Advanced Billing Smart Meter for Electricity, Water, and Gas using GSM

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Abstract - *Due to the COVID-19 lockdown, people faced the problem with the electrical billing system. The computergenerated billing system is set in such a way that it is taken either monthly/bi-monthly. But, this time the bill has been generated after 65 to 67 days due to COVID-19 lockdown. So there has been a jump in the slab rates, this made consumers suffer by being charged more than what is to be paid. To this disadvantage, we have thought of a smart energy meter utilizing GSM. The system to explore the new possibilities for the next generation, a programmed meter perusing, whose objective is to gather the meter perusing consequently sending messages from the Modem to remote mobile phone. The process of noting down the meter readings is easier and accurate. Besides, the consumer can access the notification regarding the scenario with power from any place. GSM recipient consists of data set that functions as a charging point that is connected to a PC from the opposite end. Occasionally from the GSM empowered energy meter's pursued live meter is directed back to the charging point. In addition to electricity, this system includes a water and gas billing system. Water and gas are vulnerable to human mistakes as well as consumption of time and labor are intensive. The proposed framework exhibited its ability to monitor the Energy utilization, send the notification to the mobile phones when the breaking point is approached, using effectively by rebooting, just by getting to a GSM-based cell phone.*

Key Words: GSM-based Energy meter, GSM-based Water billing meter, Gas Leakage Detection, Automatic meter reading (AMR).

1. INTRODUCTION

Life's content is maintained by an indispensable requirement that is electricity. For around 10 years advanced energy meter innovations have been explored. Over the decades, a lot of advancements took place that decreased hefty and complex meters to simple measuring and billing meters by improving highlights, determination. Nowadays, due to the immense distinction in energy creation and utilization, energy consumption and energy conveyance have gotten a major subject for conversation. Then again, customers are likewise not happy with the administrations of force organizations[1]. More often than not they have grumblings in regards to factual mistakes in the month-to-month bills. Advanced billing smart meters

can undoubtedly take readings, significantly decline the bill of a client by cautioning the client with an alarm message prior to multiplying the unit charge and lessen the squandering of force.

At present, the meter consists of a roundabout metal strip that pivots and as per that revolution, energy consumption is calculated. But, the consumption of energy is the main working of the meter. With this are aiming to get the month-to-month energy utilization from a distant place to an incorporated office[2]. Along these lines, we can decrease the human endeavors expected to record the meter readings which are recorded by visiting every home exclusively till today. It's difficult to screen the changing most outrageous interest of users in the circulation organizations of the current billing system. The user is confronting issues like getting due bills for charges that have effectively been paid just as helpless dependability of power supply and quality regardless of whether the bills are paid consistently. The solution for this load of issues is to monitor the customer's heap on a convenient premise, which will have held to guarantee exact charging, track the greatest interest, and checking set value. These are generally the features to be considered for arranging a capable energy charging framework.

Similarly, Water distribution and its control over the billing cycle is one of the most challenging tasks for the government[3]. Municipal Corporation Water Distribution System is a manual system and it is difficult to monitor the consumption of water centrally. The existing system fails to monitor the quantity of water. This proposed system i.e., the smart energy meter is fully automated. We get real-time data of consumption and can control the valve to restrict the flow of water. Consumers can interact with the mobile application to monitor the usage and for payment of bills or to stop or start the service. And these water meters are connected via GSM which will take the data from that meter and send it to the server. It also consists of Flow Sensor, Microcontroller, and GSM module. This system enables respective departments to access the meter recordings monthly, avoiding the traditional practice. The value will be set previously, when this value gets closer the user receives the message of alert in a verbal format via GSM.

A Smart Meter works by estimating the electrical flow stream and voltage at standard stretches and afterward adding this up to ascertain the force utilized savvy Meter works by estimating the electrical flow stream and voltage at ordinary spans and afterward adding this up to figure the

force utilized. Additionally, for gas, the stream is estimated at customary stretches. This information can be seen on your mobile application and sent to your supplier. This meter not only calculates the consumption of gas but also detects and prevents the leakage of gas. Various communications technologies might be utilized in various types of premises for the Home Area Network to convey and various advances will be utilized in various pieces of the nation to permit the Wide Area Network to send information to and from the organization giving the correspondences.

2. METHODOLOGY

The current framework presents another technique for Programmed meter perusing electronically and communicating to base camp for additional handling and consumers. This aids in lessening the human mistakes that happen in the current meter perusing frameworks blend of both technologies: GSM networks and embedded systems. The proposed system consists of three main components: Electricity, Water, and Gas.

Allow us to think about an illustration of Electricity; here we are associating the Energy Meter between the fundamental stockpile and load, by which Microcontroller will want to quantify the energy units devoured by the user. When the various applications are given squinting, the units are considered the family devours energy the energy meter peruses the perusing persistently and this burnedthrough burden is displayed on the meter. It is observed that the LED of the meter constantly squints, which checks the meter perusing. The units are checked based on the number of times it blinks.

Typically, 3200 flickers are one unit. In our task, we are attempting to create, a framework where PIC16F877A goes about as the fundamental regulator, which constantly monitors the advanced building meter. According to the flickering of the LED on this meter, the PIC16F877A will gauge the unit utilization. The deliberate perusing with the estimation of the expense will be consistently shown on the web that we have developed. Communication medium that depends on the current GSM network. The Meter billing and control operations will be performed simply using the Short Messaging System service that is available over GSM. For this, no alteration or even customization is required in the actual network.

The threshold value can be set according to the user's necessity. At the point when the users perusing will be close reaching the set edge esteem it's anything but a warning worth to the customer Via GSM. Above limit, esteem warning builds mindfulness among the buyer about this energy. Similarly, Gas and flow meters are used to check how much amount of gas and water has been used based on that bill has been generated. The Microcontroller processes the measure of energy, water, and gas burned through. Then, at that point, the determined quantities are sent

immediately by means of GSM to the MAIN STATION and the essential updates are performed.
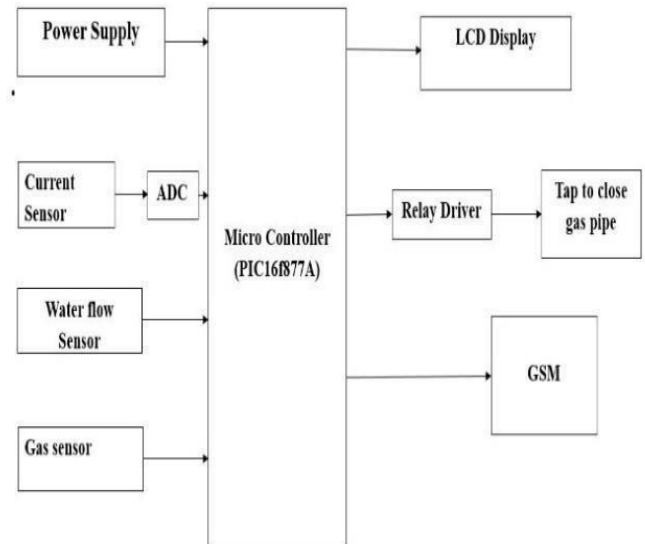
3. BLOCK DIAGRAM

Fig -1: Block diagram of the proposed system.

Fig 1 shows the block diagram of the proposed system. The micro-controller used in this is PIC16f877A to which the power supply is connected. The current sensor, water flow sensor, and gas sensor are connected to the microcontroller, where the current sensor is connected via ADC. Once the operation takes place the reading of the current, water, and gas is displayed on the LCD which is again connected to the microcontroller, when there is a gas leakage, the gas sensor will detect and send it to the microcontroller, where the relay driver helps to increase the voltage and closes the tap of gas pipe, all these information will be sent to the mobile phone via GSM.

4. HARDWARE COMPONENTS

4.1 PIC16F877A

PIC belongs to a family of microcontrollers, which are made by microchip technology. They are highly used for industrial purposes as they consume low power and gives high-performance ability. The supporting hardware and software are easily available. In our project, we have used embedded C for programming this microcontroller.

4.2 Power supply

A microcontroller meets a power supply for its operation an AC to DC adapter along with the voltage regulator is used for supplying power. The voltage which is supplied to the microcontroller should be 5V DC, hence a voltage controller is used to reduce the voltage from 12 to 5V. The 12V DC

input may be un-regulated so a 7805 voltage controller is used.

4.3 Relay driver

It is an electromagnetic switch that is used to switch ON or switch OFF electrically. It is used when we have to control a circuit having low voltage with a 220 volt supply. It also has the ability to seclude the driver circuit as it can withstand high currents and electrostatic discharge.

4.4 Gas sensor

It is an electronic device used to detect or identify different gases. They can be used to detect toxic and explosive gases and also find out the concentration of that gas. it is very sensitive to liquefied petroleum gas, natural gas, town gas, and so on. It is less affected by smoke or liquor and also has a fast response time of fewer than 10 seconds. it is very stable and has a long life.

4.5 LCD (Liquid Crystal Display)

The LCD and LED are the most generally utilized showcase in the installed embedded systems. Embedded indicates a combination of hardware and software. LCD is a 16 pin connector.

4.6 Water Level Sensors

It is used to indicate the water level in a container or a tank. It uses sensor probes for indication purposes. We have used it to measure the amount of water flow that takes place through the pipe.

4.7 Current sensor

It is used to check the amount of current in a wire and generates a signal which is proportional to the current flowing in the wire. The signal generated is used for displaying the magnitude of current flow or save it for future references or analysis. We used current sensors in this paper to maintain or check the current flow into different components.

4.8 GSM Modem SIM 300

GSM means a global system for mobile communication. It is a hardware device that uses GSM mobile telephone technology to connect remote networks. A modem is used to send and receive messages. It uses AT commands for its operations. To interface GSM modem with microcontroller and computer we use RS232 interface. The device comes with a SIM holder and an antenna

Table-1: Specification of the Components.

SI NO.	Components	Specification
1	PIC16F877A	Operating voltage : 2 to 5.5 Program Memory: 14KB CPU Speed (MIPS): 5 MIPS RAM Bytes: 368
2	Power supply	Output voltage: 12 V
4	Gas sensor	Detection Range: 100 - 10,000ppm Fast Response Time: <10s Heater Voltage: 5.0V
5	LCD	Display: 16×2 characters Operating Temp : (0-5 ^{0}C) Power supply: 5.0 V
6	Water Level Sensors	Voltage Range: 5 to 18V DC Max current draw: 15mA at 5V Flow Rate: 1 to 30 Liters/Minute. Max water pressure: 2.0 MPa
7	Current sensors	Supply Voltage: 4.5V ~ 5.5V DC Measure Current Range: 30A ~30A Sensitivity: 100mV/A.
8	GSM Modem SIM 300	Operating Voltage: 7~15V

5. SOFTWARE COMPONENTS

In this paper, we have used embedded C programming and MPLAB IDE, and PICkit 2 software.

5.1 Embedded C

Embedded C uses C language programming and is used to develop applications that are based on microcontrollers. They are used to program hardware addresses of input and output, arithmetic operations, access of address spaces, so on.

5.2 Programming PIC Microcontroller

We use IDE (Integrated Development Environment) to program the PIC microcontroller. PIC Microcontroller programming is achieved bt a software called MP-LAB, then a suitable compiler is selected and installed like CCS, GCC compiler, etc.

5.3 PICkit 2

PICkit 2 is used for evaluation debugging and programming. PICkit belongs to a family of PIC microcontroller programmers. They also have a feature of a logic analyzer and serial communication tools.
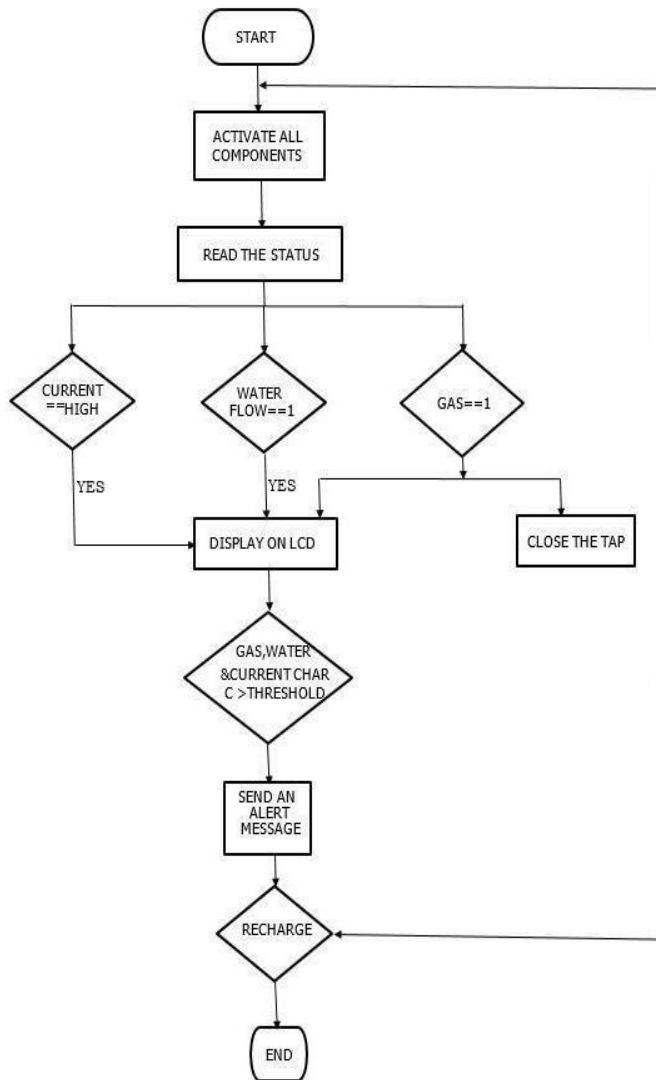
5. FLOW CHART

Fig -3: Flow Chart of the proposed system.

In fig 3, it explains the working of the system. The system starts and activates all the components as soon as it is switched on. It reads the status, if the electricity, water, and gas are higher than the previously set threshold value then it will be displayed on the LCD and also sends an alert message to our phones via GSM if it exceeds the set values the flow of the current, water, and gas will stop. If the gas leakage is detected it will close the pipe**.**

6. RESULT

The major application of this paper is related to electricity, water, and gas billing system. The electricity bill will be generated automatically every month and will be updated to the concerned department through GSM and the bill generated will be sent to consumers through SMS. Similar to the electricity bill the water and gas bills are generated. The amount of water consumed by the customers will be recorded in the meter and the meter sends the information to the concerned department through GSM and they, in turn, send the bill to the consumers.

Currently, in most parts of India, the gas will be delivered in cylinders to the consumers. In the coming future, gas pipelines will be established similar to water and the gas will be delivered through these pipes. Then the consumption of the gas must be recorded using a meter. So, this meter is automated to send the gas usage details to the concerned department and they will send them to the consumers through GSM.

Another application of this paper is the detection of gas leakage in the pipelines and taking preventive measures before the issue gets serious.

We also have the facility inbuilt for a prepaid billing system for the future. Where the supply will be stopped immediately if the prepaid amount is over.

3. CONCLUSIONS

The future advancements of this unassuming thought of our own can be the acknowledgment of a solitary chip arrangement that will impregnate inside itself a force reestimating unit, alongside a GSM-based module. This will not only reduce the size of the meter but will also make it more robust and commercially available. The tedious job of Energy Management at each substation can also be simplified by using this system, I have conglomerated the modern technologies of SIM cards and meters into a single unit believing that this will revolutionize the power scenario in our country. Along with this, Detection and Prevention of Gas Leakage are also carried out as an additional necessity by the system. To conclude, I would like to say that there can be no conclusion to the human race's constant striving for Excellence and the evolution of technology.

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