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# Rechargable and Sensible Smart Energy Meter

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**Abstract:** *This study has specifically focused to develop a Rechargeable and sensible Smart Metering System which would be able to address some of the challenges currently available in the regular digital automated metering system in Eurasia. Smart Metering with its unique performance with the Internet of Things (IoT) tend to be an efficient system for electricity management, se-cure against the intervention by third parties, and reliable for tracking and real-time remote monitoring. Hence, this project work is accomplished by analyzing available functions and journals on the existing design of Smart Metering and discussed on further preferable application. In the currently working system, electricity meter reading for electricity usage and billing is done by human workers from home to home and building to buildings. The purpose of this project is to develop a Smart Electricity meter using ESP8266-12E & Atmega328. This can reduce human errors and helps to retrieve the real time meter value via IOT and send it to customer's mobile phone through IOT. This also al- lows electricity board to modify the variable package price in specific duration. The administrator can analyse the customer's power consumption data and generate the report from the data online. The prototype will be able to introduce the billing system to the customers, get the power consumption data from smart meter, keep the data in centralized database and generate the report.*

**Keywords:** ESP826612E, ATmega328,Energy Meter, Display

## I. INTRODUCTION

With increase in population and infrastructure, need for energy production is gradually increasing and to full fill the demanding needs of consumers is in organization hands. This brings the issue of energy production and energy distribution for the organization. Existing meters are not so consumer friendly and always need a periodic checking from utility to inform about their monthly tariff, which requires more man power and is a time consuming process. Also the organization is not able to maintain proper record of consumer data. This project aims to reduce this burden and it makes a real time observation of energy consumption for the consumer as well as the organization. The consumer as well as the organization is able to monitor the real time usage of energy and receive notification to their mobile or on organization website. Also, it notifies the consumer about the peak hours and the grid is able to monitor their geographical area. This project involves Atmega328 as main controller and for internet communication and sending real time data over internet, current and voltage sensors

An Energy meter is a device that measures the entire amount of electrical energy mostly consumed by areas like commercial area, domestic. A smart energy meter (SEM) is electrical device having energy meter chip for electric energy consumed measurement and for digital communication using wireless protocol and peripheral devices for security purpose, data showing, meter controlling etc [1]. It is clear that today's emerging developments in every sectors with growing demand of electrical power, so electricity has become high priority for every individual and also for organizations like a daily needs. The very basic procedure of power supply includes power generation, power transmission and power distribution to the varied consumers and consumer could also be corporate or domestic. Technically due to somefaults in the system, losses may occur. These losses are often resolve or minimized using the advanced technologies, but some losses unpredictable. These are the losses caused by groups of people for their illegal access to the facility distribution, which we said the facility theft [2].In Proposed system, method of GSM (Global system for mobile communication) based electronic energy meter is used. This paper which can automatically sense the

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usedenergy, and continuously records the reading, then sends itfor the billing to billing section through the GSM module.Finally, after processing the collected data bill is generatedwith web based system software.

## II. LITERATURE SURVEY

AnMr.Paraskevakos was first introducer of Automatic MeterReading system, he used an advance technology developedlike wired or wireless such as, power lines, cable networks,RF modules, GSM modules, LCD Display for just viewpurpose. Mr. Jain Abhinandanetal.[3] developed an entireAutomated Energy Meter which has features like remotemonitoring and energy meter controlling. TheAMR(Automatic meter reading) continuously observe andmonitors the energy meter then sends meter reading tothe service provider via SMS(short message service). Thebill was allowed to pay online and option for payment bycredit card or debit card or even by net banking. Using aGSM(Global system for mobile communication) , automaticelectric meter reading was built to demonstrate anautomatic electric meter reading during this network.Meter reading may have many errors due to manualsystem. The government employee who took meterreading from the EB (Electronic board) he takesapproximately quite 150 meters photo every day. Thendata of those photos will be get checked and put these dataat server. Reading taking person has to revisit that place one to 2 times, just in case if the house is closed. Somemeters are also not reachable. Second option to takereading is by taking average of preceding bills, if home isclosed for more than 2 months. Such problems are due tohuman involvement and to avoid this, billing process AMR(Automatic meter reading) is employed [4]. For futurescope we will also update the tariff within the energymeter by writing a program. This process will be flexible for both user and therefore the company.

Ashna.K **"GSM Based Automatic Energy Meter Reading System with Instant Billing"** proposed the design of a simple low-cost wireless GSM energy meter and its associated wave interface, for automating billing and managing the collected data globally.

Vivek Kumar Sehgal **"Electronic Energy Meter with Instant Billing"** introduced the concept of Postpaid Energy Meter which automatically sense the energy used in the home and when it reaches value which is initially fed in the hardware it will disconnect the power line. A user interface given in the hardware for user which will interact with the hardware, through user interface user can set a value.

Ms.Prajakta B.Murmude, Mr. Sachin G. Jagdale, Ms.Sunita D. Giri **"GSM based Prepaid Energy Meter"** proposed the design and implementation of a GSM based remote operation of an energy meter which gives the solution to power theft, consumption control, auto billing and payment, data logging and Manpower reduction in power distribution and management.

The major disadvantage of the present systems is these systems are post-paid base service, Electricity board gives the service before collecting the payment from the customers and it is difficult for Electricity board to collect the payable amount from the customers and at the same Electricity board cannot stop to providing the service. So there is need of a system service after payment.

## III. PROPOSED SYSTEM

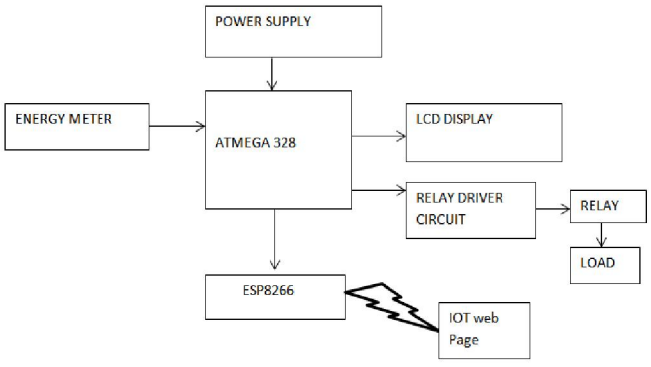


Fig.1. Block Diagram

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The power is measured by the energy meter with respect to time and is calculated by multiplication of voltage and current signals. The IC of energy meter generates pulses according to real power utilization. This energy meter calculates 1KWh for 3200 impulses, so rated as 3200imp/KWh, and there will be blinking of an LED for its every pulse. An Optocoupler has been connected to this LED so Optocoupler will be switched whenever LED blinks. We cannot directly connect energy meter's LED with Arduino because LED possesses analogue signals while we are feeding Arduino on the digital side. The pin number(4) of Atmega328 is attached to the switching side of an Optocoupler for detecting pulses coming from energy meter. When a pulse occurs from energy meter, optocoupler is switched, pin D2 of Atmega 328 detects a digital 0, otherwise it is not active and is in undefined state. There will be a count 1 to a data when there will be change on the state of the pin from digital 1 to 0. We have interfaced GSM module with Arduino UNO. The data communication pins are RX and TX, Arduino's RX pin is connected with GSM module's TX pin and vice-versa. Before connecting GSM module with Arduino, a valid SIM card must be installed in SIM card port of GSM module. All ground pins GND are connected together. For switching purpose (ON/OFF) to supply a relay is being used. We cannot connect Arduino directly with relay because as Arduino has ATMEGA328P processor and its pins can supply roughly 25mA, Processor pins have large effective resistance and a high voltage will "drop" as increasing current is drawn and a low voltage will rise as load increases. Pins may be specific with a maximum short circuit current but at that point a high pin will be pulled low and a low pin will be pulled high so short circuit current has limited applicability. So, relay is connected with Arduino through ULN2003 IC or relay driver, ON/OFF instructions are sent over to relay driver by Arduino and it can turn ON/OFF relay. LCD is also interfaced with Arduino digital pins (7, 6, 5, 4, 3, 2) on which we can see how much units are purchased, remaining units and balance, etc. [7]. Fig. 3 shows the flow diagram of processes involved in prepaid energy meter.

**ESP8266-12E**

ESP-12E WiFi module is developed by Ai-thinker Team. core processor ESP8266 in smaller sizes of the module encapsulates Tensilica L106 integrates industry-leading ultra-low power 32-bit MCU micro, with the 16-bit short mode,Clock speed support 80 MHz, 160 MHz, supports the RTOS, integrated Wi-Fi MAC/BB/RF/PA/LNA, on-board antenna.

The module supports standard IEEE802.11 b/g/n agreement, complete TCP/IP protocol stack. Users can use theadd modules to an existing device networking, or building a separate network controller.ESP8266 is high integration wireless SOCs, designed for space and power constrained mobile platform designers.It provides unsurpassed ability to embed Wi-Fi capabilities within other systems, or to function as a standaloneapplication, with the lowest cost, and minimal space requirement. Ports on the basis of the esp-12, spi leads.

**Features:**

- 802.11 b/g/n
- Integrated low power 32-bit MCU
- Integrated 10-bit ADC
- Integrated TCP/IP protocol stack
- Integrated TR switch, balun, LNA, power amplifier and matching network
- Integrated PLL, regulators, and power management units
- Supports antenna diversity
- Wi-Fi 2.4 GHz, support WPA/WPA
- Support STA/AP/STA+AP operation modes
- Support Smart Link Function for both Android and iOS devices

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Fig. 2.ESP8266-12E Wifi Module

ATmega 328

**ATMEGA328P** is high performance, low power controller from Microchip. ATMEGA328P is an 8-bit microcontroller based on AVR RISC architecture. It is the most popular of all AVR controllers as it is used in ARDUINO boards.

ATmega328 has 1KB Electrically Erasable Programmable Read-Only Memory (EEPROM). This property shows if the electric supply supplied to the micro-controller is removed, even then it can store the data and can provide results after providing it with the electric supply.

Moreover, ATmega-328 has 2KB Static Random Access Memory (SRAM). ATmega 328 has several different features which make it the most popular device in today's market. These features consist of advanced RISC architecture, good performance, low power consumption, real timer counter having separate oscillator, 6 PWM pins, programmable Serial USART, programming lock for software security, throughput up to 20 MIPS etc.

ATmega328 is an 8-bit, 28-Pin AVR Microcontroller, manufactured by Microchip, follows RISC Architecture and has a flash-type program memory of 32KB.

Atmega328 is the microcontroller, used in basic Arduino board's i.eArduino UNO, Arduino Pro Mini and Arduino Nano.

It has an EEPROM memory of 1KB and its SRAM memory is 2KB.

It has 8 Pins for ADC operations, which all combine to form PortA( PA0 - PA7 ).

It also has 3 built-in Timers, two of them are 8 Bit timers while the third one is 16-Bit Timer

Fig.3. ATmega328

**LCD Display**

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

.A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD.

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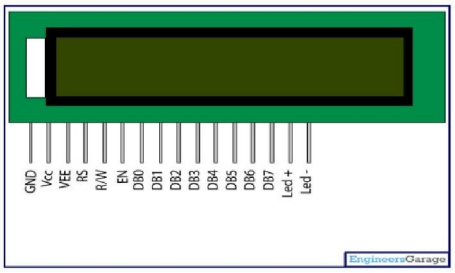


Fig. 4. LCD Display

**I2C Module for LCD Display**

This I2C uses only two bidirectional open collector or open drain lines, Serial Data Line (SDA) and Serial Clock Line (SCL), pulled up with resistors. Typical voltages used are +5 V or +3.3 V, although systems with other voltages are permitted. For more about I2C protocol click here. It is also known as I2C Module

It is also known as I2C Module. It has total of 20 male pins. 16 pins are faced to rear side and 4 pins faced towards front side. The 16 pins for connect to 16x2 LCD and the 2 pins out of 4 pins are SDA and SCL. SDA is the serial data pin and SCL is the clock pin. The rest 2 pins for power supply (Vcc and ground). There is a POT on the I2C Module. We can control the contrast of the LCD display by rotating this POT.

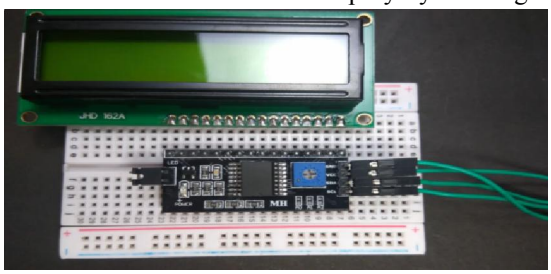

Fig.5.I2C Module for LCD Display

**Relay**

Relays are electromechanical switches, used to control the several circuits by using low-power signal or one signal. These are found in all sorts of devices. Relays allow one circuit to switch a second circuit which can be completely separate from the first. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical only.

Basically a Relay consists of an electromagnet, an armature, a spring and a series of electrical contacts. The electromagnet coil gets power through a switch or a relay driver and causes the armature to get connected such that the load gets the power supply. The armature movement is done using a spring. Thus the relay consists of two separate electrical circuits which are connected to each other only through magnetic connection and the relay is controlled by controlling the switching of the electromagnet.

Fig.6. Relay

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**Energy Meter**

**Energy Meter** or **Watt-Hour Meter** is an electrical instrument that measures the amount of electrical energy used by the consumers. Utilities are one of the electrical departments, which install these instruments at every place like homes, industries, organizations etc. The basic unit of power is watts and it is measured by using a watt meter. One thousand watts make one kilowatt. If one uses one kilowatt in one-hour duration, one unit of energy gets consumed. So energy meters measure the rapid voltage and currents, calculate their product and give instantaneous power. This power is integrated over a time interval, which gives the energy utilized over that time period.


Fig.7. Energy Meter

## IV. CONCLUSION

Smart energy monitoring system includes Node MCU, WI-FI, and energy meter. The system automatically reads the energy meter and provides home automation through an app developed and power management done through this application. The proposed system consumes less energy and it will reduce manual work. We can receive monthly energy consumption from a remote location directly to centralize office. In this way we reduce human effort needed to record the meter reading which are till now recorded by visiting the home individually.

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