car over the same terrain repeatedly, the fuel consumption will not be the same each time. Further, we believe that our study could serve as a foundation for future fuel efficiency innovations and be of enormous use to the automotive industry, which places a high priority on distance and cost.

V. FUTURE SCOPE

However, our project's goal is to revolutionize standard fuel management systems by connecting the vehicle's software and sensors, allowing us to link the vehicle's performance to real-time traffic, road surfaces conditions and driver habits. It seeks to make the process of calculating gasoline costs considerably easier.

• Incorporating the technology with AI

• Suggesting different routes to the user depending on their travel patterns

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