International Journal of Computational Intelligence Research (IJCIR). ISSN 0973-1873 Vol.14, No.1 (2018)

Automated PNG Meter Reading and Monitoring Using Internet of Things

Vipul Bhanushali
UG Student, KJSIEIT, Mumbai
University of Mumbai, India
vipul.mb@somaiya.edu

Dhanesh Bhat
UG Student, KJSIEIT, Mumbai
University of Mumbai, India
dhanesh.bhat@somaiya.edu

Akash Deshpande
UG Student, KJSIEIT, Mumbai
University of Mumbai, India
akash.deshpande@somaiya.edu

Himanshu Dhedhu
UG Student, KJSIEIT, Mumbai
University of Mumbai, India
himanshu.dhedhu@somaiya.edu

Sunil Patil
Faculty, KJSIEIT, Mumbai
University of Mumbai, India
sunilpatil@somaiya.edu

***Abstract*— With the rapid growth in use of PNG by domestic customers for cooking purpose, there is a dire need to automate the PNG meter reading. Currently the process of meter reading is as follows:**

The general pattern of billing is to bill for gas consumption every two months. The first bill is as per the meter reading. It gives actual gas consumption. The second bill is as per "assessed" basis. Thereafter, repetition of actual reading and assessed reading is done alternately for billing purpose. If actual reading is unavailable, for whatsoever reason, the bill is then generated on "estimated" basis.

Thus in order to overcome the drawbacks and to minimize human involvement and efforts, automatic bill reading and monitoring system is required. Since the meter data is readily available, the billing cycles are available to the customers instead of the traditional billing cycles. Automatic bill reading and monitoring system also provides improved billing and tracking of usage.

This project focuses on automatically collecting consumption data from gas meter and transfer of that data to a central database for the purpose of troubleshooting, billing and analyzing.

Keywords—PNG Meter, Internet of Things (IoT), BMP180, Arduino.

I. INTRODUCTION

A PNG meter is primarily used for the measurement of volume of gas consumed at residential, commercial or industrial premises.

Gas meters can be categorized into two types:

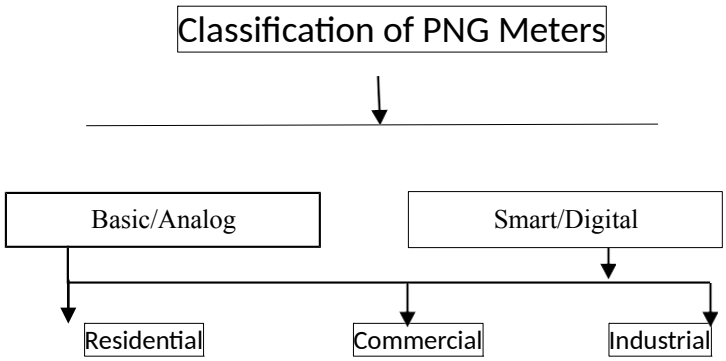
1. Basic/Analog: Analog gas meters need a meter reader to record the measured data. multiply current network speed.

2. Smart/Digital: Smart meters are capable of wireless communication, and transmit all the necessary information related to gas consumption.[2]

II. SMART METERS:

1) PNG Smart meters work with a smart energy monitor, that can be placed anywhere in homes, to show how much energy has been used and an indication of how much it's costing the consumer, in desired currency. It can view both your gas and electricity consumption.

2) The smart PNG meters are the new trend setters in energy market because of the major benefits.



BENEFITS OF SMART METERS:

1) Better management of energy use: The smart energy monitor displays the natural gas consumption rates in real time. It helps the user to manage consumption and restrict gas use through small changes such as switching off appliances when not in use, thereby leading to considerable savings.[2]

2) Personalized report: The smart meter can generate a smart and personalized report which gives valuable insights to the customer about the gas usage as well as about its cost. Report statistics are available on an hourly, daily, weekly, and monthly basis with a detailed breakdown of particular usage.

3) Accurate billing: Smart gas meters provide accurate readings, eliminating the possibility of human error while taking the readings from the meter. The automated utility bills the user appropriately based on their exact consumption.[2]

OBJECTIVES:

1) The users can be aware of their gas consumption. The human work of collecting readings by visiting every home at the end of every two month can be avoided by generating bills automatically. The errors in the system can be identified quickly.

2) The main intention of the project is to automatize the reading and monitoring of the LPG Gas meter reading.

3) To create and maintain a data base of the LPG Gas consumed by the consumers. This timely information coupled with analysis can help control the consumption of the LPG Gas.

4) The main aim of project is to provide lowering the cost of meter reading, provides real-time billing information, reducing estimated readings and re-billing costs, enhances employee and customer safety by reducing the number of personnel on the road and providing safer reading methods, reduces billing errors and disputes, enables flexible reading schedules.

III. COMPONENTS

- ARDUINO UNO:

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller, simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The UNO is the latest in a series of USB Arduino boards and the reference model for the Arduino platform.

Some technical specifications of this device are as follows:

- Microcontroller : ATmega328
- Operating Voltage : 5V
- Input Voltage(recommended) : 7-12V
- Input Voltage(limits) : 6-20V
- DC Current per I/O pin: 40mA
- DC Current per 3.3V pin: 40mA
- SRAM : 2 KB
- EEPROM : 1 KB
- Clock Speed : 16 MHz

- HC-05 BLUETOOTH MODULE:

HC-05 module is an easy to use Bluetooth SPP (Serial Port

Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3 Mbps.

Fig. 1: Arduino Uno

- BMP180:

The BMP180 is a basic sensor that is designed specifically for measuring barometric pressure (it also does temperature measurement on the side to help). It's one of the few that does this measurement, and it's fairly low cost so you will see it used a lot. You may be wondering why someone would want to measure atmospheric pressure, but it is actually really useful for two things. One is to measure altitude. As we travel from below sea Level to a high mountain, the air pressure decreases. That means that if we measure the pressure we can determine our altitude -handy when we don't want the expense or size of a GPS unit. Secondly, atmospheric pressure be used as a predictor of weather which is why weather-casters often talk about "pressure systems."

Specifications:

- Pressure sensing range:300-1100 hPa (9000m-500m above sea level)
- Upto 0.03 hPa/0.25m resolution.
- -40 to +85°C operational range, ÷ -2°C temperature accuracy.
- 2-pin I2C interface on chip.
- V1 of the breakout uses 3.3V power and logic level only.
- V2 of the breakout uses 3.3-5V power and logic level for more flexible usage.

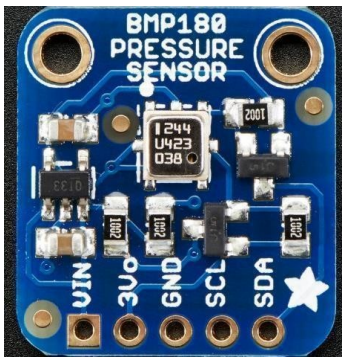


Fig. 2: BMP180 Sensor

IV. IMPLEMENTATION

❖ Working:

Modulation with complete 2.4 GHz radio transceiver and baseband. It uses CSR Bluecore04-External Single chip Bluetooth system with

CMOS technology and with AFH (Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7mmx27mm.[3]

Hardware Features:

- Typical -80dBm sensitivity
- Up to +4dBm RF transmit power
- Low Power 1.8V Operation
- PIO control
- UART interface with programmable baud rate
- With integrated antenna
- With edge connector
- Power supply: +3.3V DC 50mA
- Working temperature: -20 to 75 Centigrade
- Frequency: 2.4 GHz ISM band

Software Features:

- Default Baud Rate : 38400
- Data Bits : 8
- Data Control: Has supported baud rates 9600, 19200, 38400, 57600, 115200, 230400, 460800.
- Auto connect to the last device on power as default.
- Permit pairing device to connect as default.
- Modulation: GFSK (Gaussian Frequency Shift Keying)
- Security : Authentication and Encryption.4

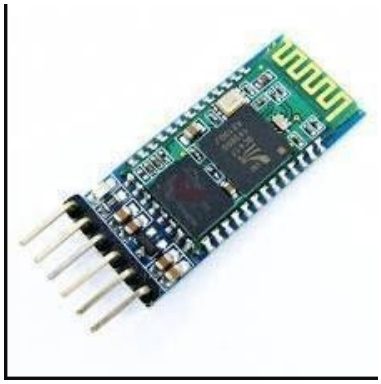


Fig. 3: HC-05 Bluetooth Module

- Hardware Implementation:

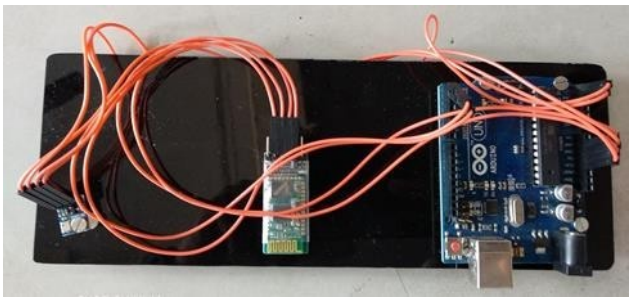


Fig. 5: Hardware Implementation

Connect the VCC pin to a 3.3V power source. The VI of the sensor breakout cannot be used with anything higher than 3.3V so don't use a 5V supply. V2 of the sensor board has a 3.3V regulator so you can connect it to either 3.3V or 5V if you do not have 3V available. Connect GND to the ground pin. Connect the I2C SCL clock pin to the I2C clock pin. On

- BMP180 is Pressure sensor which senses the pressure and temperature.
- Sensor is directly connected to a microcontroller via the I2C bus.
- The pressure and temperature data has to be compensated by the calibration data of the E2PROM of the BMP180.
- The BMP180 delivers the uncompensated value of pressure and temperature.
- The E2PROM has stored 176 bit of individual calibration data. This is used to compensate offset, temperature dependence and other parameters of the sensor.
- The arduino receives the readings from the pressure sensor.
- It is further connected to the computer using USB connector.
- Purchase cloud space from the provider.
- The cloud space is used to create a database of the all the users meter readings and the application is also put on the cloud.
- The respective users can get their readings via this application.
- The computer has a program running in Visual Basics. The program in Visual Basics keeps transmitting the values being received from the arduino board to the cloud.
- Another application written in asp.net is put on the cloud space, This app which is running on the cloud can be accessed by any customer via the web browser.

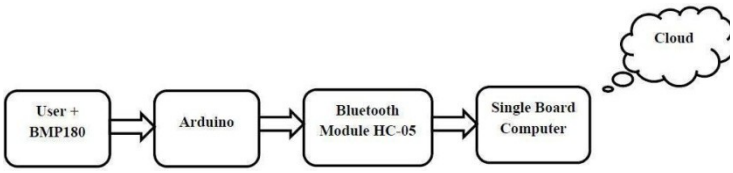


Fig. 4: Block Diagram

the classic Arduino Uno/Diecimilia/etc this is Analog pin #5. Connect the I2C SDA data pin to your I2C data pin. On the classic Arduino Uno/Diecimilia/etc this is Analog pin #4. Unfortunately, the I2C lines on most microcontrollers are fixed so you're going to have to stick with those pins.

The Arduino Uno is attached to the PC using a USB cable and the latest version of the Arduino IDE has to be installed in the computer to be used.

- Softwares Used:

1. Arduino IDE:

Arduino is an open source computer hardware and software company, project and user community that designs and manufactures single board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. The project's products are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License

(GPL), permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially in preassembled form, or as do-it- yourself (DIY) kits.
Arduino board designs use a variety of microprocessors and controllers. The boards are 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 boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler tool chains, the Arduino project provides an IDE based on the Processing language project.

Applications:

- Domestic Gas Meters.
- Commercial Gas Meters.
- Prepaid Gas Meters.

Future Scope and Benefits:

2) Microsoft Visual Studio:

Microsoft Visual Studio is an integrated development environment (IDE) from Microsoft. It is used to develop computer programs, as well as web sites, web apps, web services and mobile apps. Visual Studio uses Microsoft software development platforms such as Windows API, Windows Forms, Windows Presentation Foundation, Windows Store and Microsoft Silverlight. It can produce both native code and managed code.
Visual Studio supports 36 different programming languages and allows the code editor and debugger to support (to varying degrees) nearly any programming language, provided a language-specific service exists. Built-in languages include C, C++, C++/CLI, C#, F#,JavaScript, TypeScript, XM L, XSLT, HTML and CSS. Support for other languages such as Python, Ruby, Node.js, and M among others is available via plug-ins. Java (and J#) were supported in the past.
The most basic edition of Visual Studio, the Community edition, is available free of charge.

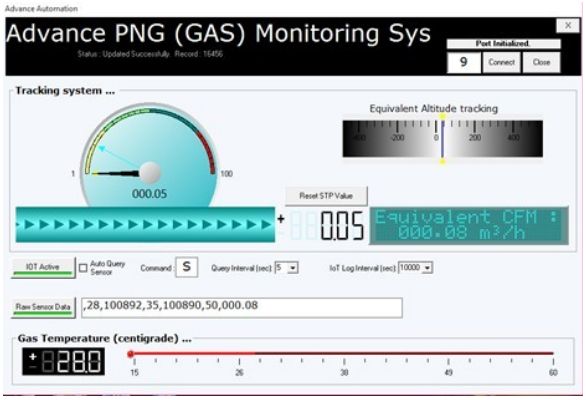


Fig. 6: Microsoft Visual Studio

V. Results And Conclusion:

Thus with this project we will be successfully able to automatize the PNG meter reading at every household, save utility providers the expense of periodic round trips to each physical location to read a meter. We will also create and maintain a database of the PNG consumption. This information coupled with analysis can help control the consumption of the gas. We wish to reduce manual labor which obviates capital cost. Additionally this will be an accurate and cost effective model.

In our prototyped project the readings obtained from arduino board are stored in computer using visual basic software, however in future for commercial use the SBC (single board computer), such as Raspberry pi can be used.

Also home automation can be provided by reading and monitoring the energy meter along with LPG gas meter using

Internet of Things (IoT). If implemented professionally „N" number of I2C sensors can be ordered with each one having a unique slave address, when the socket application updates the data onto the cloud it can be programmed to send both the address and the pressure value.

Benefits of advanced metering:

Advanced metering systems can provide benefits for utilities, retail providers and customers. Benefits will be recognized by the utilities with increased efficiencies, outage detection, tamper notification and reduced labor cost as a result of automating reads, connections and disconnects. Retail providers will be able to offer new innovative products in addition to customizing packages for their customers. In addition, with the meter data being readily available, more flexible

billing cycles would be available to their customers instead of following the standard utility read cycles. With timely usage information available to the customer, benefits will be seen through opportunities to manage their energy consumption and change from one REP to another with actual meter data. Because of these benefits, many utilities are moving towards implementing some types of AMR solutions. The benefits of smart metering for the utility:

- Accurate meter reading, no more estimates.
- Improved billing.
- Accurate profile classes and measurement classes, true costs applied.
- Improved security and tamper detection for equipment.
- Energy management through profile data graphs.
- Less financial burden correcting mistakes.
- Less accrued expenditure.
- Transparency of "cost to read" metering.
- Improved procurement power though more accurate data - 'de-risking" price.

The benefits of smart metering for the customer:

- Improved billing and tracking of usage.

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