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Design & Development of A Digital Fuel Indicator for Two wheelers

Mahendra Kumara C [a], Bapu Gowda C M [b], Vishnu P [c],
a. Assistant Professor, Mechanical Enginering Department, B N M Institute of Technology
b. Assistant Professor, Mechanical Enginering Department, B N M Institute of Technology
c. Assistant Professor, Mechanical Enginering Department, B N M Institute of Technology

ABSTRACT

The amount of petrol that is still in a vehicle's fuel tank is shown digitally on a digital fuel indicator. Traditional gasoline gauges, which employ a mechanical float coupled to a resistor, have been superseded by this technology. For precise real-time fuel level display, digital fuel indicators often include sensors, microprocessors, and LCD panels. The gadget is housed in the vehicle's dashboard and is powered by the battery. The fuel tank's sensors continuously check the fuel level and alert the CPU with their findings. The fuel level is then calculated by the microprocessor and shown on the LCD panel in litres or gallons. Accuracy is one of a digital fuel indicator's primary benefits. Digital fuel indications offer an exact measurement of the fuel level at all times as opposed to traditional fuel gauges, which might be impacted by the angle of the vehicle or the quantity of fuel. Additionally, digital gasoline indicators may have functions that give the driver useful information, such as low fuel warning lights, distance-to-empty calculations, and fuel consumption statistics.

Overall, a digital fuel indicator is a cutting-edge and dependable way to check the gasoline level in a car. By giving the driver precise and practical information, it may enhance the driving experience.

1.0 INTRODUCTION

An electronic gadget that shows the amount of fuel in a car's fuel tank is called a digital fuel indicator. Drivers can make educated decisions regarding re-fueling and lower their risk of an unplanned fuel runout thanks to the exact information it gives them about the amount of fuel still in the tank.
A gasoline tank sensor that measures the amount of fuel present and a display device that informs the driver of the fuel level make up most digital fuel indicators. The ability to determine the vehicle's fuel efficiency is another feature that some digital fuel indicators may have in addition to warning lights that flash when the fuel level is low.
Modern vehicles frequently have digital fuel gauges that are integrated into the instrument cluster or dashboard. They have mainly superseded conventional mechanical fuel gauges, which can be less accurate and reliable and rely on a float and needle mechanism to show the fuel level.
Overall, digital fuel indicators give drivers a practical and reliable way to check the gasoline level in their car, enabling them to confidently plan their trips and fuel stops.

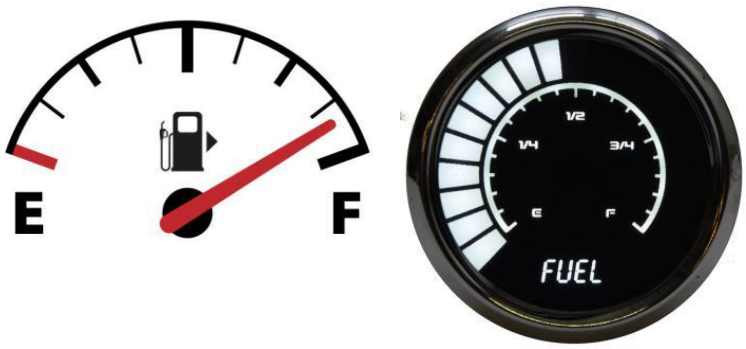

Fig 1: Analog Fuel Indicator/Existing Digital Fuel Indicator

The various aspects of a digital fuel indicator:

1. Sensor Technology: Digital fuel indicators employ advanced sensor technology to measure the fuel level accurately. There are different types of sensors used, including pressure-based and capacitance-based sensors. Pressure-based sensors measure the pressure exerted by the fuel in the tank, which varies with the fuel level. Capacitance-based sensors, on the other hand, utilize changes in electrical capacitance caused by the presence of fuel. These sensors provide precise and reliable measurements, ensuring accurate fuel level readings.

2. Control Unit: The control unit serves as the central processing component of the digital fuel indicator. It receives data from the sensor and processes it to determine the fuel level. The control unit applies algorithms and calibration data to convert the raw sensor readings into meaningful information that can be displayed to the driver. It also accounts for factors such as temperature compensation and fuel sloshing to ensure accurate and stable readings

3. Display Panel: The display panel is the interface through which the fuel level is presented to the driver. Digital fuel indicators use various display formats, including numeric displays and graphical representations. Numeric displays show the fuel level as a precise numerical value, while graphical representations often mimic traditional analog fuel gauges, displaying a graphical icon or bar that visually represents the fuel level. The display panel is designed to be easily visible and legible, allowing the driver to quickly assess the fuel level while driving

4. Accuracy and Precision: One of the primary advantages of digital fuel indicators is their high accuracy and precision. Analog fuel gauges may suffer from inaccuracies due to factors such as mechanical wear, calibration errors, or fluctuations in electrical connections. In contrast, digital indicators provide more precise readings, allowing drivers to have a clear understanding of their remaining fuel. This accuracy enables better fuel management, helping drivers plan their refueling stops more effectively and avoid running out of fuel unexpectedly.

5. Additional Features: Many digital fuel indicators offer additional features to enhance their functionality. These features can include warning lights or audible alarms that activate when the fuel level drops below a certain threshold, alerting the driver to the need for refuelling. Some indicators may also provide a distance-to-empty calculation, which estimates the remaining driving range based on the current fuel level and the vehicle's fuel efficiency. This feature is especially helpful during long trips or when traveling through areas with limited refuelling options.

2.0 LITERATURE REVIEW

Design and Implementation of a Digital Fuel Level Indicator System" by Kumar et al. (2017):
This study focuses on the design and implementation of a digital fuel level indicator system using microcontroller-based technology. It discusses the hardware components involved, such as sensors, microcontrollers, and display units. The research explores the accuracy and reliability of the digital indicator system by conducting experimental tests and comparing the results with traditional analog fuel gauges. It also discusses the benefits of using digital indicators, including better precision and real-time fuel level updates.
Smart Fuel Indicator System for Vehicles" by Sivakumar et al. (2018): This paper proposes a smart fuel indicator system that incorporates ultrasonic sensors to measure the fuel level in real-time. The study investigates the integration of this system with other vehicle systems, such as the onboard computer, to provide additional fuel-related information to the driver. It explores the challenges and solutions involved in designing and implementing the smart fuel indicator system. The research also evaluates the accuracy and effectiveness of the system through experimental tests and user feedback
A Comparative Analysis of Fuel Gauge Technologies for Electric Vehicles" by Li et al. (2019):
This research paper focuses on the comparison of different fuel gauge technologies, including digital indicators, specifically for electric vehicles (EVs). It discusses the unique challenges faced by EVs in accurately measuring and displaying the battery state of charge (SOC) as an equivalent of fuel level. The study evaluates the accuracy, reliability, cost-effectiveness, and user experience of various fuel gauge technologies, including digital indicators, coulomb counting, and model-based estimations. It provides insights into the strengths and limitations of each technology for EV applications
"Digital Fuel Level Indicators: A Review of Design and Implementation Techniques" by Verma et al. (2018):
This review paper focuses on the design and implementation techniques of digital fuel level indicators. It discusses the different components involved in the system, such as sensors, microcontrollers, and display units. The paper provides an overview of various signal processing algorithms used for accurate fuel level estimation. It also

explores the integration of digital fuel indicators with vehicle networks and data communication protocols for enhanced functionality and integration with other vehicle systems.

3.0 OBJECTIVES

An accurate and timely measurement of the gasoline level in a vehicle's fuel tank is the primary goal of a digital fuel indicator. This enables drivers to keep an eye on their fuel usage and decide when to recharge with knowledge. One or more of the specific goals of a digital fuel indication might be:

Accurate Fuel level Measurement:
The objective of accurate fuel level measurement is to provide drivers with precise and reliable information about the amount of fuel remaining in the vehicle's fuel tank. This ensures that drivers can make informed decisions about refueling, avoiding the risk of running out of fuel unexpectedly. Accurate measurement is essential for effective fuel planning and optimizing fuel consumption.

Real Time Fuel Monitoring:
Real-time fuel monitoring is a key objective of a digital fuel indicator. It involves continuously updating the fuel level display to reflect the current fuel quantity in the tank. This objective allows drivers to have immediate visibility into their fuel levels while driving

User Friendly Interface:
The objective of a user-friendly interface is to present the fuel level information in a clear and intuitive manner, enabling drivers to quickly and easily interpret the displayed information. A user-friendly interface enhances the overall user experience and minimizes the chances of confusion or misinterpretation

4.0 METHODOLOGY

Requirement Analysis:
Engage with stakeholders, including end-users, automotive experts, and project sponsors, to gather requirements. Conduct interviews, surveys, or focus groups to understand their specific needs, expectations, and challenges.

System Design:
Develop a comprehensive system architecture that defines the components, interfaces, and communication protocols. Consider factors such as scalability, modularity, and ease of integration with different vehicle platforms.

Prototyping and Testing:
Build a functional prototype of the digital fuel indicator based on the system design. This prototype should incorporate the selected fuel level sensing technology, microcontrollers, display interfaces, and software components.

Performance Optimization:
Fine-tune the algorithms and data processing logic to optimize the performance of the digital fuel indicator. Consider factors such as accuracy, stability, response time, and power efficiency.

Maintenance and Updates:
Establish a plan for ongoing maintenance and support of the digital fuel indicator. Monitor the performance, reliability, and user feedback to identify areas that require improvement or updates.
Address bug fixes, and compatibility issues in a timely manner. Continuously evaluate the performance and reliability of the digital fuel indicator and release updates or patches as needed

6.0 COMPONENTS USED

0.96 I2C LCD DISPLAY:
A 0.96" I2C LCD refers to a small liquid crystal display (LCD) module that has a screen size of 0.96 inches and uses the I2C (Inter-Integrated Circuit) communication protocol for interfacing with other devices.

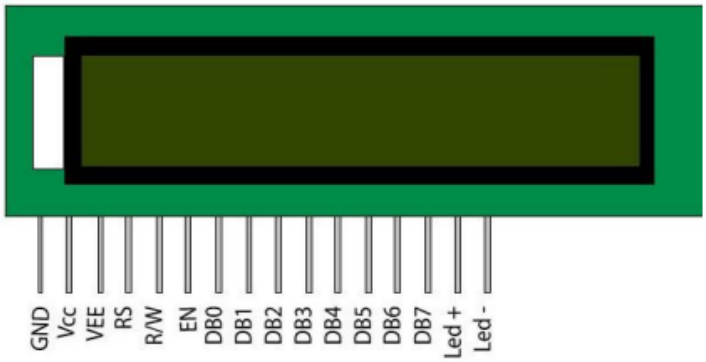

Fig 2: LCD Display

PRESSURE SENSOR:

A diaphragm pressure sensor is a type of sensor that measures pressure by utilizing a flexible diaphragm that deforms in response to applied pressure. This deformation causes a change in the electrical output of the sensor, which can be used to determine the pressure being measured.

Fig 3: Pressure Sensor

ARDUINO UNO:

The Arduino Uno is a popular open-source microcontroller board that has gained significant popularity among hobbyists, students, and professionals in the field of electronics and programming. It was developed by Arduino.cc and was initially released in 2010. The board is designed to provide an accessible and user-friendly platform for creating and prototyping various electronic projects

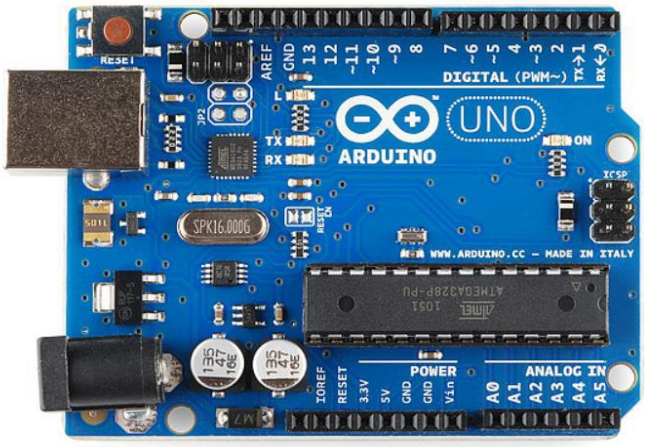

Fig 4: Arduino Uno

CALIBRATION OF PRESSURE SENSOR:

To calibrate the pressure sensor for the development of a digital fuel indicator, the following steps can be taken using the provided information:

Prepare the pressure sensor: Ensure that the magnetic pressure sensor is properly installed and connected to the fuel indicator system. Make sure it is clean and free from any debris or obstructions.

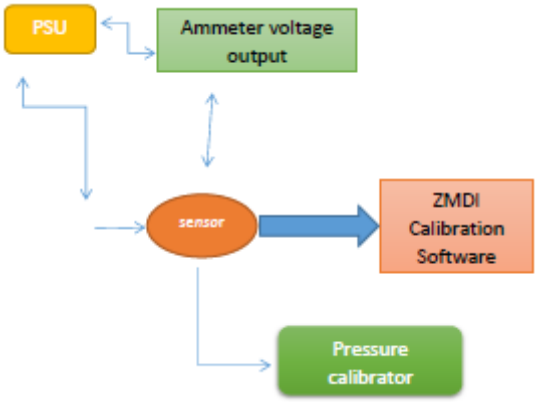

Fig 5: Outline of the calibration setup

7.0 RESULTS AND DISCUSSION

a. Calibration at 50°C: Set the pressure at 0-50 mbar and record the corresponding sensor readings. This establishes the calibration points for the high-temperature range.

b. Calibration at 10°C: Again, set the pressure at 0-50 mbar and record the sensor readings. This provides calibration points for the low-temperature range.

c. Calibration at 25°C: Set the pressure at 0, 25 mbar, 37.5 mbar, and 50 mbar, recording the sensor readings for each value. These calibration points help determine linearity across a moderate temperature range.

Repeat calibration if necessary: If the initial calibration results show significant discrepancies or non-linearity, repeat the calibration process by adjusting the calibration parameters or collecting additional data points. This iterative process helps refine the calibration and improve accuracy.

Validate calibration: Once the calibration parameters have been adjusted and the calibration process completed, validate the calibration by testing the fuel indicator system using known fuel levels and comparing them to the measured values. Fine-tune the calibration if needed based on the validation results.

By following these steps, you can effectively calibrate the magnetic pressure sensor for the digital fuel indicator, ensuring accurate and reliable fuel level measurements across different temperatures and pressure ranges.

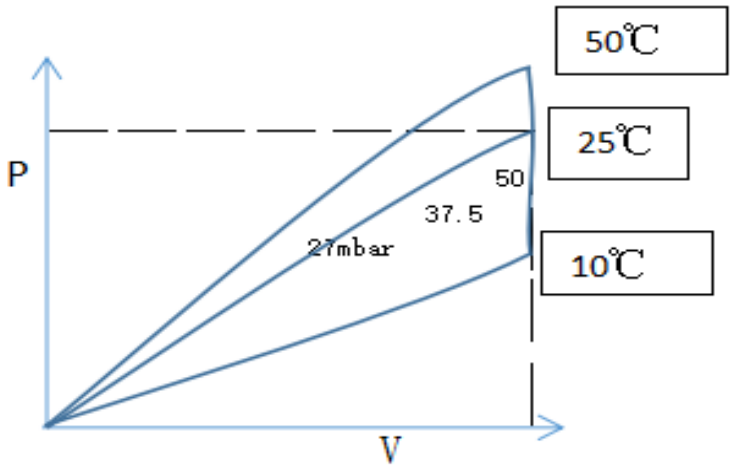

Fig 6: The graph obtained during the calibration of pressure sensor.

8.0 CONCLUSION

An accurate and timely measurement of the fuel level in a vehicle's fuel tank is provided by a digital fuel indicator, which is a cutting-edge and dependable piece of technology. It gives drivers exact information using sensors, microprocessors, and LCD panels so they can make educated decisions about refueling and track their fuel efficiency.

Traditional gasoline gauges have been replaced by digital fuel indicators because they were prone to errors and fluctuations caused by the vehicle's angle or the fuel level. Drivers may check their fuel level in real-time using a digital fuel gauge and get alerts when it drops below a predetermined level.

Additionally, digital fuel indicators can offer other functions like distance-to-empty estimations and fuel consumption information that can assist drivers in streamlining their driving practices and enhancing their fuel efficiency.

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