



## GSM AND RFID BASED DIGITALIZED PETROL BUNK

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**Abstract:** *This paper introduces a fuel-filling system that uses RFID and GSM technologies. Customers are issued a petrol card, similar to a debit card, which simplifies transactions. The system verifies balance availability and automatically fills petrol. It uses an Arduino Uno micro-controller, EM-18 RFID reader, SIM 800L GSM module, 16x2 LCD, pump motor, and motor driver. It has four primary operations: recharge, balance check, fuel filling, and update. The recharge operation allows users to top up their cards, while the balance check operation monitors card balance. The system enhances efficiency and convenience in fuel-filling processes at petrol stations.*

**Keywords:** *RFID, GSM, Arduino*

### 1. INTRODUCTION

Petrol bunks, also known as gas stations or fuel stations, are essential infrastructure nodes for transportation systems and fuel-powered industries. They have evolved into multifunctional service centers, offering amenities like convenience stores and car wash facilities. These stations also contribute to local economies through taxes and revenue streams. They cater to commercial vehicles, public transportation, and individual commuters, offering convenient access to fuel and essential services. Advanced technologies like GSM and RFID have revolutionized petrol bunk operations, enhancing efficiency, accuracy, and security. GSM-based solutions enable real-time monitoring, allowing owners to remotely manage inventory and track sales. RFID technology facilitates seamless transactions, enhancing customer convenience.

### 2. OBJECTIVE

#### 2.1 RFID Authentication

Utilize EM-18RFID reader and tags for secure entry and authentication, ensuring access only to authorized users with unique RFID card IDs and passwords.

#### 2.2 Recharge Management

Implement a recharge operation allowing consumers to replenish their petrol card balances through a connected Bank account, ensuring smooth fueling transactions and preventing interruptions due to insufficient funds.

#### 2.3 Real-time Updates

Enable real-time communication via SIM 800L GSM module to send SMS notifications to both the petrol bunk control room and consumers, ensuring instant updates on transactions and balance changes

#### 2.4 Fuel Filling Options

Provide consumers with flexible fuel filling options including liter-based, amount-based, and tank-fill based operations, catering to varying preferences and requirements for fueling vehicles.

## **2.5 Price Update Functionality**

Facilitate centralized price management with an update operation exclusively accessible to petrol station authorities, allowing quick adjustments to petrol prices and automatic calibration of remaining balances accordingly.

## **3. EXISTING METHOD**

The methodology employed in this paper involves implementing an automated fuel-filling system at petrol bunks using RFID and GSM technology aimed at enhancing customer convenience. Each customer is issued a Petro card akin to a debit card for stream lined transactions. A petrol card reader is installed at the bunk for authentication and processing. Upon swiping the card, prompts for password and petrol quantity are displayed, followed by authentication and balance verification. Once validated, fuel filling initiates automatically via the connected pump, stopping upon reaching the specified quantity. The system also incorporates level and smoke detection functionalities, alerting the bunk owner of low fuel levels and potential fire hazards. The proposed system utilizes an interconnected ARM-7 controller, RFID reader, LCD, keypad, GSM module, and sensors for seamless operation. Software development in Embedded C provides flexibility and security, while future enhancements include automatic billing, real-time fuel density monitoring, and touch screen integration. The methodology emphasizes user-friendliness, security, and efficiency, aiming to save time and resources for both customers and businesses while also paving the way for potential loyalty programs and technological advancements.

## **4. PROPOSED METHOD**

The proposed GSM and RFID-based digitalized petrol bunk method uses an Arduino Uno micro-controller, EM-18RFID reader and tag, SIM 800L GSM module, 16x2 LCD display, pump motor, and motor driver. The system operates through four operations: recharge operation, balance operation, fuel filling operation, and update operation.

The EM-18 RFID reader is placed in the petrol bunk, ready to read data from the RFID tag when scanned. The RFID tag contains the consumer's unique ID number, mobile number, present amount in the petrol card, and linked bank account details for recharge purposes. When the petrol card is scanned, the system asks for the password and allows for further operations.

The balance menu displays the consumer's amount in the petrol card. The fuel filling menu is divided into three sub- operations: liter-based fuel filling, amount-based fuel filling, and tank fill-based fuel filling.

Liter-based fuel filling involves entering the level of the liter filled, which must be within 500ml and the maximum level is about 5 liters. If the entered liter level is not within 500ml, wrong liter level information is passed. If the entered liter level is within 500ml, the amount for the liter is displayed. Fuel filling operation starts using the pump motor, and SMS is sent to the petrol bunk control room and the consumer's mobile number.

Amount-based fuel filling involves entering the amount for the liter filled, which must be below the 5 liter amount. If the entered amount is higher, the amount for 5 liter over amount information is passed. If the entered amount is less than the 5 liter amount, the liter for the entered amount is displayed. Fuel filling operation starts using the pump motor, and SMS is sent to the petrol bunk control room and the consumer's mobile number.

Lastly, the update operation is accessible only for the central petrol station. It updates the price for one liter of petrol when the price increases or decreases. The petrol bunk officer only

needs to change the amount for one liter, and the remaining liter levels are calibrated automatically.

### 5. BLOCK DIAGRAM

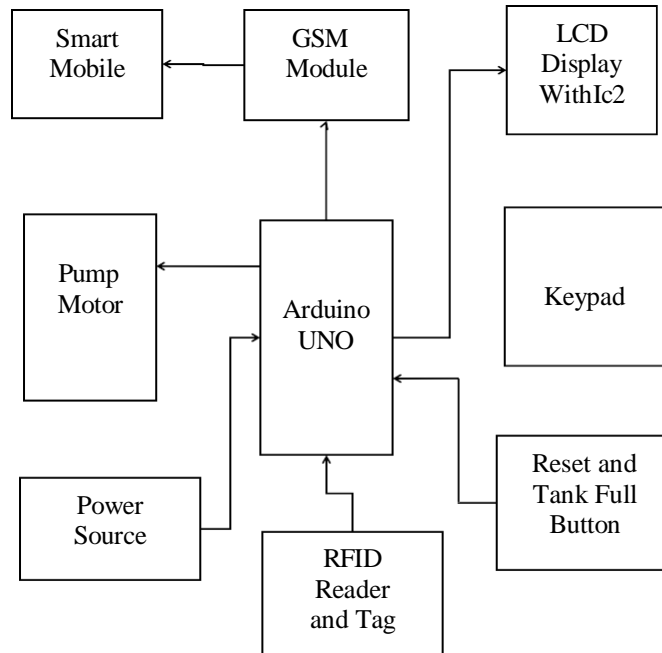


Fig.1. Block Diagram

### 6. COMPONENTS OF BLOCK DIAGRAM

#### 6.1 Power supply

AC power is primarily generated, transmitted, and distributed in AC due to economic reasons, but most electronic devices require DC supplies. Dry cells and batteries are portable and ripple-free, but have low voltages, frequent replacement, and high costs. Nowadays, most electronic equipment includes a circuit that converts AC to DC power. The DC power supply is the part of equipment that converts AC into DC, essential for basic house hold electronic circuits. It must supply a constant DC voltage within a certain power supply limit. However, the supply from mains can fluctuate, potentially breaking down the equipment if not properly limited.

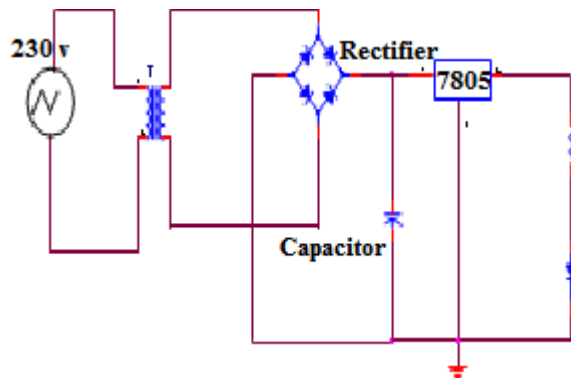


Fig.2. Power Supply

A regulated power supply circuit converts unregulated AC to limited DC, ensuring output remains constant despite input fluctuations modules, enabling real-time data acquisition and

processing. Infrared sensors detect commuters approaching the bus stop, triggering accurate arrival times on an LED board. The microcontroller manages communication between the bus fleet and the display system, providing up-to-date information. The Arduino Uno also incorporates smart features like automated announcements and user-friendly interfaces, enhancing efficiency and responsiveness to public transportation.

## 6.2 ARDUINO UNO

The Arduino board is a versatile device that can be powered via USB or AC mains power supply. It features a voltage regulator, crystal oscillator, and reset button. The board has six analogue input pins, which convert signals from sensors like heart beat or temperature sensors into digital values. Each Arduino board has a unique microcontroller, typically from ATMEL Company. To load a new program from the Arduino IDE, the board's ICSP pin, also known as an AVR is required. The power LED indicator should light up when plugged into a power source. The board also has two labels: TX (transmit) and RX (receive), which flash at different speeds while sending serial data. The Arduino UNO board has 14 digital I/O pins, 6 of which provide PWM output. These pins can be configured to read logic values or drive modules like LEDs or relays. The AREF (Analog Reference) pin can set an external reference voltage as the upper.

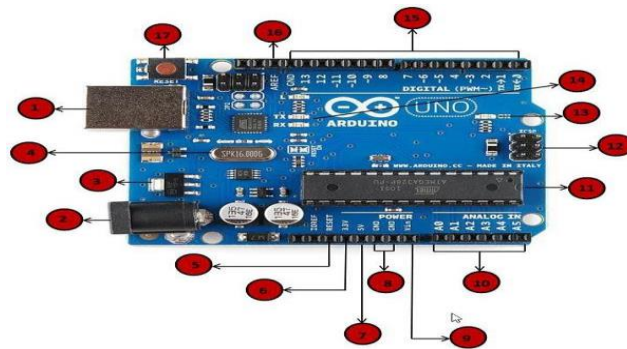


Fig.3. ARDUINO UNO

## 6.3 Keypad

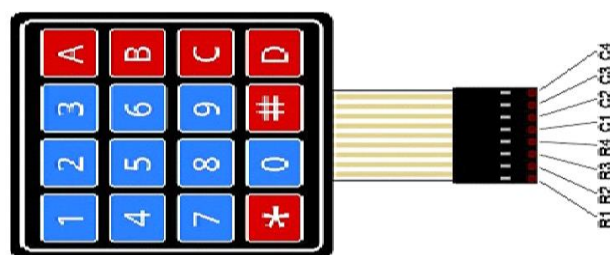


Fig.4. Keypad

Matrix keypads are used in various applications, such as Access Control Systems, Security Systems, Data Entry Systems, Industrial Control Systems, Robotics, and Electronic projects. They are organized in a matrix of rows and columns, and when a key is pressed, a row and a column make a contact. To detect a pressed key, the microcontroller grounds all rows by providing 0 to the output latch and reads the columns. If the data read is all 1s, no key has been pressed, and the process continues until a key press is detected. If the column is not equal to 1111, the key has been pressed.

## 6.4 I2C16XLCD Display

A 16x2 LCD is a popular liquid crystal display used in electronic projects, embedded systems, and devices for displaying information. It has 16 characters in each row and can display alphanumeric characters or symbols. The display uses LCD technology, manipulating liquid crystals to control light passage. It is usually backlit for better visibility. To interface with digital devices, 16x2 LCDs are often connected with microcontrollers, such as the HD44780 controller. A typical 16x2 LCD has 16 pins for connection, power, contrast adjustment, and data and control pins. Common programming languages for 16x2LCDs include C, C++, and Python.

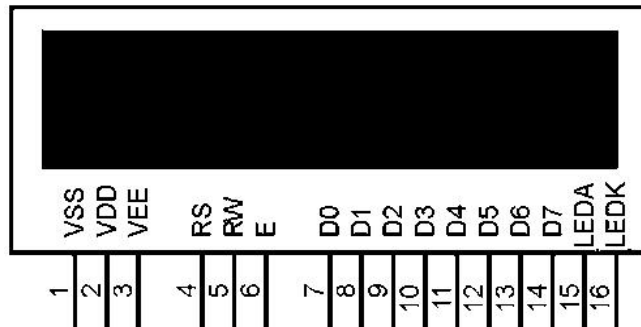


Fig.5. I2C16XLCD Display

## 6.5 GSMSIM800L

The SIM800L GSM cellular chip from Sim com is the core of the module, suitable for direct LiPo battery supply and projects with limited space. Its data pins are broken out into 0.1" pitch headers, including those for communication with the microcontroller over UART. The module supports baud rates ranging from 1200 bps to 115200 bps and features automatic baud rate detection. To connect to the network, an external antenna is required, typically a helical antenna that can be soldered to the module or a U.FL connector. The module also features a SIM socket for any 2G Micro SIM card, with the proper inserting method engraved on the surface.

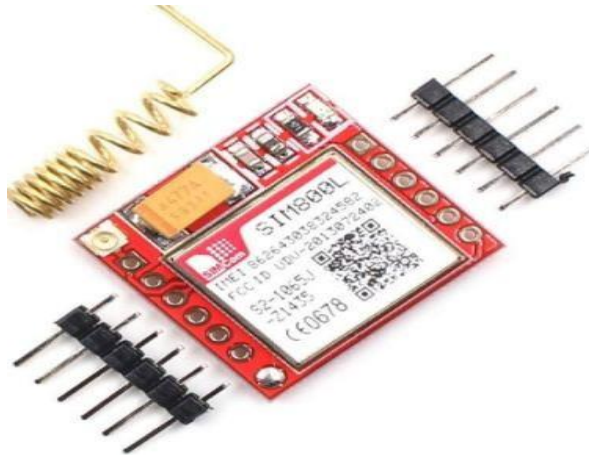


Fig.6. GSMSIM800L

## 6.6 EM-18 RFID READER AND TAG

The EM-18 RFID Reader Module 125 KHz is a versatile module for Radio Frequency Identification projects, compatible with any 125 KHz RFID tags and providing UART/Wiegand26 output formats. It can be inserted into a breadboard for project development and uses wireless non-contact electromagnetic fields to automatically identify and track tags. The module has a built-in antenna and can output a serial string containing the unique ID of a card. The module's mode of communication is determined by the SEL pin, with RS232 being the most popular. The module's output is 9600bps, and the controller should be programmed to receive this rate for proper functioning.



Fig. 7. RFID Reader and Tag

## 6.7 DC PUMP MOTOR

A 12 Volt water pump is a DC electric motor used for transferring, lifting, or circulating liquids like water, oil, or coolant. Its low price, small size, and long working lifespan make it popular in various industries like automotive, submersible, booster, and circulation systems. The pump motor starts, and the impeller rotates, causing water to move between blades. The centrifugal force causes water to exit the center, gaining kinetic energy and leaving the outer edge at a higher speed. The water then enters the volute pump casing, decelerating and converting kinetic energy into pressure energy.



Fig.8.DC Pump Motor

## 7. CIRCUIT DIAGRAM

The GSM and RFID-based digitalized petrol bunk system uses an Arduino Uno microcontroller as the master controller. It connects to an EM-18 RFID reader and tag, scanning the RFID petrol card containing consumer data. A SIM 800L GSM module sends SMS notifications to the consumer and central station. A 16x2 LCD displays operation statuses to the user. The system includes a pump motor and motor driver for dispensement of petrol. The RFID reader scans the card's RFID tag, granting access to the system upon successful password authentication. The system also includes fuel-filling options and automatic price adjustments. This integration streamlines operations and enhances user experience.

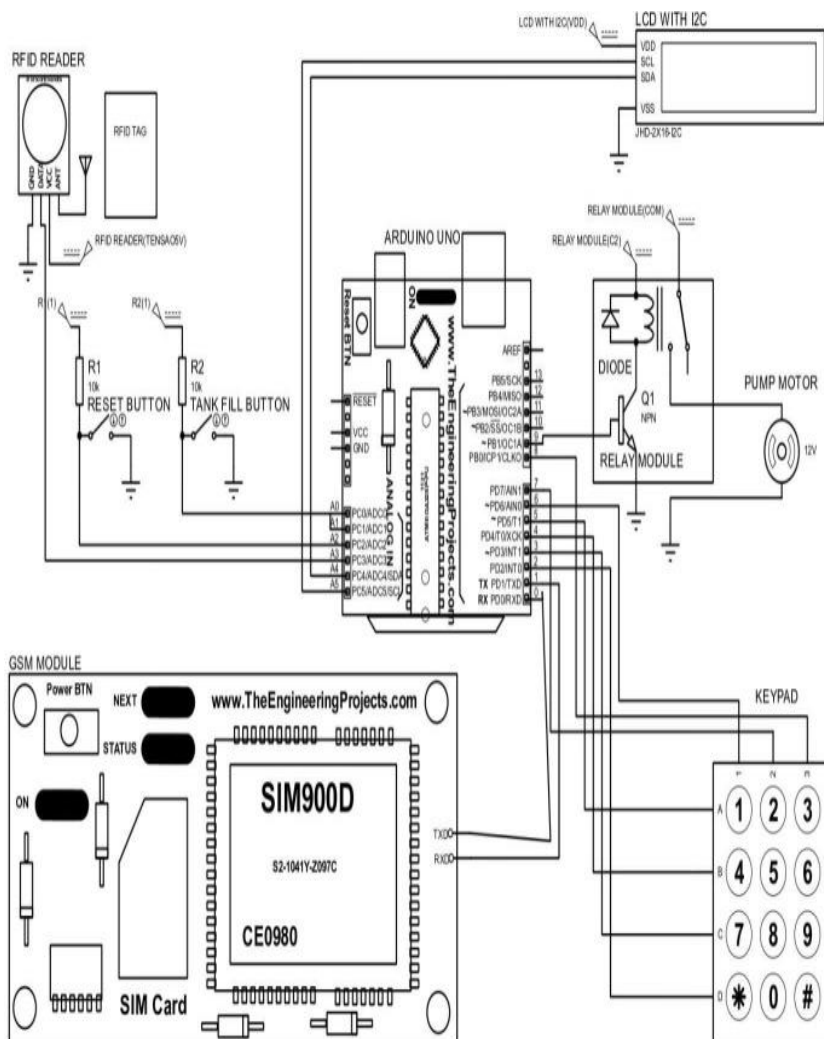


Fig.9.Circuit Diagram

## 8. SIMULATION SOFTWARE USED

The Proteus Design Suite is a proprietary software tool developed by Lab center Electronics Ltd in Yorkshire, England, primarily used for electronic design automation by electronic design engineers and technicians. Initially called PC-B, it was initially developed for DOS and later expanded to include Schematic Capture support in 1990. It was later integrated with mixed mode

SPICE Simulation in 1996, followed by microcontroller simulation in 1998. Shape- based auto routing was added in 2002, and 3D Board Visualization was added in 2006. A dedicated IDE for simulation was added in 2011, and MCAD import/export was added in 2015. The suite is a Windows application for schematic capture, simulation, and PCB layout design, available in various configurations based on design size and microcontroller simulation requirements.

## 9. SIMULATION RESULTS

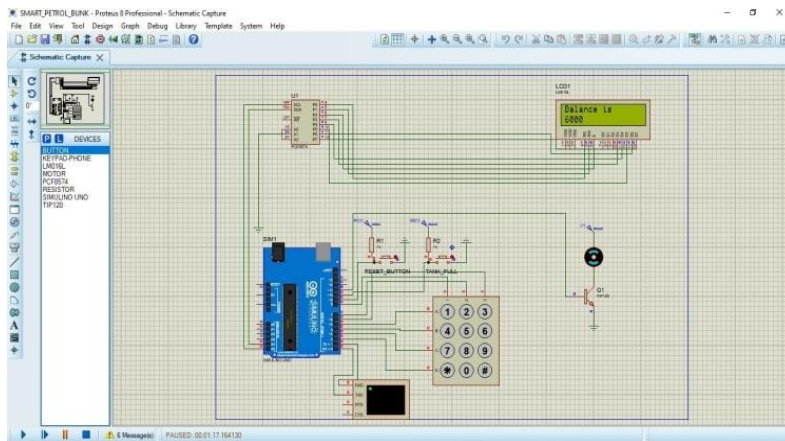


Fig.10.Output for Recharge of Petrol Card

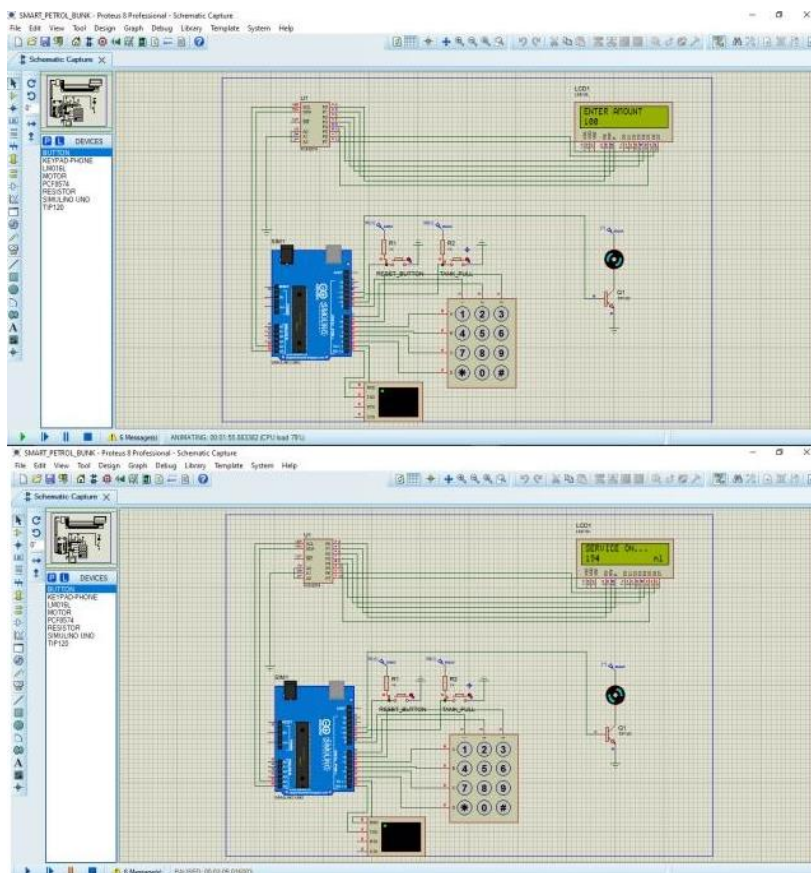


Fig.11.Output for Petrol Card Balance Check

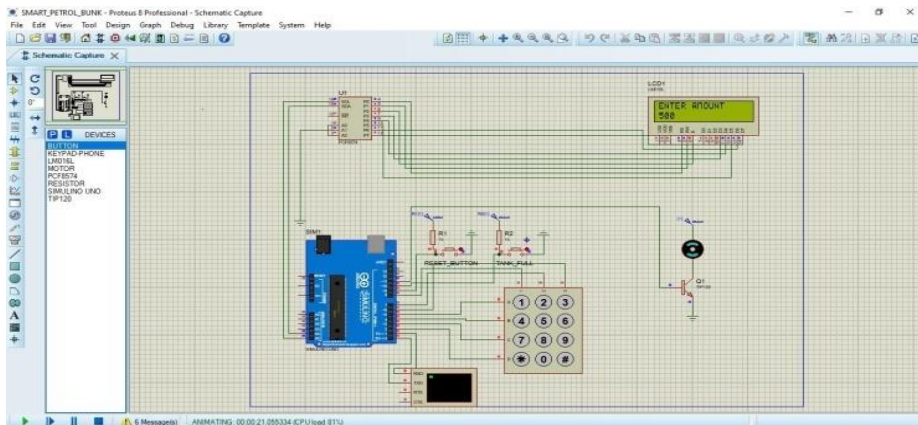


Fig.12.Outputs for Amount Based Fuel Filling

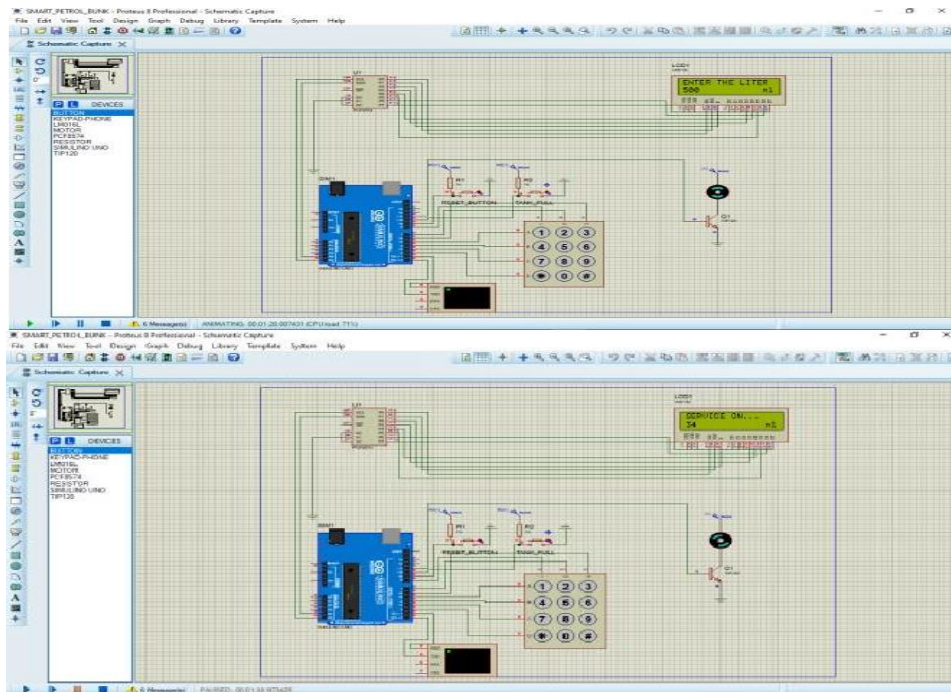


Fig.13.Output for Litre Based Fuel Filling

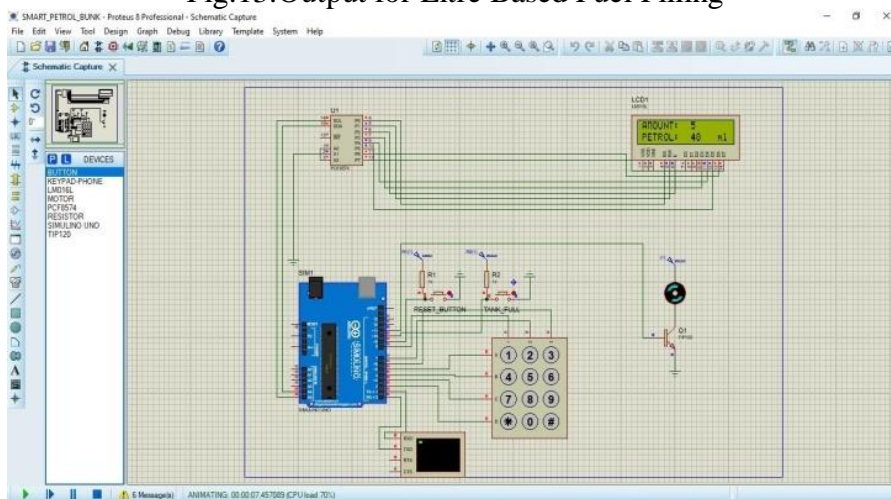


Fig.14.Output Tank Fill Based Fuel Filling

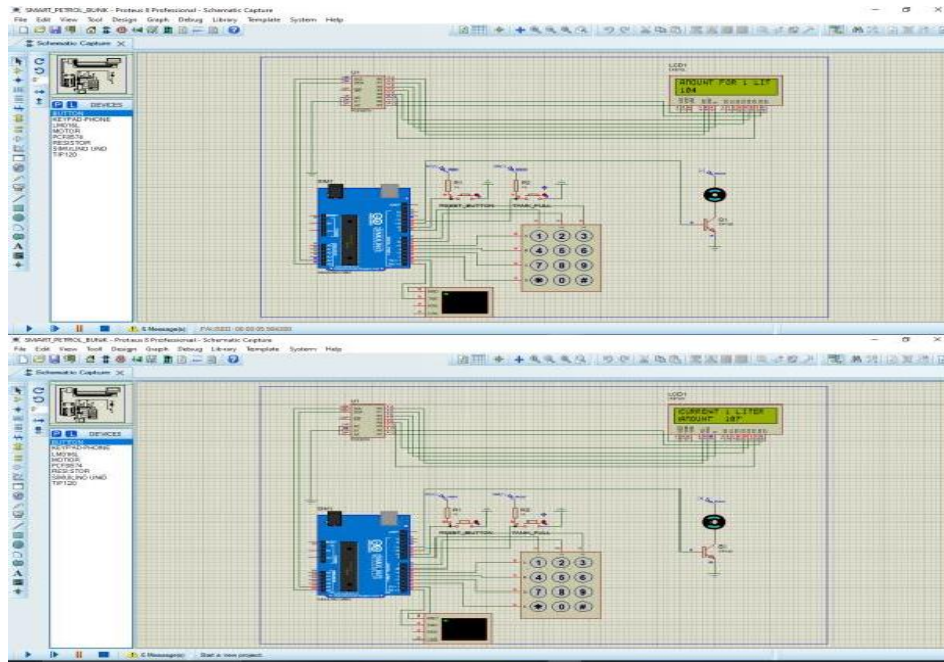


Fig.15.Output for Petrol Price Update

## 10. HARDWARE SNAPSHOT

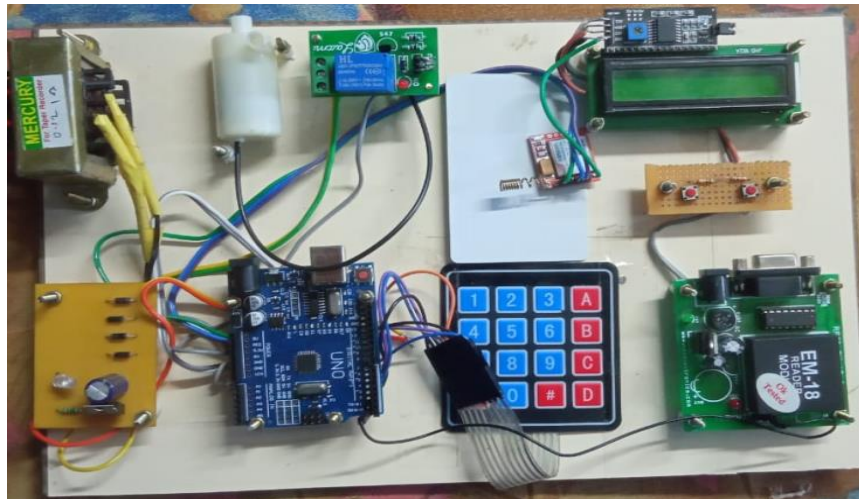


Fig.16. Hardware Snapshot

## 11. CONCLUSION

The proposed GSM and RFID-based digitalized petrol bunk method offers a comprehensive solution for efficient petrol dispensing and management. By integrating Arduino Uno microcontroller, EM-18 RFID reader and tag, SIM 800L GSM module, 16x2 LCD, pump motor, and

motor driver, the system orchestrates four primary operations: recharge, balance check, fuel filling, and price update. Including an EM-18 RFID reader and tag ensures secure access to the system, while the GSM module facilitates communication between the petrol bunk, consumers, and the central station. The 16x2 LCD provides real-time feedback on operation statuses, enhancing user experience and transparency. The recharge operation is crucial for maintaining the petrol card's balance, with strict Checks on account numbers and recharge amounts to prevent unauthorized transactions. Additionally, the balance menu allows consumers to conveniently monitor their petrol card's funds. Fuel-filling operations are streamlined into liter- based, amount-based, and tank-fill-based options, catering to different consumer preferences. Each method is meticulously designed to ensure accurate dispensing and transaction logging, with notifications sent to the petrol bunk control room and consumers upon completion. Finally, the update operation empowers petrol bunk officers to adjust prices seamlessly, reflecting market changes while ensuring price consistency across transactions. Overall, this method enhances operational efficiency and customer satisfaction.

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