A Reviev Paper on Automatic Energy Meter Reading System

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Abstract- **The focus of this study was on the automatic reading of energy meter for billing purposes.[1] This task is accomplished using remote metre readings using GSM technology, which is used for remote readings as and when needed. As a result, there is no need to send somebody to the customer's location to gather manual readings. Smart energy metre (SEM) are these types of metre that can communicate directionally and push data without the utility's intervention. Another advantage of this method is that it can disconnect customer load if it exceeds its predefined load limit by simply sending an SMS to the client once the load is disconnected. Both the utility and the client have access to it.**

Keywords—(SEM) Smart Energy Meter, (AMR) Automatic Meter Reading, (GSM) Global System for Mobile, (SMS) Short Messaging System.

I. Introduction

In past, all homes have mechanical energy meter, which used a metal wheel to compute energy usage, but these meter could not automatically push their readings. So one person went to each customer's residence to gather the meter readings, and then a bill was created and mailed to them; this was a time-consuming and expensive process.[2] The new AMR technology, on the other hand, is extremely beneficial and beneficial to both customers and utilities. The NAN (neighborhood area network) is a sort of automatic metre reading technology that is used for short distance readings (up to 100 to 150 metre) and works on an RF Mesh Network. The other type of automatic metre reading technology is the RF Mesh Network.

[3] In this AMR technology, two modules are used: one at the meter end for data transfer to the utility server, and one at the utility server end for data collection from the smart metre side. This data is recorded in the utility server of all the energy metre installed in various locations on an hourly, weekly, and monthly basis, and can be obtained by the utility authorized person for billing purposes as and when needed. Area network in the neighborhood It is used for short distance readings, because its range is limited to 100 to 150 metre. This technology is based on an RF Mesh Network.

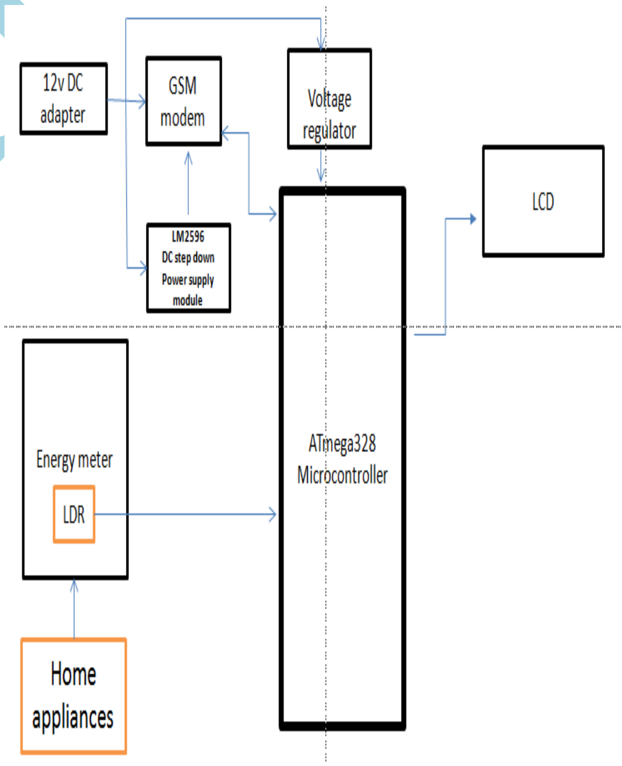

Fig. 1: Automatic Energy Meter Reading System

II. BRIEF HISTORY

Mr. Paraskevakos implemented the first AMR system in the United State in 1974, using advanced technology created by Theodore George in 1972. Smart meter billing system is a system that consists of sophisticated power measuring equipment.. These are smart energy meter, gas meter and Smart water meter, functioning of these meters are on calculating the total consumption of energy in watts or kilo watts in energy meters.[4] A low cost AMR system is designed by GPRS but the GPRS is not reliable, these meters have some features extra than the normal meters, in this system there is no need to put cables for communication. The Smart energy meter is connected to the (HES) head end system always to transfer threading. One more main advantage of smart meter is that it can push tamper events made by any customer to stop recording or disturbed its functioning either by putting abnormal electromagnetic fields or any high frequencies to the meter surface. Smart meter are differ than normal meter in terms of tamper detection feature, load switch disconnection & reconnection and payment either prepayment or postpaid type. Also we can configure these meter metering mode either net metering or import only mode as per utility requirements.

III. SMART ENERGY METER

Smart metre are digital metre that have the same size as traditional metre. Smart Energy Meters provide more precise readings in Kwhr, allowing utilities to plan transmission network development and power quality improvements. Instead of employing potential and current transformers, the Smart Energy Meter uses voltage and current sensors to monitor voltage and load currents, which are then stored in power factor controller and energy metering ICs for power factor and power calculations, respectively.

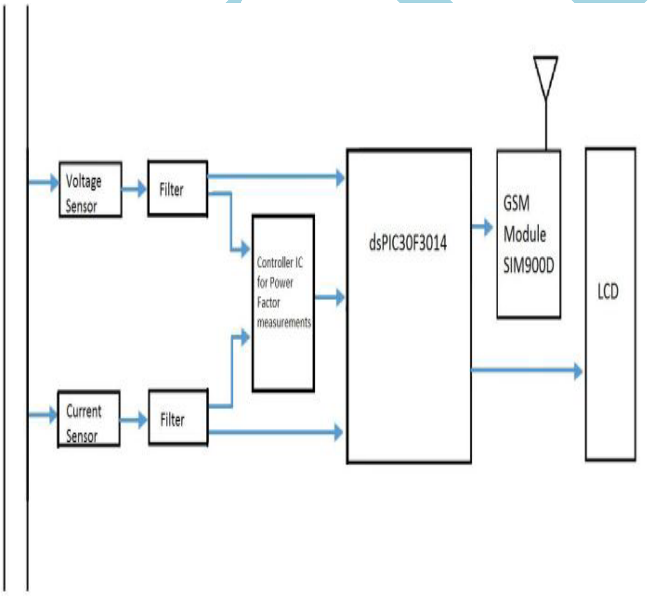

Fig. 2: Smart Energy Meter diagram

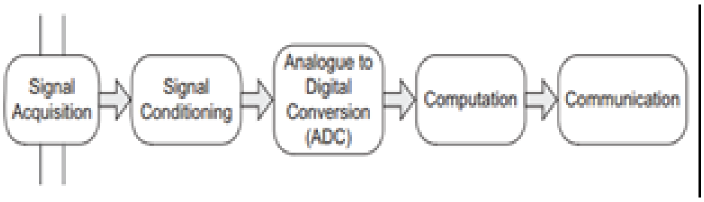

Fig. 3: An Overview of Smart meter Hardware

The five sections of the smart meter architecture are signal acquisition, signal conditioning, Analogue to Digital Conversion (ADC), processing, and communication.
The fundamental parameters must be precisely and continuously acquired during signal capture. Among the fundamental features are the magnitude and frequency of the voltage, as well as the magnitude and phase displacement (relative to the voltage) of current. Other properties such as the power factor, active/reactive power, and Total Harmonic Distortion are calculated using these fundamental numbers (THD). The current and voltage sensors, respectively, monitor the current through the load and the voltage at the supply. Signal conditioning is the process of preparing an input signal for the following stage, which is Analog to Digital Conversion (ADC).

The ADC converts analogue sensor signals into digital signals. The current and voltage signals from the sensors are sampled, digitized, and then examined by the metering software. Computation includes arithmetic operations on input signals, data time-stamping, and data preparation for transmission or output peripherals. This stage also includes payment, tamper detection, system updates, and user interaction. [5] In all energy measurement systems, communication is a must. The computed data should be transferred to an external MCU, which comprises voltage, current, power, energy, frequency, and power quality measures. For communication purposes, a smart meters use a variety of network adapters. The Public Switched Telephone Network (PSTN) is one of the wired possibilities.

The most important characteristics of a smart meter are described below.
1. Take an automatic reading of the Energy Meter and transmit it to the customer as well as the utility.
2. During the reading, voltage, load current, active power, reactive power, power factor, and units are all measured.
3. The utility can cut off or restore the defaulter's supply via SMS.

4. When you send an SMS, the Smart Energy Meter reacts and delivers you the readings.

5. From anywhere in the world, the customer can check the status of his load via SMS.
A Smart Energy Meter's principal role is to measure meter readings and communicate them to the utility and the consumer as needed.

Working of Smart Meter:

Data on electricity use is sent to the utility administration and, if necessary, to the customer via the GSM communications network. An antenna installed to or near the meter box serves as a signal enhancer in GSM communication. [6].

Smart metering connectivity allows for centralized meter reading, which eliminates the need for meter readers to visit each client to collect data. Readers may need to observe from time to time for testing and maintenance purposes.

A Smart Energy Meter's principal role is to take meter readings and communicate them to the utility and the consumer as needed. The RMS voltage and current values are measured by the voltage and current sensors and fed into the microcontroller, which performs active and passive computations. One of the most essential characteristics of a Smart Energy Meter is that it allows a utility company to cut off and reconnect a user's energy connection via SMS instead of sending someone to do it manually [7].

If a utility company needs to disconnect a client due to non-payment of bills or other conditions, it can use this form. Other important characteristic of a smart energy metre is that it alerts the user when his load exceeds the maximum limit for which he was granted a utility connection [8].

If the user does not reduce his load, the meter will disconnect him automatically. The electricity used is sent through the GSM communications network.

Main Parts of Smart Energy Meter:

The Smart Energy Meter is made up of three basic components:

A. Measurements of voltage and current

B. Measurements of the power factor

C. GSM part [9]

A) Measurements of voltage and current.

In our project, we used a current and voltage sensor to monitor voltage and load current. As a current sensor, we used the ACS712ELC-20A, which gives us the RMS value of currents. This current sensor accurately measures the current of both AC and DC transmissions. This sensor can detect current up to 20A. These sensors record overall power use, metering, and measurements. The OPAMP stage is used to handle sensitive current measurements. We can measure very small currents by altering the gain. The output voltage of the ACS712ELC-20A varies linearly with measured currents. ACS712ELC-20A was used to measure voltage in a similar way. SMS allows you to communicate with people all around the world. The Smart Energy Meter's main function is to take metre readings and transfer them to the cloud.

B) Measurement of power factor.

The power factor is the cosine of the angle between voltage and current. It truly assesses the efficiency with which energy is turned into useful work. We were able to measure it using a microcontroller and an LM358 in our project by taking the XOR of voltage and current waves. [10]. The LM 358 was used to transform weak sinusoidal impulses to large square signals.

As seen in Figure 4, after XOR, we get a signal with a twofold frequency (c). The power factor was calculated using the XOR signal's timing. If the power factor is 0, the output of XOR for 50Hz can be 10 milliseconds. The value is "0" if the power factor is unity. As a result, the XOR output can be anywhere between 0 and 1. As seen in Figure 4, after XOR, we get a signal with a twofold frequency (c). The power factor was computed using the time of the XOR signal. If the power factor is 0, the output of XOR for 50Hz can be 10 MS. If the power factor is unity, the value is "0." As a result, for a given power factor, the output of XOR is between 0 and 1.

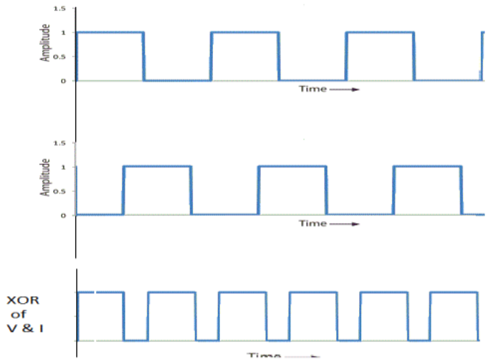

Fig. 4: The consequence of the XOR operation on a square wave of voltage and current.

C) Wireless portion.

Power Line Carrier (PLC) communications, Supervisory Control And Data Acquisition (SCADA), telephone modem, internet, Ethernet, Embedded RF Module, Wi-Fi, Bluetooth, and ZigBee are just a few of the technologies used in AMR.

Wire-based AMR systems include Power Line Carrier (PLC) and Telephone Line Network, while wireless AMR systems include GSM and Bluetooth. The Smart Energy Meter's transmission system makes use of the existing GSM network. In our project, we used a SIM900 GSM modem to send information about the number of units of electricity consumed to our chosen cellphone number using a GSM modem as mobile equipment/Data Communication Equipment. [11] For data transmission, the modem makes use of a SIM card. Communication Devices We used a SIM900 GSM modem in our project. A SIM card is used within the modem for data transmission. Meter readings can also be obtained using Power Line Communication (PLC), however it is insufficient due to interference and noise. Wi-Fi and ZigBee can be used to transmit metering data, however, their capabilities are restricted, and they are not cost-effective. GSM communication systems, on the other hand, are far more efficient across longer distances [12].

IV. GSM and Bluetooth are examples of wireless AMR systems, whereas Power Line Carrier (PLC) and Telephone Line Network are examples of wired AMR systems.

V. CONCLUSION

Automatic meter reading is defined as "reading a utility meter without the need for visual inspection of the meter," and it is a simple and reliable approach for monitoring a customer's consumption information. Meter manipulation and unlawful power drawing (hooking/power pilfering) can be detected with Automatic Meter Reading. AMR as a means of increasing customer service and lowering meter reading costs. The Automatic Meter Reading technology allows us to save millions of dollars in annual meter reading expenditures while also providing better water usage information, more accurate billings, and keeping rates as low as possible for our consumers.

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