Project Report on

SMART GAS BOOKING SYSTEM AND LEAKAGE DETECTION

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ABSTRACT

Many times LPG cylinder in our home goes empty. And if the LPG provider does not deliver gas cylinder on time then we face many problems due to unavailability of the LPG. Another major problem is that many times accidentally there is a LPG leakage, which can cause fire in house. To solve above problems, we are implementing a project that will detect the low level of LPG in the cylinder. And it also detects the LPG leakage.

LCD display connected to this system displays the amount of LPG in the cylinder by measuring it by weight sensor. Weight sensor is used to detect if LPG in the cylinder is about finish. If so, then an alert is given to the owner and the LPG provider through a SMS.

Gas sensor is used to detect the LPG leakage. If there is any leakage then the servo motor turns the regulator valve off and gives a buzzer alert for small duration of time and a SMS alert is sent to the owner. GSM or Wi-Fi module is used to send the SMS.

CONTENT

REFERANCES

[1] Rajkamal,"Embedded Systems: Architecture, Programming and Design", Tata McGraw-Hill Education.

[2] A. Mahalingam, R. T. Naayagi, N. E. Mastorakis, "Design and Implementation of an Economic Gas Leakage Detector", Recent Researches in Applications of Electrical and Computer Engineering.

[3] Specification and concepts of Load cell CZL601, range (0 to 20) Kg, http://www.standardloadcells.com/tabletop-loadcell-czl-601-greenlable.html.

[4] Specification of Liquid Crystal Display (LCD) 4 *16, JHD539, http://www.alldatasheet.com/datasheet-pdf/ pdf/276143/JHD/JHD539-164B.html

[5] S. Rajitha, T. Swapna,"Security alert system using GSM for gas leakage"International Journal of VLSI and Embedded Systems- IJVES

1. INTRODUCTION

In India there are approximately 43 Crore LPG consumers according to Times of India, Feb 6 2017. LPG cylinders are the primary fuel source for cooking and are used in various applications such as fuel source for heating system, motor vehicles (B.D.Jolhe, P 2013). Booking of the LPG cylinder at the right time is very difficult for the people as they cannot predict the exact content of the cylinder, and they cannot predict when the cylinder will go empty and after what amount of the usage. Therefore the proposed system detects the low level of LPG gas along with automated booking of LPG cylinder. An automated LPG system can help the consumers in overcoming the above issue and can be an alternative to the existing IVRS (Interactive Voice Response Service) LPG booking system. In existing system, the consumer has to dial a toll free or non-free number in order to register a booking service. In this case, there are high chances where the consumer may forget to book for his next cycle (S Shyamaladevi, 2014).

Consumers are mostly frustrated with the quantity of LPG in the cylinder as most of the vendors do not meet the promised quantity during the delivery. This problem can also be solved by the proposed system because the amount of LPG in the cylinder is displayed.

Due to the combustible nature of LPG, it was much required to maintain safety measures to predict unknown leakage of LPG which may lead to serious fire accidents. Hence in the proposed system if the LPG sensor senses any gas leakage from storage the output of this sensor goes low. This low signal is monitored by the microcontroller kit and it will identify the gas leakage. Now the microcontroller kit gives Buzzer. And it also turns off the regulator of cylinder. And finally sends a SMS alert to the customer that the leakage is detected and the system is turned off.

1.1. PROBLEM STATEMENT

Many times LPG cylinder in our home goes empty without prior information. And if the LPG provider does not deliver gas cylinder on time then the customers have to face many problems due to unavailability of the LPG. Another major problem is that many times accidentally there is a LPG leakage, which can cause fire in house. Gas leakage detection

in residential houses has become one of the fundamental issues in the recent times. Accidents mainly occur due to the negligence and technical fault. Electronic and press media have reported many accidents which were caused mainly because of gas leakage in residential houses and industries.

1.2. OBJECTIVES

- We have implemented an embedded system which will provide low level detection of LPG, of the consumers to the service provider, so that they can deliver the LPG cylinder on time.
- The system also takes care of the consumer's safety by turning off the cylinder's regulators on the sense of LPG leakage and it also gives a buzzer alert and a SMS alert to the owner.
- The weight sensing function of the system helps the customer to monitor the level of LPG and can use accordingly.
- The system can also check the full level of LPG in the new cylinder at the time of delivery.

1.3. PRESENT SYSTEM

In India, there is a system to measure daily consumption of petroleum products but there is no system to measure daily consumption of LPG in domestic market. In the existing system, LPG providers are not able of predicting the daily LPG usage of their customers and customers can only able to predict the emptiness of the LPG cylinder at verge of inflammable burner. And there is no system to detect the leakage of LPG and take safety measures to avoid any type of accidents that may cause Sevier damage. This has given the motivation to estimate the LPG consumption and to develop a monitoring and booking system.

1.4. PROPOSED SYSTEM

The proposed system measures the low percentage level of LPG in the cylinder and triggers a SMS to the LPG provider for booking the next LPG cylinder and sends a confirmation SMS to the customer about the same. By implementing this, the LPG provider can reduce the delivery delay time and helps to improve customer support service in transparent manner. The proposed system takes care of customer's safety by turning off the system and giving a buzzer alert at the time of LPG leakage detection, and the same is notified to the user by SMS.

1.5. LITERATURE SURVEY

Various research groups are working all over the world for the development of Microcontroller based LPG Gas Leakage Detectors using GSM Module. LPG, first produced in 1910 by Dr. Walter Snelling is a mixture of Commercial Propane and Commercial Butane having saturated as well as unsaturated hydrocarbons. Before the development of electronic household gas detectors in the 1980s and 90s, gas presence was detected with a chemically infused paper that changed its color when exposed to the gas. Since then, many technologies and devices have been developed to detect, monitor, and alert the leakage of a wide array of gases.

According to Sunithaa Jet al **[1],** the design of a wireless LPG leakage monitoring system is proposed for home safety. The system detects the leakage of the LPG and alerts the consumer about the leak and as an emergency measure the system will switch on the exhaust fan and also checks the leakage. An added feature of the system is that the approximate consumption is indicated in terms of the total weight. The proposed system makes use of GSM module in order to alert about the gas leakage via an SMS. Whenever the system detects the increase in the concentration of the LPG it immediately alerts by activating an alarm and simultaneously sending message to the specified mobile phones. The exhaust fan switched on and an LPG safe solenoid valve fitted to the cylinder is given a signal to close avoiding further leakage. The device ensures safety and prevents suffocation and explosion due to gas leakage**.**

According to V.Ramyaet al [2], Safety plays a major role in today's world and it is necessary that good safety systems are to be implemented in places of education and

work. This work modifies the existing safety model installed in industries and this system also be used in homes and offices. The main objective of the work is design in microcontroller based toxic gas detecting and alerting system. The hazardous gases like LPG and propane were sensed and displayed each and every second in the LCD display. If these gases exceed the normal level then an alarm is generated immediately and also an alert message (SMS) is sent to the authorized person through the GSM. The advantage of this automated detection and alerting system over the manual method is that it offers quick response time and accurate detection of an emergency and in turn leading faster diffusion of the critical situation.

According to Sagar Shindeet al [3], the former systems can not react in time, even cannot obtain data from an accident and locate accurately. This system gives real time detective of potential risk area, collect the data of leak accident and locate leakage point. This system having protection circuitry consists of exhaust fan and a Liquefied Petroleum Gas Safe Solenoid Valve. The hazardous gasses like Liquefied Petroleum Gas and Propane were sensed and displayed each and every second in Liquid Crystal Display. If these gasses exceed normal level then alarm is generated immediately. In this system MQ-6 gas sensor used to sense poisonous gas and has high sensitivity to LPG and also response to natural gas. This work modifies the existing safety model installed in industries. It offers quick response time and accurate detection.

According to Mahalingam et al [4], Gas leakage is a major concern with residential, commercial premises and gas powered transportation vehicles. One of the preventive measures to avoid the danger associated with gas leakage is to install a gas leakage detector at vulnerable locations. The objective of this work is to present the design of a cost effective automatic alarming system, which can detect liquefied petroleum gas leakage in various premises. In particular, the alarming system designed has a high sensitivity for primarily butane, which is also individually sold bottled as a fuel for cooking and camping. The proposed system is designed to meet UK occupational health and safety standards. Test results are demonstrated for an USB powered gas leakage detection system and it gives early warning signals under less severe conditions and activates a high pitched alarm in case of emergency situations to safeguard the users.

According to S. Rajitha et al [5], the aim of this project is to monitor for liquid petroleum gas (LPG) leakage to avoid fire accidents providing house safety feature where security

has been an important issue. The system detects the leakage of the LPG using gas sensor and alerts the consumer about the gas leakage by sending SMS. The proposed system uses the GSM to alert the person about the gas leakage via SMS. When the system detects the LPG concentration in the air exceeds the certain level then it immediately alert the consumer by sending SMS to specified mobile phone and alert the people at home by activating the alarm which includes the LED, Buzzer simultaneously and display the message on LCD display to take the necessary action and switch on the exhaust fan to decrease the gas concentration in the air.

2. SMART GAS BOOKING SYSTEM AND LEAKAGE DETECTION

This section contains the detailed description of the components used in the implementation of smart gas booking system and leakage detection system. This contains Gas sensor, weight sensor, LCD display, GSM module, Arduino board, Keypad and Buzzer.

2.1. Gas sensor

MQ-2 gas sensor is SnO2, which has lower conductivity in clear air. When the target combined gas exist, the sensors conductivity is heavier with the gas concentration rising. We used simple circuit to convert respective output signal according to concentration level. MQ-2 gas sensor has high sensitive to Methane, Propane and Butane. The sensor can be used to detect different combustible gas, especially Methane; it is with cost effective and useful for so many applications.

Fig.2.1: Gas sensor

2.2. Weight sensor

As per dictionary, a load cell is described as a "weight measurement device necessary for electronic scales that display weights in digits." However, load cell is not restricted to weight

measurement in electronic scales. Load cell is a passive transducer or sensor which converts applied force into electrical signals. They are also referred to as "Load transducers". Strain gauge load cells convert the load acting on them into electrical signals. The measuring is done with very small resistor patterns called strain gauges - effectively small, flexible circuit boards. The gauges are bonded onto a beam or structural member that deforms when weight is applied, in turn deforming the strain-gauge. As the strain gauge is deformed, it's electrical resistance changes in proportion to the load. The change to the circuit caused by force is much smaller than the changes caused by variation in temperature. Higher quality load cells cancel out the effects of temperature using two techniques. By matching the expansion rate of the strain gauge to the expansion rate of the metal it's mounted on, undue strain on the gauges can be avoided as the load cell warms up and cools down. The most important method of temperature compensation involves using multiple strain gauges, which all respond to the change in temperature with the same change in resistance. Some load cell designs use gauges which are never subjected to any force, but only serve to counterbalance the tempverature effects on the gauges that measuring force. Most designs use 4 strain gauges, some in compression, and some under tension, which maximizes the sensitivity of the load cell, and automatically cancels the effect of temperature. It is often easy to measure the parameters like length, displacement, weight etc that can be felt easily by some senses. However, it is very difficult to measure the dimensions like force, stress and strain that cannot be really sensed directly by any instrument. For such cases special devices called strain gauges are very useful. There are some materials whose resistance changes when strain is applied to them or when they are stretched and this change in resistance can be measured easily. For applying the strain you need force, thus the change in resistance of the material can be calibrated to measure the applied force. Thus the devices whose resistance changes due to applied strain or applied force are called as the strain gauges.

Fig.2.2: Weight Sensor

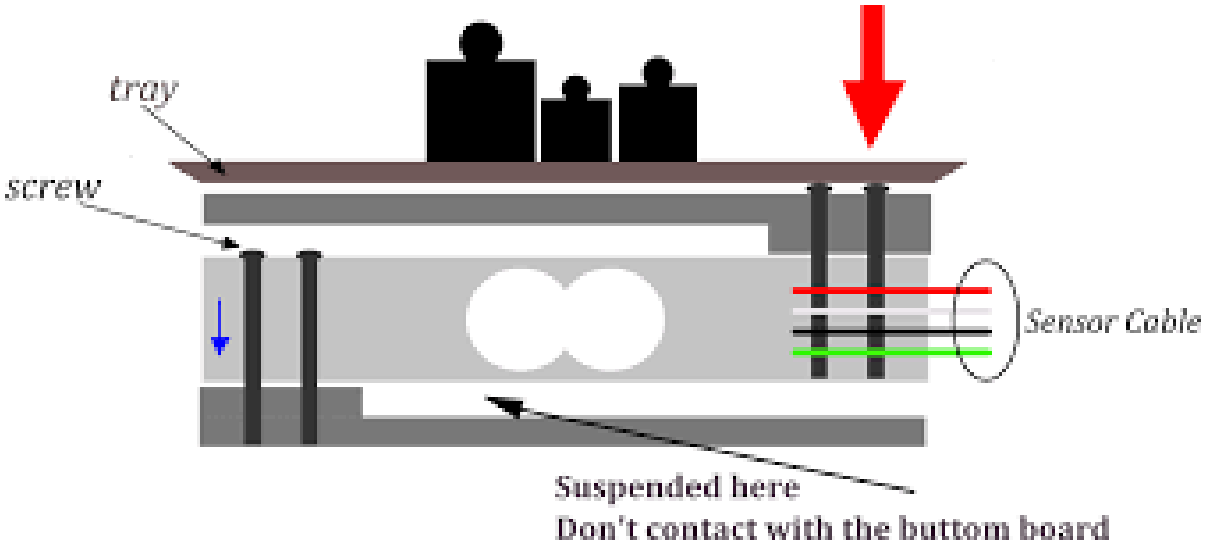

Fig.2.3: Weight sensor with weight on it

2.3. LCD Display

LCD stands for Liquid Crystal Display. They have become very common with industry by clearly replacing the use of Cathode Ray Tubes (CRT). CRT consumes more power than LCD and also bigger and heavier. We all know about LCD‟s, but no one knows the exact working of it. LCD is finding wide spread use replacing LEDs (seven segments or other multi segment LEDs) due to the following reasons:

1. The declining prices of LCDs.
2. The ability to display numbers, characters and graphics related data. This is in contrast to LEDs, which are limited to numbers and a few characters.
3. Incorporation of a controller into the LCD, thereby making the CPU to keep displaying the data.

4. Ease to program for characters, strings and graphics related data. These are specialized for being used with the microcontrollers, which makes that they cannot be activated by standard IC circuits. They are used for writing different messages on a miniature LCD.

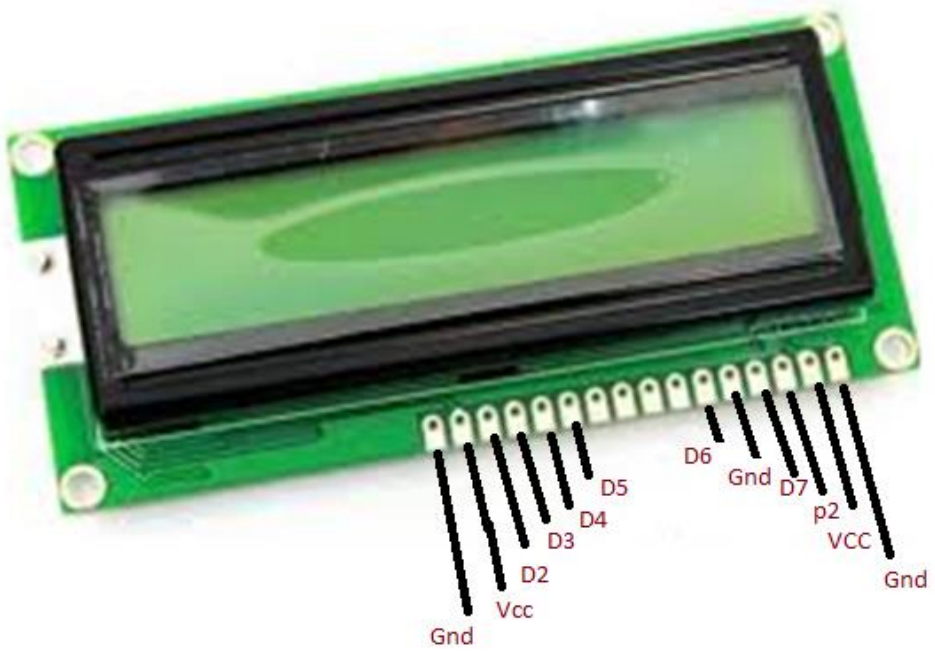

Fig.2.4: LCD Display module

2.4. GSM Module

GSM (Global System for Mobile) / GPRS (General Packet Radio Service) TTL modem s SIM900 quad-band GSM / GPRS device, works on frequencies 850 MHZ, 900 HZ, 800 MHZ and 1900 HZ. It is very compact in size and easy to use as plug in GSM Modem. The Modem is designed with 3V3 and 5V DC TTL interfacing circuitry, which allows User to directly interface with 5V microcontrollers (PIC, AVR, Arduino, 8051, etc.) as well as 3V3 Microcontrollers (ARM, ARM Cortex XX, etc.). The baud rate can be configurable from 9600-115200 bps through AT (Attention) commands. This GSM/GPRS TTL Modem has internal TCP/IP stack to enable User to connect with internet through GPRS feature. It is suitable for SMS as well as DATA transfer application in mobile phone to mobile phone interface. The modem can be interfaced with a Microcontroller using USART (Universal Synchronous Asynchronous Receiver and Transmitter) feature.

Fig.2.5: GSM module

2.5. Arduino Board

The Arduino UNO is a widely used open-source microcontroller board based on the ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board features 14 Digital pins and 6 Analog pins. It is programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. It can be powered by a USB cable or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts. It is also similar to the Arduino Nano and Leonardo. The hardware reference design is distributed under a Creative Commons Attribution Share-Alike 2.5 license and is available on the Arduino website. Layout and production files for some versions of the hardware are also available. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform. The ATmega328 on the Arduino Uno comes preprogrammed with a bootloader that allows to

upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol. The Uno also differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter. The Arduino UNO is generally considered the most user-friendly and popular board, with boards being sold worldwide for less than 5$.

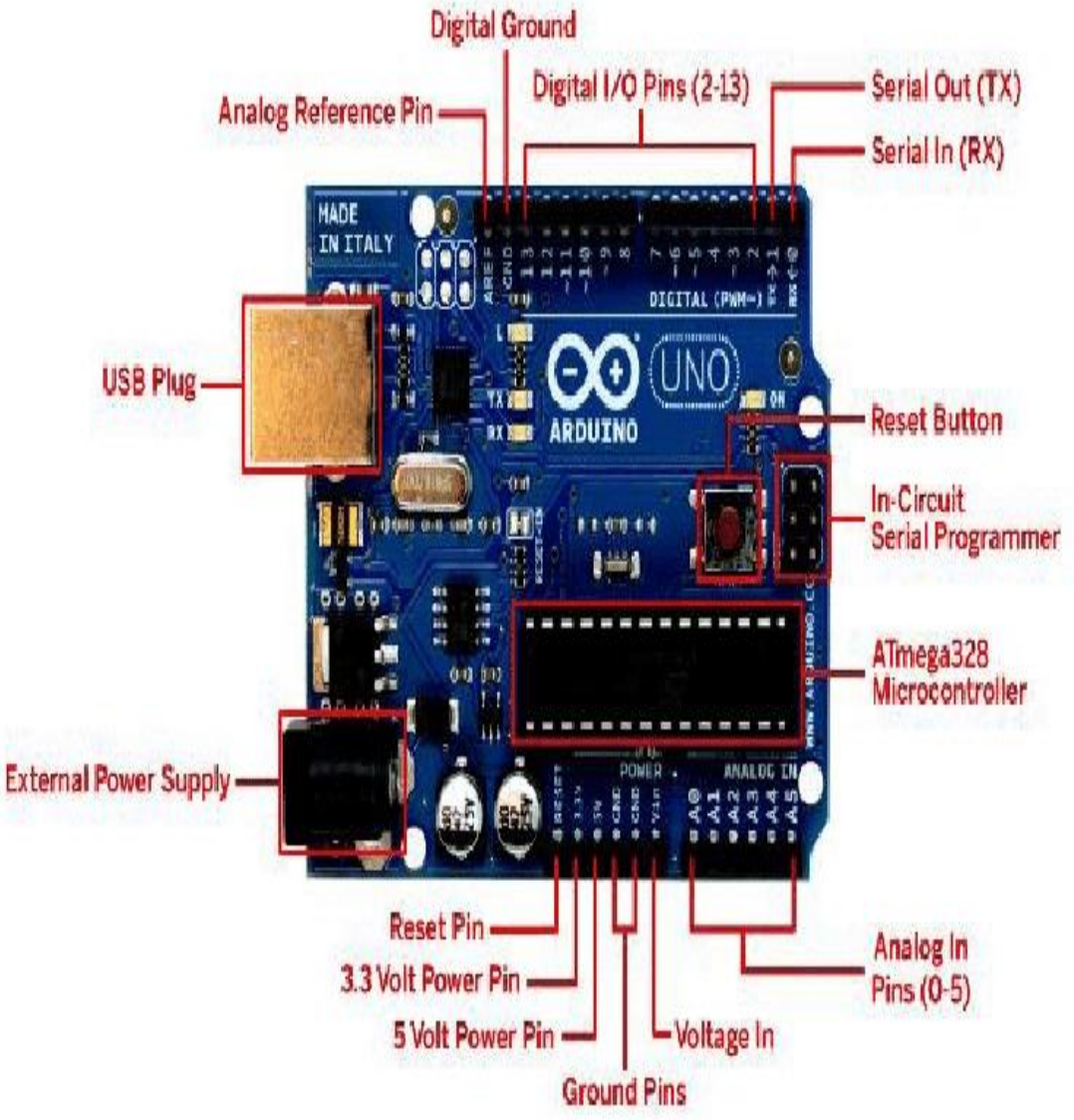

Fig.2.6: Arduino Uno board

2.6. Keypad

A keypad is a set of buttons arranged in a block or "pad" which bear digits, symbols or alphabetical letters. Pads mostly containing numbers are called a numeric keypad. Numeric keypads are found on alphanumeric keyboards and on other devices which require mainly numeric input such as calculators, push-button telephones, vending machines, ATMs, Point of Sale devices, combination locks, and digital door locks. Many devices follow the E.161 standard for their arrangement.

Fig.2.7: key pad

2.7. Buzzer

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

Fig.2.8: Buzzer

3. SYSTEM DESIGN

Fig.3.1 shows the functional block diagram of smart gas system. It consists of an Arduino MCU kit, which is the base platform of our project. It has the peripherals as LCD display, GSM module, Gas sensor, Weight sensor and Buzzer. The block diagram explains the functional flow of the system's operation taking place at a time.

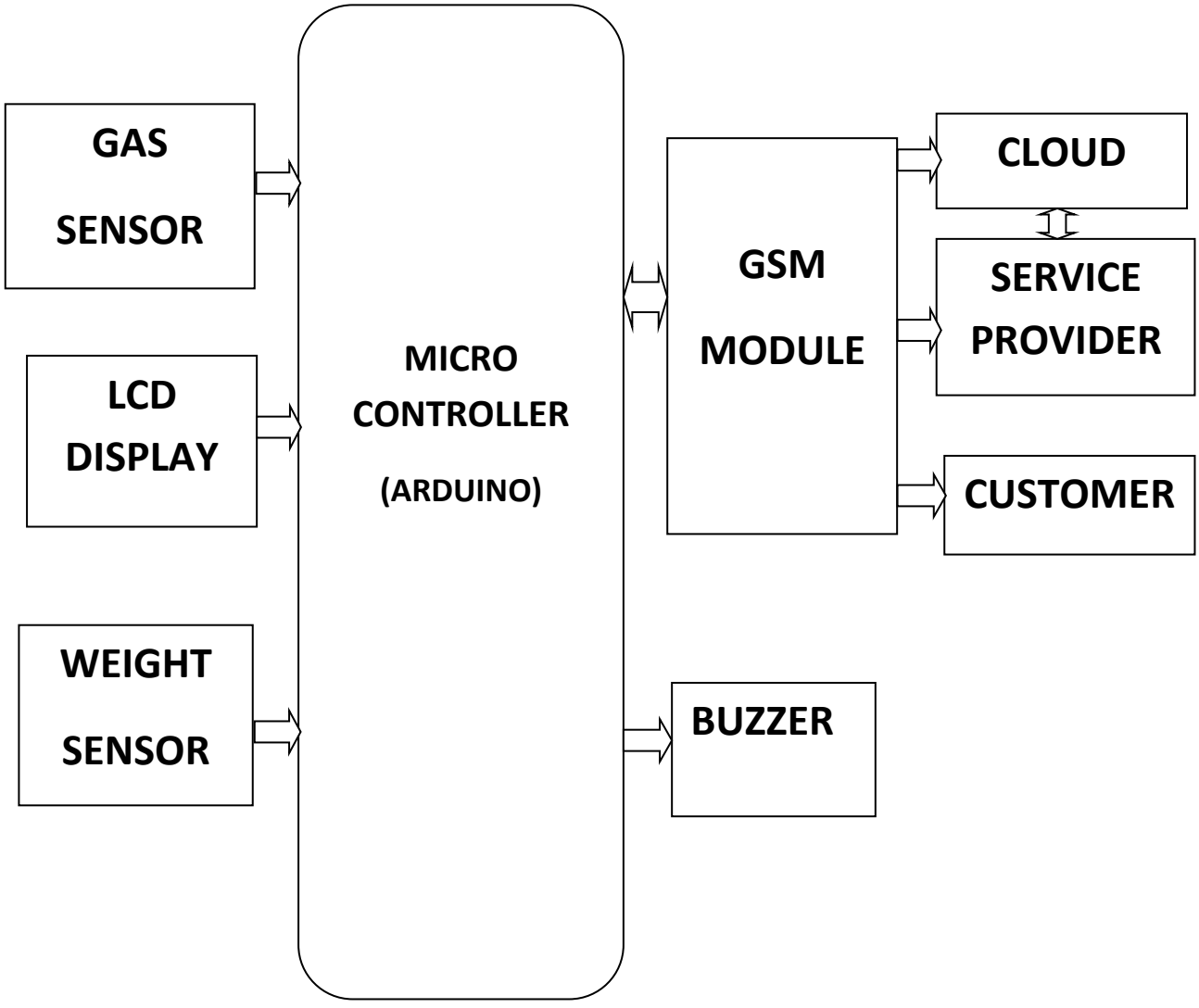

Fig.3.1: Block Diagram of Smart Gas Booking System And Leakage Detection

The functions of the blocks shown in above Fig.3.1 can be elaborated briefly in the following discussed points.

- LCD display continuously displays the percentage value of LPG present in the cylinder.
- Weight sensor measures the amount of LPG present in the cylinder.
- Gas sensor checks the over leakage of LPG.
- GSM module is used for send the SMS alerts to the user and service provider, and also sends the data of periodic usage to the provider's data base.
- The function of buzzer is to give the sound alert at the time of leakage.
- Cloud based server is used to store the LPG regular usage of the customer.
- Arduino board is a microcontroller development board which is used for controlling all the peripherals interfaced to it.

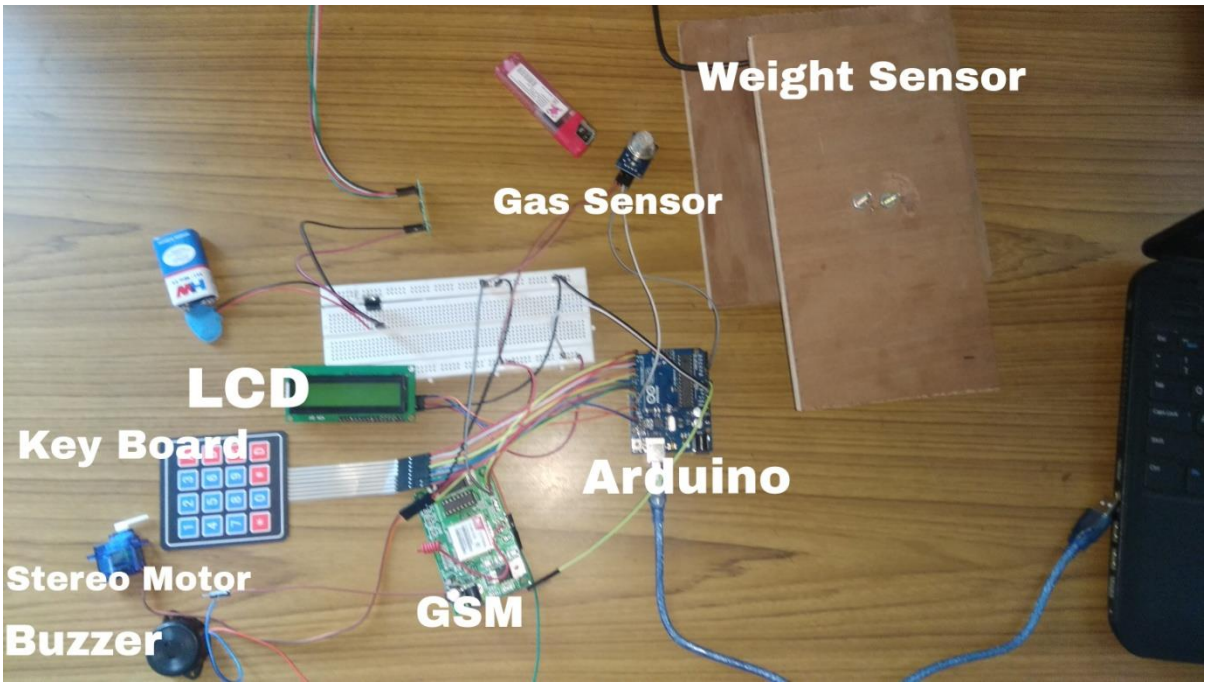

Fig 3.2: Photo of the components with their connection

The figure 3.2 shows the picture of all the components with their connections which are used in the design of the system.

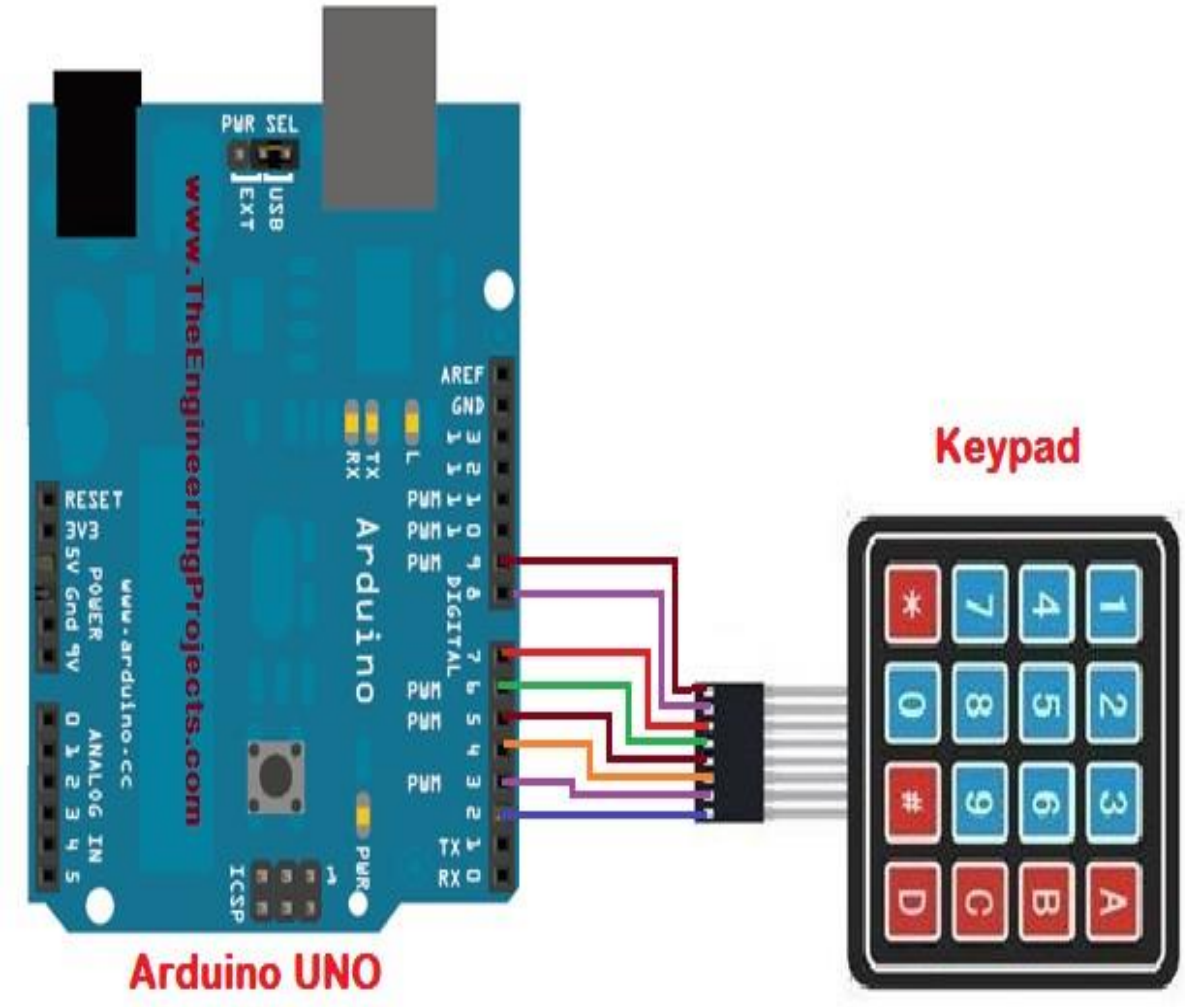

Fig 3.3: Interface of the Key Pad with the arduino UNO

The figure 3.3 shows the Interfacing diagram of the key pad with the micro controller arduino UNO. It shows how the wiring should be done between the arduino board and the key pad. Key pad has 8 pins which represent 4 rows and 4 columns of the key pad. They are to be given to the digital pins of arduino from pin number 2 to pin number 9 as shown in the above figure 3.3.

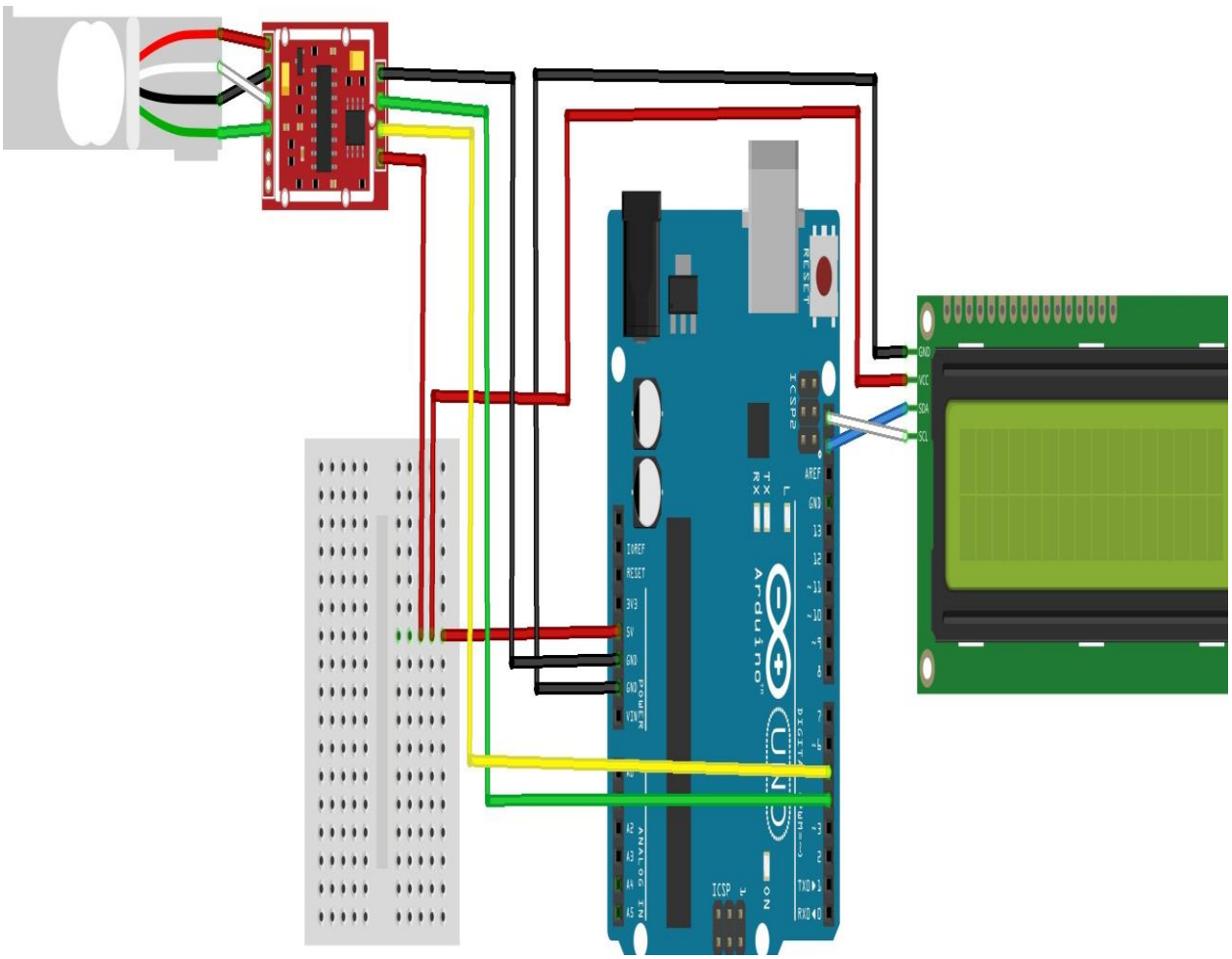

Fig 3.4: Interface of the LCD and the Weight sensor with the Arduino UNO

The figure 3.4 shows the Interfacing diagram of the LCD display and the weight sensor with the Arduino UNO board via bread board. Weight sensor has 4 pins, they are VCC, GND, SCK (serial clock) and DT (data transfer).

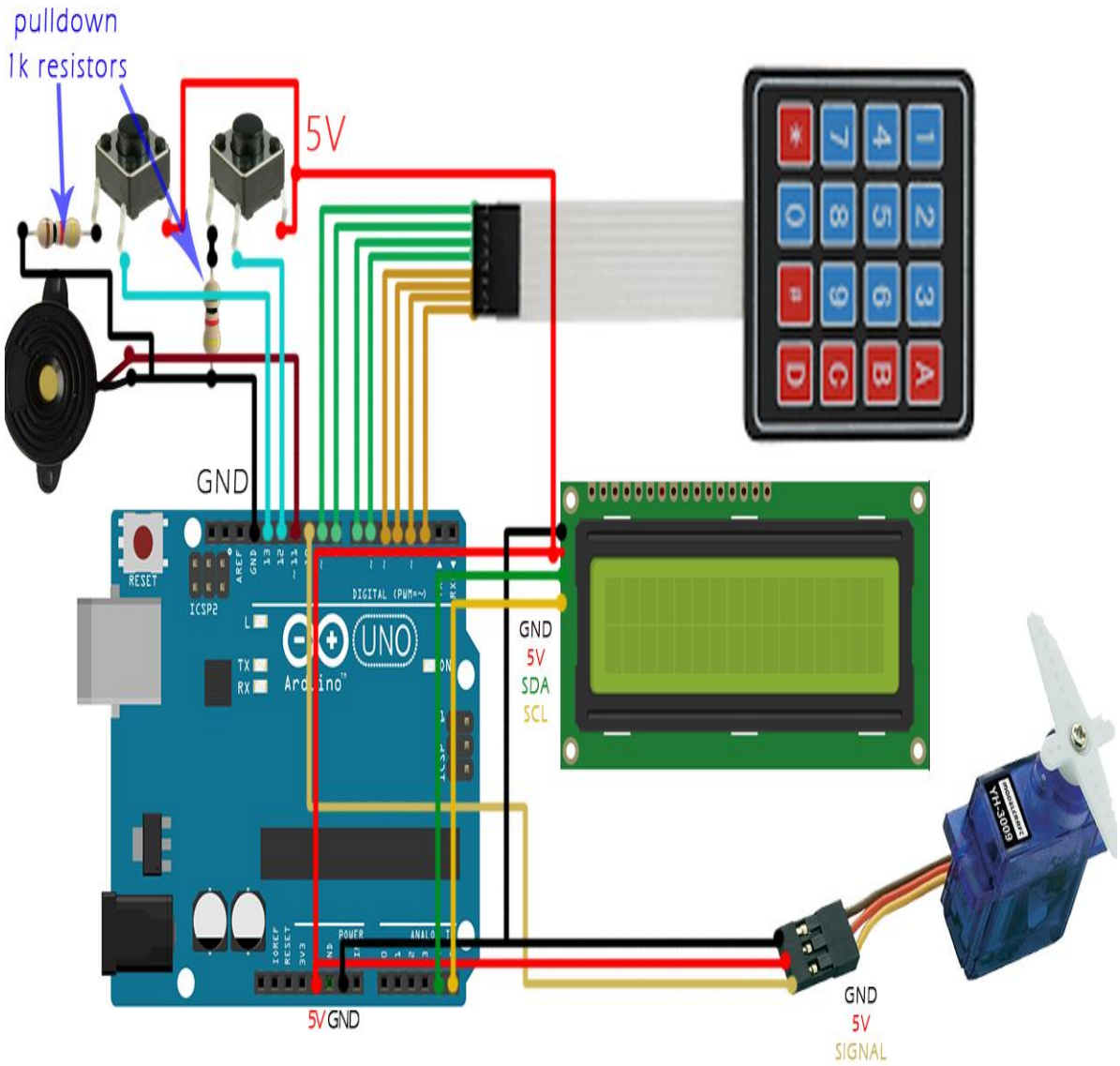

Fig 3.5: Interface of Servo motor, key pad, LCD and buzzer with Arduino UNO

Figure 3.5 shows the interfacing diagram of the LCD, buzzer, Key Pad and Servo motor with Arduino UNO. Servo motor has 3 pins that are VCC, GND,

4. SYSTEM IMPLEMENTATION

System implementation here refers to the designing of the system in terms of programming it to do all the required works of the system. First we shall see what all libraries should be attached to the program so that we can make use of the various functions under them. The below figure 4.1 is the screenshot of code that shows how the libraries can be attached to the program.

The initialization of all the peripheral components such as LCD, key pad, servo motor load cell and GSM can be done as shown in the figure 4.1. And the set up of servo motor, load cell, LCD and buzzer as shown in the figure 4.2. And the loop function which keeps the system in the continuous working state is shown in the figure 4.3. Then selectable options of the operation to be performed are to be displayed on the LCD. So the portion of code for this is shown in the figure 4.4. Then the keypad event function which deals with the keypad and detects which key is pressed by the user and performs that particular task of action. This portion of the code is shown in the figure 4.5.

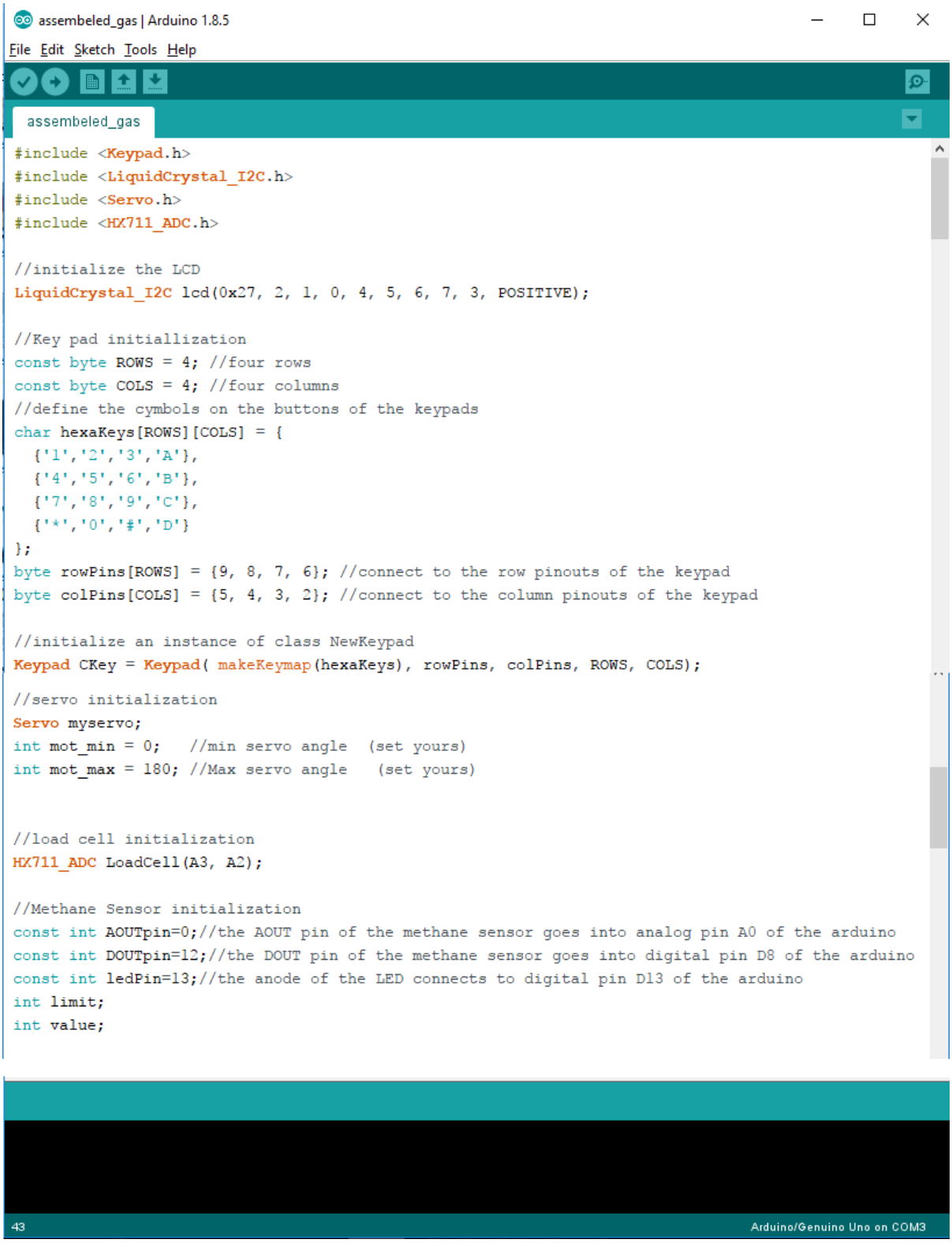

Fig. 4.1: Code for library and initialization

Fig. 4.2: Code for setting up of peripherals

Fig. 4.3: Code for contineous loop function

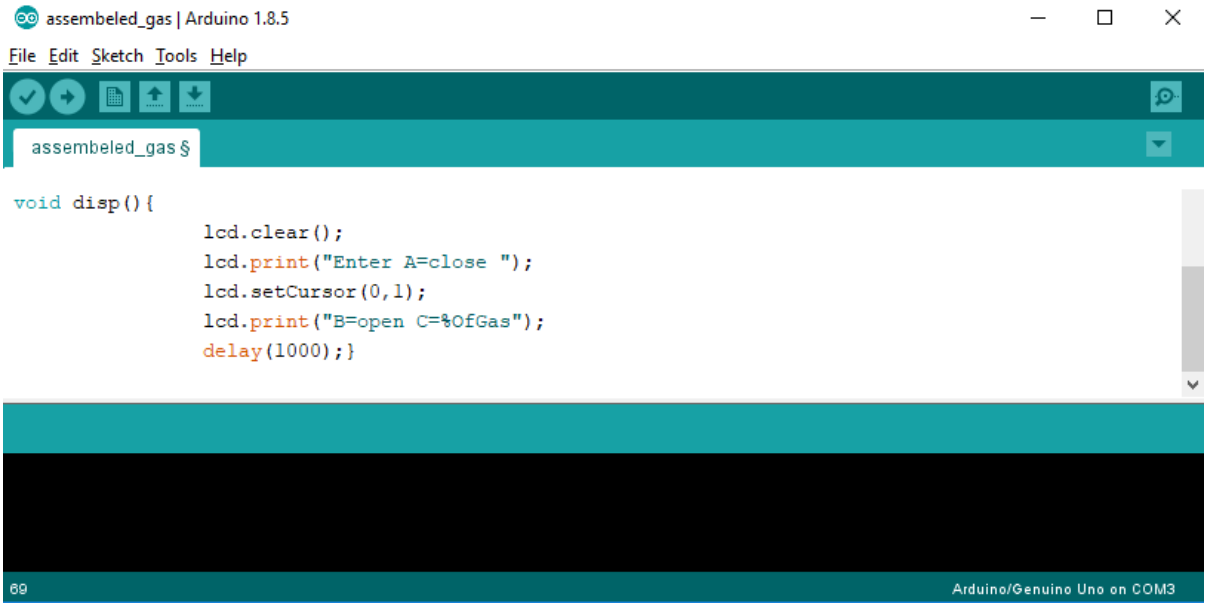

Fig. 4.4: Code for displaying options of operation

Fig. 4.5: Code for keypad event

5. OPERATION

Operation describes how various operations take place during the step by step working of system. The operation of the system can be understood by referring to the outputs of the system when the particular inputs are given. The following pictures show the various results which were observed while working on the system at the different stages of operation.

When the system is initially turned ON, it displays the short title of the system as "<--Smart GAS-->" in the first line of the LCD display. In the second line the system asks the user to press "*" key from the key pad to start the system. This is shown in the below figure 5.1.

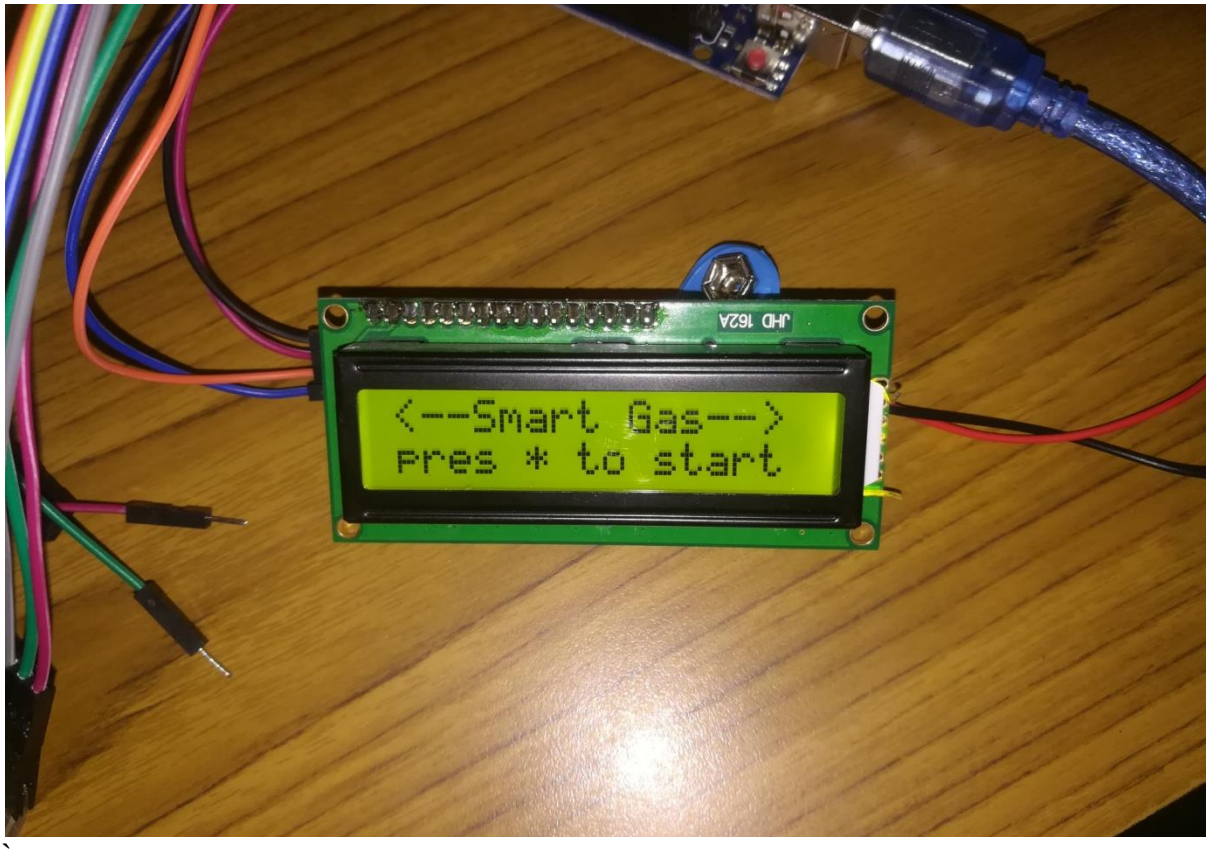

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Fig. 5.1: Initial start up display from LCD

When the "*" key is pressed from the Key Pad, the system gets started. The system gives three options to user to select the operation to be performed by the system. The three options are displayed on the LCD display. The three options are as follows:

Enter

- A = Close
- B = Open
- C = Percentage Of Gas

This is displayed on the LCD as shown in the below figure 5.2

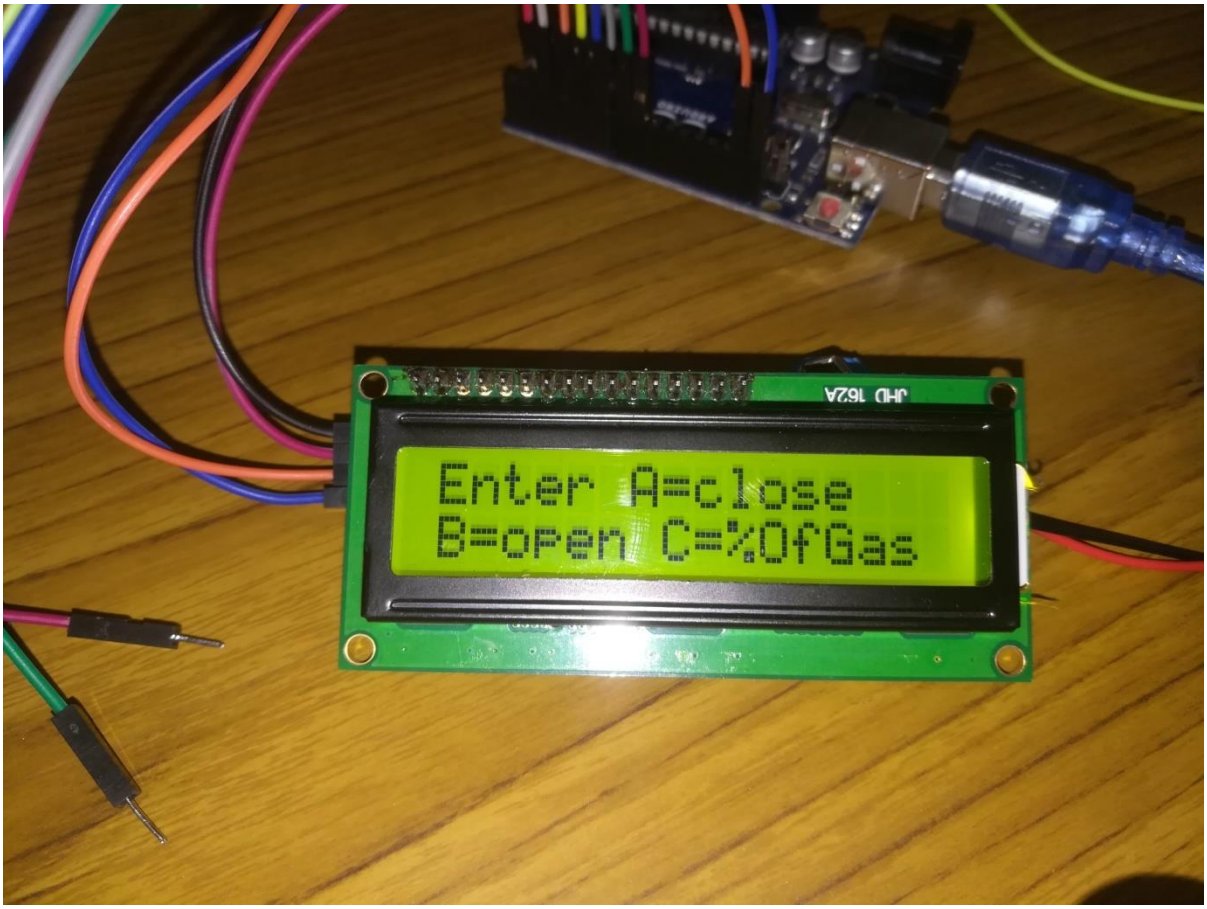

Fig. 5.2: Options to select the operation of the system

When the user selects the option A, the regulator valve of the cylinder is turned OFF and the same is displayed on the LCD as “Valve Closed”. And when the user selects the option B, the regulator valve of the cylinder is turned ON and the same is displayed on the LCD as “Valve opened”. These operations are shown in the below figure 5.3 to figure 5.6.

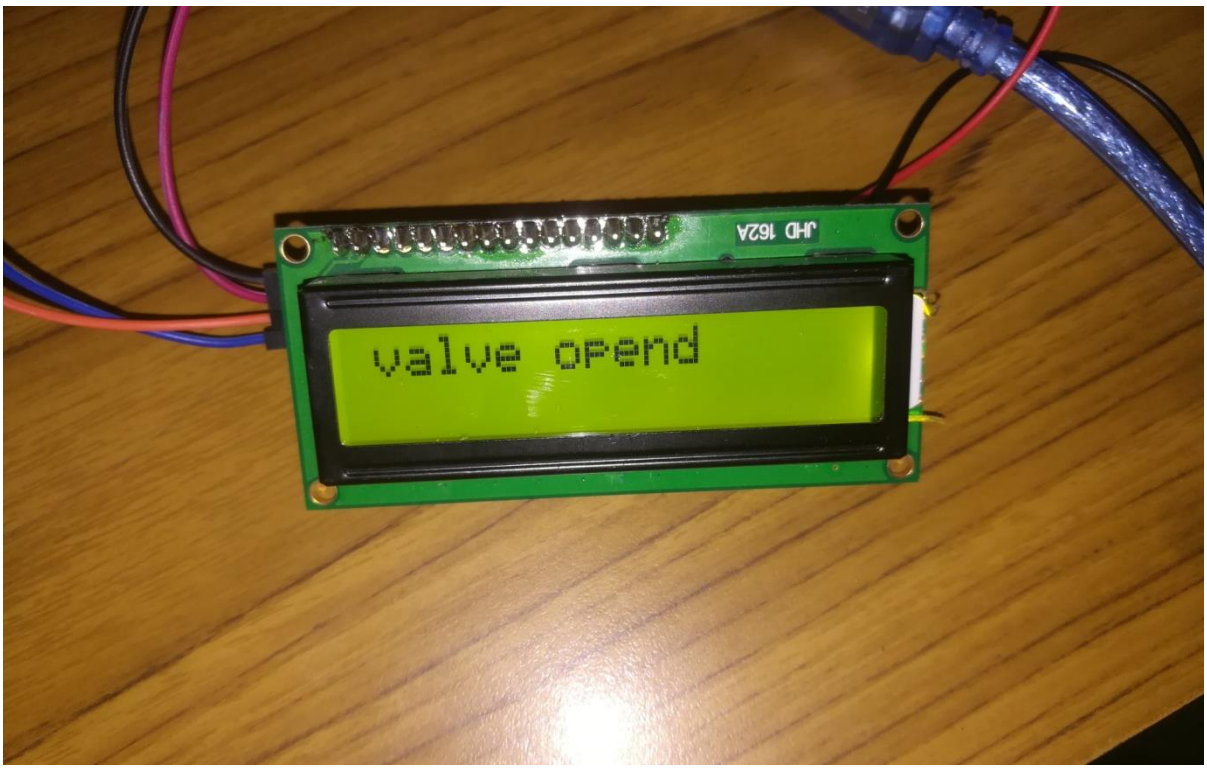

Fig. 5.3: LCD display showing Valve Opened

Fig. 5.4: Servo motor showing Valve Open

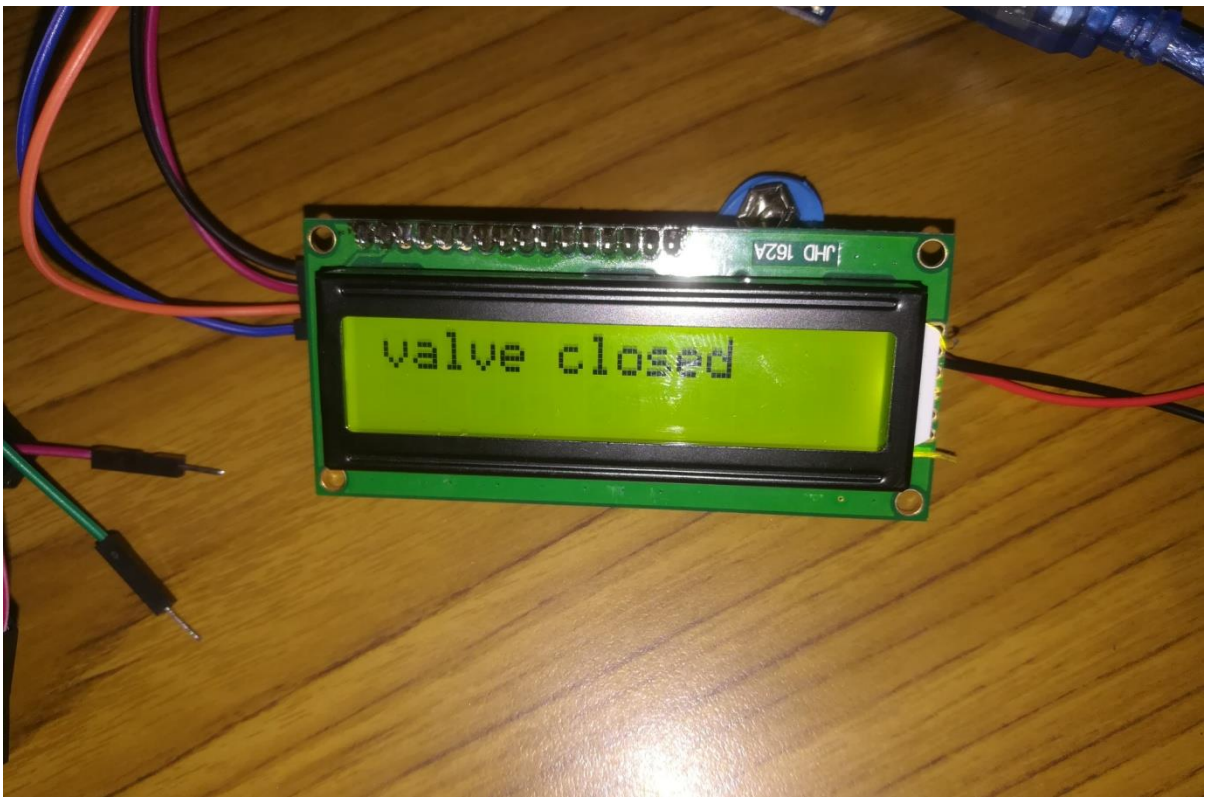

Fig. 5.5: LCD display showing Valve closed

Fig. 5.6: Servo motor showing Valve Close

When the user selects the option C, the percentage of the gas present in the cylinder is displayed on the LCD. This is shown in the below examples of various percentages in the figure 5.7 and figure 5.8.

Fig. 5.7: Percentage of gas displayed on LCD

Fig. 5.8: Percentage of gas displayed on LCD

When the gas sensor detects any kind of gas leakage then it gives buzzer and turns OFF the regulator. The system informs to the user by sending SMS that “Gas LEAKAGE was detected, Regulator was turned OFF” through GSM module. The screenshot of the SMS that was sent by “Smart Gas” is shown in the figure 5.9.

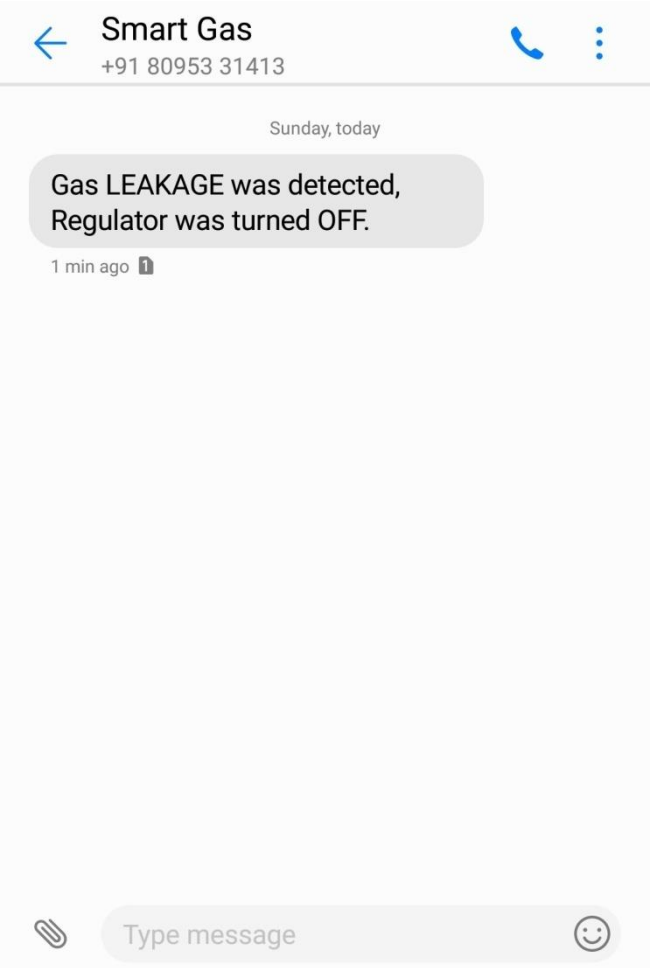

Fig 5.9: Screenshot of the SMS sent by Smart Gas

6. CONCLUSION AND FUTURE SCOPE

The on time level of LPG gas was successfully measured by the weight sensor and the same was displayed on the LCD display. The alert signal of low level LPG in the cylinder was detected by the weight sensor and a SMS was sent to the user and the LPG cylinder provider using GSM module. And whenever the leakage of LPG was detected by the gas sensor, an alert buzzer was turned on for a short duration of time, and the system's regulator valve was turned off using servo motor, and the SMS alert was sent to the owner.

In future, the system can be improved in terms of software or hardware. The software can be improvised by updating it to work on the new features such as collection of the day today usage of the LPG cylinder for the analysis purpose. This data can be used to deliver the LPG cylinder just before the cylinder goes totally empty. This data can also be used to analyze various parameters and form a statistical data of total and average usage of all the LPG users.

The hardware can be improved by using more efficient microprocessors such as Raspberry pi which contains the WIFI module in-build on it. So that the use of GSM module can be eliminated. This will reduce the overall power usage of the system. The weight measuring capacity of the system can be increased by using the load cell of higher capacity.