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# Configurable Liquid Fuel Refill SMS-based Reminder System for 2-Wheelers

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***Abstract*— Often, people tend to forget to refill fuel in 2-wheelers, and they need to push the vehicle to the nearest petrol pump or call somebody with a full fuel tank to transfer the fuel. The scenario would be even worse if the fuel tank was empty while overtaking; it could cause an accident. The module introduced can be a compact-size module that can be installed in any IC engine two-wheeler vehicle system and can be used for generating SMS-based reminders for fuel refilling. In EV models, the smart clusters are connected to the user's phone, but old vehicles do not have this facility. The module is designed in such a way that it will offer the user the flexibility to set the SMS trigger based on the various threshold levels of fuel. The user can decide the trigger levels based on the distance to a nearby petrol pump from his home, office, etc.**

***The paper explains the hardware architecture, details of the workings of the module, how it can be installed, and how it could be beneficial for 2-wheeler users.***

***Index Terms*— Fuel refill, SMS based Reminder**

## I. INTRODUCTION

The fuel level is indicated on the cluster but often people tend to forget refilling due to which they face problems while traveling. If we can set a reminder based on fuel level in the fuel tank, we can refill it before the fuel reaches an alarming level and the problem can be solved. A fuel level sensor is used in all automobiles to indicate fuel level. Various methods are used to measure fuel level such as resistive film, discrete resistors, capacitive, and ultrasonic. Resistive-based sensors are most used for this application. These sensors are mechanically connected to a float which moves up or down depending on the fuel level. As the float moves, the resistance of the sensor changes. This sensor is part of a current balance circuit of the fuel gauge display circuit which typically consists of coils for actuation of the display needle. As the resistance of the fuel sensor changes, the position of the needle changes proportional to the current flowing in the coil. Thus, displaying the fuel level on the cluster.

A Hall effect base IC can be used for sensing the fuel level to provide high reliability and accurate fuel level sensing for automotive applications. Hence, we are proposing the idea for integration of this hall-IC based fuel level sensor with a microcontroller which will be connected to GSM for generating reminder SMS on the phone when the level of the fuel reaches the level the user has defined. The user must set the fuel level for which he/she wants reminder to refill the fuel. The level of the fuel tank and shape of the tank can be different for different vehicles thus based on user requirement and fuel tank shape the reminder can be set and generated.

**Conventional fuel sensing methods:**

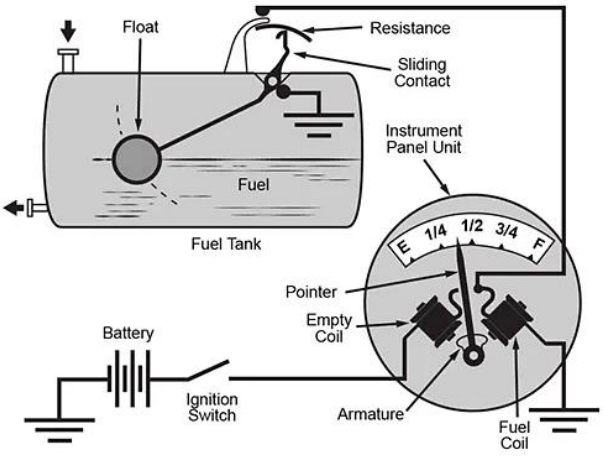


**Figure.1**

Up until now the accuracy of the fuel level measurement has not been of great importance. The purpose measuring the fuel level has been to present the information on the dashboard with a fuel level meter. Instead of accuracy the two most important things have been to avoid rapid changes in the fuel level displayed and the meter must indicate that the tank is empty when the fuel level is below a predefined level. This system is not capable of providing the exact value of fuel in the fuel tank. Also, such a system cannot protect us from getting cheated at petrol pumps and this costs more for less amount of fuel so filled. So, it becomes necessary to develop such a system which gives the exact (numeric) value of fuel in the fuel tank.

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Volume 11 Issue 07 July 2024

A fuel level sensor is a device used in vehicles to measure the amount of fuel in the fuel tank. It typically utilizes various technologies such as resistive, capacitive, ultrasonic, or magnetic to detect the level of fuel. This information is then sent to the vehicle's onboard computer, which can display the fuel level to the driver via a gauge on the dashboard. Accurate fuel level sensing is crucial for proper fuel management and preventing running out of fuel unexpectedly.

A fuel level sensor (FLS) is used in all automobiles to indicate fuel level. Various methods are used to measure fuel level such as resistive film, discrete resistors, capacitive, and ultrasonic. Resistive-based sensors are most used for this application. These sensors are mechanically connected to a float which moves up or down depending on the fuel level. As the float moves, the resistance of the sensor changes. This sensor is part of a current balance circuit of the fuel gauge display circuit which typically consists of coils for actuation of the display needle. As the resistance of the fuel sensor changes, the position of the needle changes proportional to the current flowing in the coil. A typical resistor based FLS is shown in Figure 1.[1]

The disadvantage of the resistive contact-based sensor is the wear and tear of the sensor due to the sliding contact inside the sensor elements. The wear and tear lead to a reduction in the sensor life.

Another method for Fuel level sensing is using an ultrasonic sensor. Ultrasonic sensors are the sensor that sends the high-frequency ultrasonic waves and utilizes the echo principle. This method is competent enough to trace the minute changes happening inside the fuel tank.

## II. USER INTERFACE OF THE MODULE & DESCRIPTION

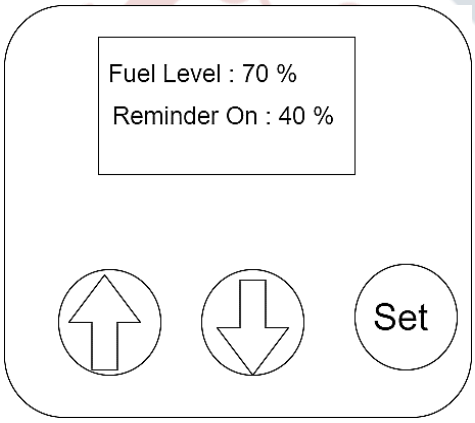


**Figure 2**

The user interface for the module can be represented as Figure 2, in which there will be three switches. One for leveling up the fuel level represented as upside arrow, one with downwards arrow for lowering the fuel level & last one is set to select the level for the reminder.

User needs to calculate the or observe the level from which he/she can reach the nearby petrol station for refilling the fuel and based on the observation user can set reminder according to his convenience.

The first line on the display represents the existing fuel level in the vehicle based on real time data. The second line is for setting the reminder for the user to generate SMS based on selection using the three switches as represented in figure2. The display will be turned ON at the time of ignition and turned OFF when ignition switch is off.

Whereas for the reminder to be sent there will be an independent Li-ion rechargeable battery for sending the SMS even when the vehicle ignition is OFF. This battery will get charged via the main vehicle battery.

## III. HARDWARE ARCHITECTURE

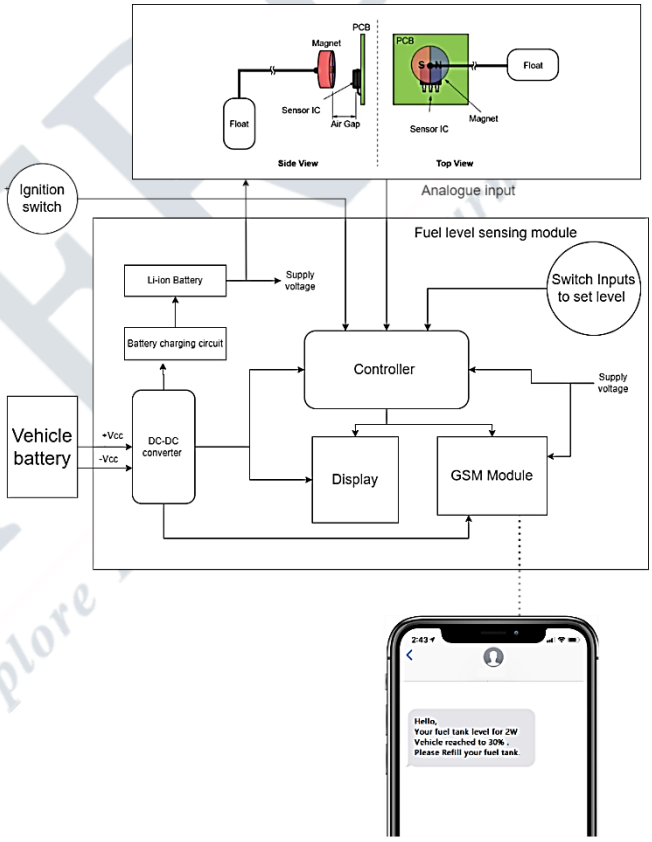


**Figure.3**

The hardware architecture for the module is as represented in Figure.3. The module would primarily contain Battery, Hall IC sensor, Switches for user input, small display, DC-DC converter, Microcontroller & GSM module.

## IV. MICROCONTROLLER

Microcontroller is the main component in the system it is used for sensing the output voltage from the hall IC fuel sensor. The user input from switches as shown in Fig.2 & Fig.3 are taken to decide the level of fuel on which user must get the reminder on. Conversion of the fuel level to the percentage is done by microcontroller and information is sent

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to LCD display for user to be aware of level and reminder level settings in real time.

## V. LI-ION RECHARGEABLE BATTERY

Lithium-Ion Rechargeable Batteries have excellent performances as secondary batteries with high energy density, long cycle life and safety characteristics. To be best situated among secondary batteries, new technologies must be conducted into Lithium-Ion Rechargeable Batteries.[10]

## VI. LI-ION RECHARGEABLE BATTERY CHARGER CIRCUIT

Li-Ion battery is the main power source for portable devices and electric vehicles because of their excellent characteristics. After being used to supply energy, Li-Ion batteries will reduce their energy capacity and need to be charged so that the battery returns to its maximum capacity. There are several methods for charging a battery, one of the methods is Constant Current Constant Voltage (CC-CV). This method provides a a constant current first and continues with constant voltage under certain conditions. This method is suitable for Li-Ion battery because the age of Li-ion battery is greatly affected by overcharging conditions so that using this method can extend battery life. In this research, Li-Ion battery charger will be designed using the Buck Boost converter topology with the CC-CV method.[12]

## VII. HALL IC & ITS TYPES

A Hall Effect sensor, commonly referred to as a Hall IC (Integrated Circuit), is a device that utilizes the Hall Effect to measure magnetic fields. When a current-carrying conductor is placed in a magnetic field perpendicular to the current flow, a voltage difference, known as the Hall voltage, develops across the conductor perpendicular to both the current and the magnetic field.

Hall Effect sensors are used in a wide range of applications for proximity sensing, position sensing, speed detection, and current sensing. They are categorized into several types based on their construction, output signal, and intended application. Here are some common types:

1. **Digital Hall Effect Sensors:** Digital Hall Effect sensors provide a digital output signal (typically high or low) based on whether the magnetic field exceeds a predefined threshold. They are commonly used in applications such as proximity switches, door and window sensors, and speed detection in consumer electronics.
2. **Linear Hall Effect Sensors:** Linear Hall Effect sensors provide an output voltage that varies linearly with changes in the magnetic field strength. They are suitable for applications that require precise measurements of magnetic fields, such as compasses and linear position sensors.

Each type of Hall Effect sensor has its own advantages and limitations, and the selection depends on factors such as the required sensitivity, accuracy, response time, and environmental conditions of the application.

For this application we are using allegro A1330. The A1330 is a 360° angle sensor IC that provides contactless high-resolution angular position information based on magnetic Circular Vertical Hall (CVH) technology. It has a system-on chip (SoC) architecture that includes: a CVH front end, digital signal processing, and an analog output driver. It also includes on-chip EEPROM technology, capable of supporting up to 100 read/write cycles, for flexible end-of-line programming of calibration parameters. Broken ground wire detection and user-selectable output voltage clamps make the A1330 ideal for high-reliability applications requiring high-speed 0° to 360° angle measurements.

The A1330 provides adjustable internal averaging, allowing response time to be traded for resolution. This is ideal for applications operating at low rotational velocities requiring high precision. For higher RPM applications, the A1330 provides industry-leading analog response time when no averaging is enabled.

With programmable angle scaling, the A1330 supports applications requiring short angular displacements, while maintaining full dynamic range on the output. Programmable minimum and maximum angle thresholds allow diagnosis of mechanical failures.

The A1330 is available as either a single or dual die option, in an 8-pin TSSOP. The package is lead (Pb) free with 100% matte-tin lead frame plating.[3]

## VIII. FUEL LEVEL SENSING RESULTS WITH A1330

Linear sensors suffer from errors due to air gap or magnet drifts. Linear angle sensors are also suitable up to 60 degrees angular displacement. Angle sensors provide wide angular displacement measurement with output voltage independent of air gap and absolute magnetic field. The A1330 is a 360° angle sensor IC that provides contactless angular position based on magnetic circular vertical Hall (CVH) technology. This application uses a diametric magnet.

Programmable parameters include zero offset to provide flexible magnet placement and short angular displacement for full dynamic range.

A1330 output voltage with float angle is shown in table 1 with 6 mm × 3 mm diametric magnet. Results show a linear output voltage over 75 degrees of displacement which is independent of the air gap.

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Volume 11 Issue 07 July 2024

| Sr. no. | Float angles (˚Degrees) | Output voltage (Volts) | Fuel level indication( %) |
|---|---|---|---|
| 1 | 0 | 0 | 0 |
| 2 | 10 | 0.225 | 5 |
| 3 | 20 | 0.675 | 15 |
| 4 | 30 | 1.35 | 30 |
| 5 | 40 | 2.25 | 50 |
| 6 | 50 | 2.7 | 60 |
| 7 | 60 | 3.15 | 70 |
| 8 | 70 | 3.6 | 80 |
| 9 | 80 | 4.05 | 90 |
| 10 | 90 | 4.5 | 100 |

**Table 1**

**LCD display:**


**Figure.4**

LCD (Liquid Crystal Display) screen is an electronic module and locate a wide scope of uses. A 16x2 LCD screen [7] is an extremely essential module and is ordinarily utilized in different devices and circuits. A 16x2 LCD means it can show 16 characters for every line and there are 2 such lines. In this LCD each character is shown in a 5x7 pixel matrix.

LCD display will be turned ON only at the time of Ignition ON to save power consumption.

**GSM Module**


**Figure.5**

SIM800-WB64 supports Quad-band 850/900/1800/1900MHz, it can transmit Voice, SMS, and data information with low power consumption. With tiny size of 24*24*3 mm, it can fit into slim and compact demands of customer design. Featuring Bluetooth and Embedded AT, it allows total cost savings and fast time-to-market for customer applications.

General features of SIM800-WB4 are as follows:

It has Quad-band 850/900/1800/1900MHz with GPRS multi-slot class 12/10. The GPRS mobile station class B •Compliant to GSM phase 2/2+. It is Class 4 (2 W @ 850/900MHz) & Class 1 (1 W @ 1800/1900MHz). It is Bluetooth compliant with 3.0+EDR, Having Dimensions as 24*24*3mm, Weight as 3.14g & it can be Controlled via AT commands (3GPP TS 27.007, 27.005 and SIMCOM enhanced AT Commands). The Supply voltage range required is 3.4 ~ 4.4V It is Low power consumption GSM module with Operation temperature as-40℃ ~85℃.

Generating SMS (Short Message Service) using GSM (Global System for Mobile Communications) typically involves interfacing with a GSM module or modem, which communicates with the cellular network to send and receive text messages. [5]

**Diametric magnet**

For a fuel sensing application, a diametric magnet must be installed such that its rotary movement is proportional to the float movement. Also, the sensor needs to be installed near the magnet. This is simpler to adopt for retrofitting compared to other non-contact sensor technologies. The magnet could be sealed to protect it from degradation inside the fuel. Even if the fuel is contaminated, the sensing operation will not be affected.

The magnet used for this application is a diametric type of magnet (round) shown in Figure 6 and it is fitted on the pivot of the float and the sensor is placed on the magnet surface with 2 mm of air gap, Magnet orientation and linear Hall sensor positioning are shown in Figure 7.

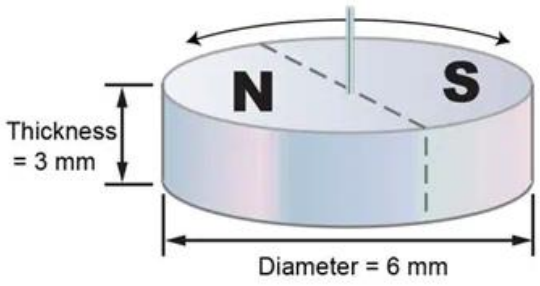


**Figure 6**

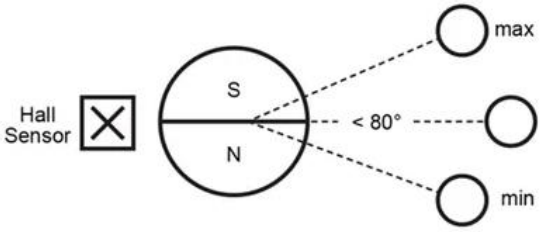


**Figure 7**

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Volume 11 Issue 07 July 2024

## IX. CONCEPT DESIGN


**Figure 8**

As shown in Figure.3 the Hall-IC sensor will sense the level of the fuel based on sensor available in the system or using Hall IC level sensor. There are 3 switches on the module to take the user input for number, to select the level and to Set or lock the settings. These 3 switches will help the user to increase or decrease the fuel level and set switch to set the fuel reminder entering cell phone number for SMS based reminders. Once the level is set, the fuel level will be monitored at the time of Ignition ON. Once the fuel is reached at the level set by the user, microcontroller will give signals to GSM for sending SMS as shown in Figure 8.

The complete module will receive the power from battery. The small display and switch will be turned ON only at the time of setting the level for reminder to save the power consumption through battery. The hall-IC will be sensing the fuel at Ignition ON & Ignition OFF. If the level is below the alarming level, microcontroller will give command to GSM to send the SMS to the user.

The mechanical assembly can be made compact and convenient to keep it user friendly. The battery can be charged using the main battery or existing vehicle battery can be used in electric vehicles.

## X. FLOWCHART

There will be 2 modes considered for the mode of operation of the module those mode will be

1. When Ignition is ON as represented in Figure 9.
2. When Ignition is OFF as represented in Figure 10.

User can set the level only when Ignition ON so that vehicle battery is turned ON for supplying power to the module.

When Ignition is OFF the module will run on the Li-Ion battery periodically after every 1 hour it will check the fuel level of the tank using hall IC as represented in the flowchart in as in Figure 9.

Thus, even when vehicle is in OFF mode user will get reminded by SMS for his/her low level of the fuel to be refilled.

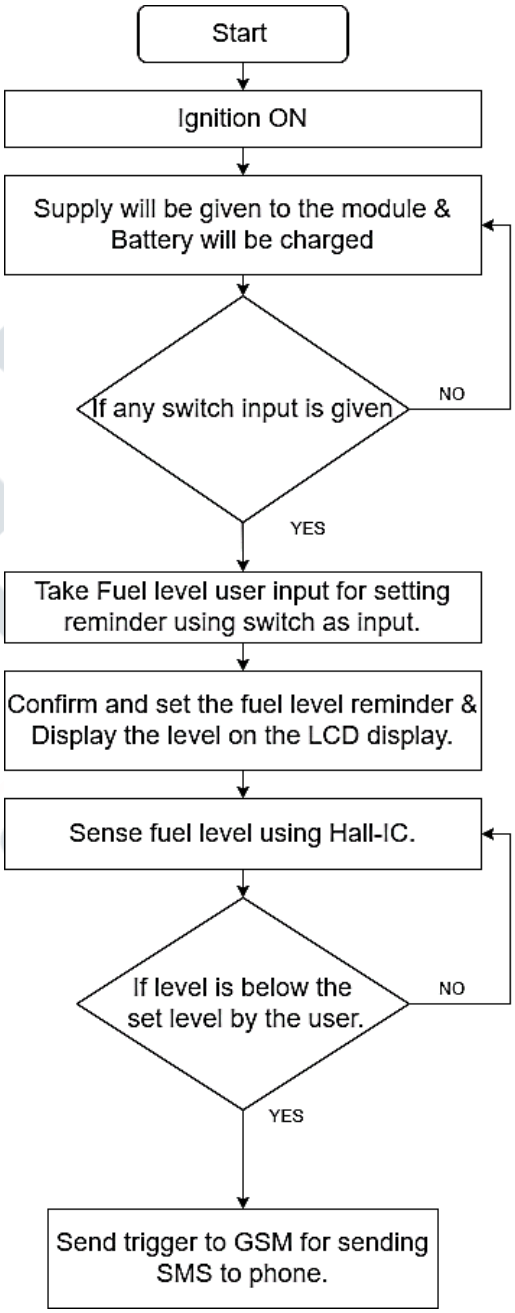


**Figure.9**

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International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE)

Volume 11 Issue 07 July 2024

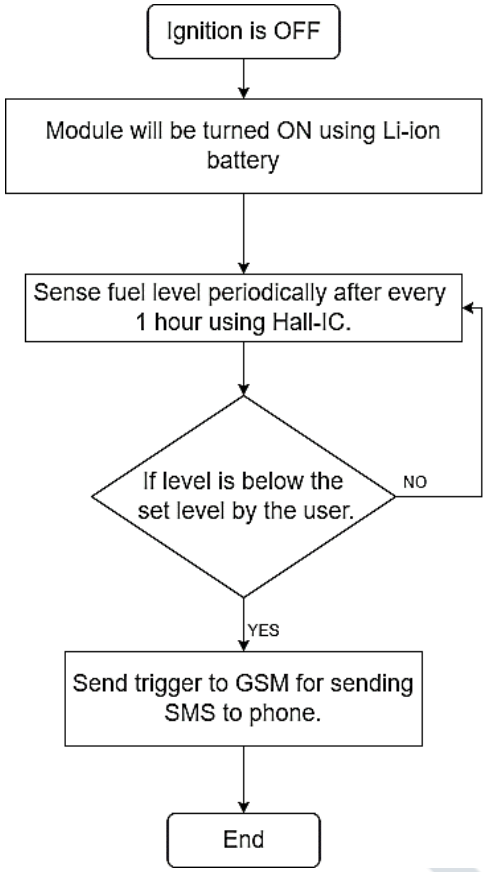


**Figure 10**

**Summary/Conclusions:**

Hall-based fuel level sensing offers reliable non-contact fuel measurement for automotive applications. A vehicle independent module for the fuel refill reminder can be created for 2-wheeler users.

**Acknowledgments**

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