# Smart Renewable Energy Monitoring And Switching Devices By Using IoT

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***Abstract-*** *The energy demand is increased day by day. To consume energy in an efficient way is very important. Increasing economic growth and consumption patterns are leading to ever growing demand for energy. The system aims to develop a System (EMS) based on the emerging technology, IOT. In this proposed system, here each electric appliance is connected to the center server. The center server controls all other nodes connected to it based on the current and voltage value measured. The Real Time Clock is used to control the usage of energy in time based. Once the AC supply is failed automatically the DC supply is switched over to consume energy in renewable source. The technological developments in this project, to consume the power by using this technology and also monitoring the renewable energy.The proposed architecture is developed by considering energy generation and consumption profiles of different facilities (residential, commercial, industrial, and community services) within smart cities. The opportunities for P2P energy sharing depend on the information exchange among different facilities. Smart Energy monitoring system provides usage of energy in an effective way.*

***Keywords***- Wireless, Energy Management

## I. INTRODUCTION

Energy systems play a key role for modernizing a city as almost all activities depend on energy (both electricity and gas)and energy consumption levels for different services in the city area are much higher than other areas, e.g., rural and suburban areas. Though the energy system is a critical component for a smart city, there have been very little efforts for managing this system from such perspectives. For this reason, these smart cities need to have provisions for effectively managing energy from renewable and sustainable sources as solar, wind, and battery energy storage systems.

In the existing system, there is manual monitoring of the energy consumption which requires manpower. There is no specialized app or web page for monitoring the energy resources. An human is required to monitor the entire management.

## II. LITERATURE REVIEW

In the title [1]Design and Implementation of Smart Energy Meter proposed by M Swamy, R Pravallika in the year 2017presented through this project to design and implement the smart energy meter system in houses and in many public places. Here this system has functionality of both pre-paid and post-paid system inbuilt in it. This system has a GSM that is used in sending the messages to the owner of house or any place where he gets the e bill of his electricity consumption. Here the bank account of the person is linked to his current billing system. Therefore, the bill will be deducted from his account and he gets two messages about the amount. one from his bank and another from current billing system**.** This paper presents a smart energy meter for an automatic metering and billing system. In this meter energy utilized and the corresponding amount will be displayed on the LCD continuously and communicated to the controlling base station. The feedback from the user helps in identifying the usages between authorized and unauthorized users which helps in controlling the power theft. Communication between user/household and substation is done using Zigbee. GSM network is used for sending SMS to the local authorities regarding theft cases. This meter can work as either prepaid or post-paid meter. The proposed system replaces traditional meter reading methods and enables remote access of existing energy meter by the energy provider. Also, they can monitor the meter readings regularly without the person visiting each house.

In the title [2] Smart Meter Privacy for Multiple Users in the Presence of an Alternative Energy Source written by Jesus Gomez-Vilardebo, Deniz G¨und¨uz in the year 2013 said that Smart Meter (SM) privacy is studied assuming that the SM readings, which report the amount of energy each user gets from the grid to the utility provider (UP) at each time instant, cannot be tempered. The privacy is measured by the amount of information about the users' energy profile leaked to the utility provider through the SM readings. Privacy can be achieved thanks to the existence of an alternative energy source (AES), whose energy generation profile is known to the UP only statistically. Assuming that a single AES with a given power generation capacity serves multiple users, the

optimal exploitation of the energy generated by the AES in order to maximize total user privacy is characterized.

In the title [3]A Review Paper on Automatic Meter Reading and Instant Billing proposed by Bhushan D. Sawarkar1, Mrs. Snehal S. Golait in the year 2015 described that the existing systems are either an electronic energy meter or an electro-mechanical meter which are currently in use is limited to record up to kWh units. The kWh units recorded by meter readers monthly, on foot which need to be processed by a meter reading company. For processing the meter reading, company needs to link each recorded usage data to the particular account holder and then determine the amount owed by means of the specific tariff in use. On basis of various platforms researchers proposed many systems for Automatic Meter Reading (AMR). There are various wire-based AMR systems like Power Line Carrier (PLC) and Telephone Line Network (optical/ cable) and wireless AMR systems such as E-metering systems based on GPRS, Bluetooth, GSM. Design of an Electric Energy Meter for long-distance data information transfers which based upon GPRS, but this system can't be implemented so easily because the regular use of GPRS is still a dream to the common man. A GSM based Energy meter with instant billing facility is introduced is efficient, but still the problem of missing SMS will degrade the accuracy and performance. A more reliable and user-friendly system by creating web portal for multiple access using the advanced Visual studio .net frame work which will manage the data efficiently even if there is loss of SMS. It makes the design different from the previous proposals and also increases the throughput. The GSM/GPRS channel is a very useful means of communication as sending data as SMS turns out to be a very handy tool, due to its good area coverage capability and cost effectiveness. The front-end web portal is User friendly and any employee with minimum knowledge of computers can work on this software. Employees can read the meter by sitting in their office.

In the title [4]Smart Meters in Smart Grid: An Overview proposed by Jixuan Zheng, David Wenzhong Gao, Li Lin in the year 2013 said that Smart meter is one of the most important devices used in the smart grid (SG). The smart meter is an advanced energy meter that obtains information from the end users' load devices and measures the energy consumption of the consumers and then provides added information to the utility company and/or system operator. Several sensors and control devices, supported by dedicated communication infrastructure, are utilized in a smart meter. This paper outlines some smart meter's aspects and functions of smart meter. In addition, it introduces two basic types of smart meter system's communication technologies: Radio Frequency (RF) and Power Line Carrier (PLC) and recent advances with regard to these two technologies. This paper also presents different policy and current status as well as future projects and objectives of SG development in several countries. Finally, the paper compares some main aspects about latest products of smart meter from different companies.

In the title[5]A Parallel Multi-Appliance Recognition for Smart Meter propsed by Lien-Chun Wang and Chin-Feng Lai, Wei-Ting Cho,Yu Sheng Chiu the year 2013 through this study proposes a non-invasive smart meter system that considers the power use habits of users unfamiliar with electric appliances, and can be used by inserting the smart meter into an electrical circuit. This study also creates a database mechanism, appliance recognition classification, and a waveform recognition method, in order to solve the large data volume problem incurrent appliance recognition systems. In comparison to other appliance recognition systems, the low-end embedded system chip used in this study has low power consumption, as well as high expandability and ease of use. This experiment is different from the research environments of other appliance recognition systems by considering parallel multi-appliance recognition and general users' habit of using power. This study will not make any assumption of power utilization in the experiment. The total system recognition rate is 84.42%, and the total recognition rate of a single electric appliance is 93.82%,proving the high feasibility of this study

## III. METHODOLOGY

Proposed methodology describes how the system must be operated and what the system should do. It gives the objectives of the project.

In this proposed system, manpower is not needed. Automatically the system can be operated with battery system. Smart Energy monitoring system provides usage of energy in an effective way.

This can detect the obstacle near the panel. The usage of energy is monitored by clock.This developed model is highly beneficial with low cost and better performance.

### OBJECTIVES

- To monitor the system without manpower.
- Time-based monitoring system.
- To detect if a person enters the room.

### BLOCK DIAGRAM

In this system, we use ARDUINO UNO microcontroller which acts as brain of the system, because the

entire system program instruction stored in it. The ultrasonic sensor is used to detect if a person enters the room. The RTC is used to monitor the time period. During the time period it turns ON and OFF the load connected via Relay module.

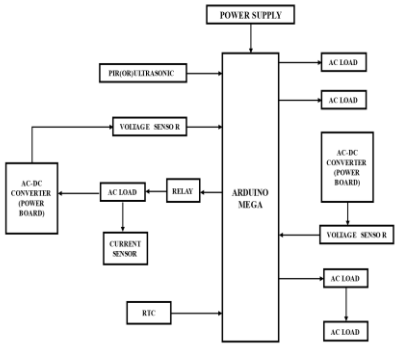


**Fig. 1 Block diagram of Smart Renewable energy**

The voltage and current sensor are used to monitor the AC current supply. Once the supply fails the Microcontroller detects and it turns ON renewable energy by solar panel.The IOT module monitors and controls the load from cloud.

The details of the hardware and software required for this project are given below;

## IV. HARDWAREDESCRIPTION

### ARDUINO UNO

Arduino is an open-source microcontroller electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message and turn it into an output - activating a motor, turning on an LED, publishing something online. The Arduino software is easy-to-use for beginners, yet flexible enough for advanced users.Arduino UNO has 14 digital input output pins, 6 pulse width modulation (PWM) pins and 6 Analog input pins. Arduino UNO has 5 volts and 3.3 volts pin as well.Arduino code is dumped into the Arduino board so that the messages are displayed in LCD and the process is executed according to the instruction.

### POWER SUPPLY

The power supply section is the important one. It should deliver constant output regulated power supply for successful working of the project. A 0-12V/1 mA transformer is used for this purpose. The primary of this transformer is connected in to main supply through on/off switch& fuse for protecting from overload and short circuit protection. The secondary is connected to the diodes to convert 12V AC to 12V DC voltage. And filtered by the capacitors, which is further regulated to +5v, by using IC 7805.

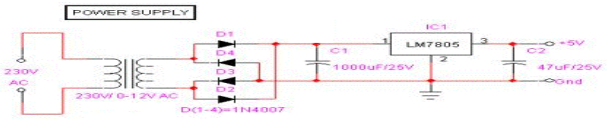


**Fig.2 Circuit Diagram**

### LCD

LCD screen is an electronic display module which uses liquid crystal to produce a visible image 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. 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 5x7pixelmatrix.Here, this displays the message like current value, distance, modes, voltage sensor values and time.

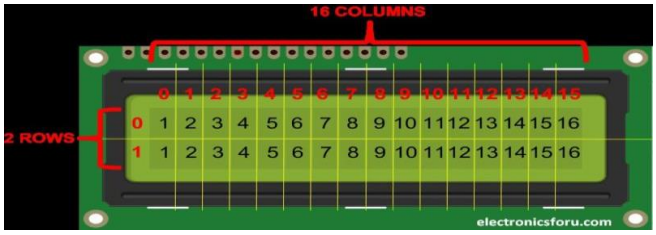


**Fig. 3 16X2 LCD**

### RTC

The DS1307 serial real-time clock (RTC) is a low-power, full binary-coded decimal (BCD) clock/calendar plus 56 bytes of NV SRAM. Address and data are transferred serially through an I²C, bidirectional bus. The clock/calendar provides seconds, minutes, hours, day, date, month, and year information. The end of the month date is automatically adjusted for months with fewer than 31 days, including corrections for leap year. The DS1307 has a built-in power-sense circuit that detects power failures and automatically switches to the backup supply.


**Fig. 4RTC**

**ULTRASONIC SENSOR**

The HC-SR04 ultrasonic sensor uses sonar to determine distance to an object like bats do. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package. The sensor head emits ultrasonic wave and receives the wave reflected back from the target. Ultrasonic measures the distance through the target by measuring time between emission and reception. Here it measures the distance between nodes.

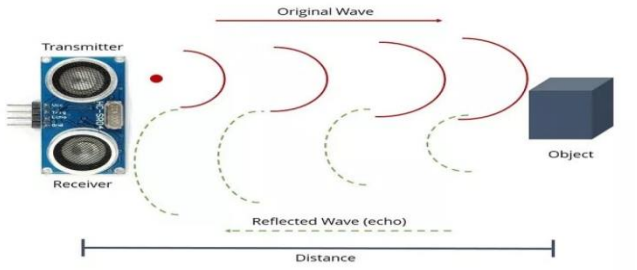


**Fig.5 Ultrasonic Sensor process**

**IOT**

The Internet of Things will become part of the fabric of everyday life. It will become part of our overall infrastructure and most recently the Internet. Whereas the current Internet typically connects full-scale computers, the Internet of Things will connect everyday objects with a strong integration into the physical world. Data is updated to a specific site or a social network by which the user can able to access the data. Here we use ESP8266 itself is a self-contained Wi-Fi networking solution offering as a bridge from existing micro controller to Wi-Fi and is also capable of running self-contained applications.

**Fig. 6 IOT board**

FEATURES OF IOT:

- Integrated low power 32-bit MCU
- Integrated 10-bit ADC
- Integrated TCP/IP protocol stack
- Provided with 3 links
  1. Data updating to a specific web site
  2. Device controlling web site
  3. Data updating to a social network

**RELAY**

The new KEYES 5V Relay Module is perfectly made for Arduino application. It has three pins, the VCC, GND and Signal. It can act as switch if the circuit and the load circuit have different supply voltage. It is a switch used to connect isolated connection from the circuit using a circuit signal.

**VOLTAGE SENSOR**

This module is based on resistance points pressure principle, and it can make the input voltage of red terminal reduce 5 times of original voltage. The max Arduino analog input voltage is 5 V. In voltage sensors, the measurement is based on the voltage divider. Mainly two types are of voltage sensors are available- Capacitive type voltage sensor and Resistive type voltage sensor. It is connected to the solar panel.

**CURRENT SENSOR**

A current sensor is a device that detects electric current in a wire, and generates a signal proportional to that current. The generated signal could be analog voltage or current or even a digital output. The generated signal can be then used to display the measured current in an ammeter, or can be stored for further analysis in a data acquisition system, or can be used for the purpose of control.

**DC FAN**

A DC ceiling fan works pretty much on the same principle as the DC motor. A DC motor uses an internal arrangement of magnets with opposing polarity. As current passes through the coil around this arrangement, a strong magnetic field is produced. This magnetic field then creates a torque that causes the motor to rotate.

## V. SOFTWARE DESCRIPTION

### EMBEDDED C

Embedded C is most popular programming language in software field for developing electronic gadgets. Each processor used in electronic system is associated with embedded software. Embedded C programming plays a key role in performing specific function by the processor. All these devices are working based on microcontroller that are programmed by embedded C.

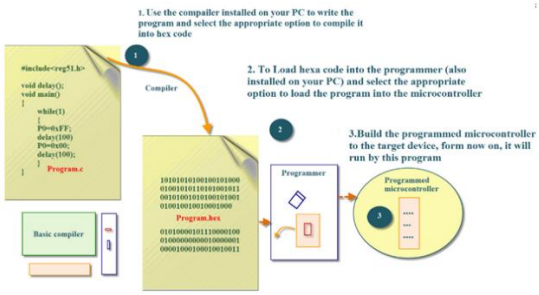


**Fig.7 Embedded C format**

In embedded system programming C code is preferred over other language. Due to the following reasons:

- ✓ Easy to understand
- ✓ High Reliability
- ✓ Portability
- ✓ Scalability

### ARDUINO SOFTWARE IDE

The Arduino Integrated Development Environment or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuine hardware to upload programs and communicate with them.

Since version 1.0.1, the Arduino Software (IDE) has been translated into 30+ different languages. By default, the IDE loads in the language selected by your operating system.

## VI. VERIFICATION AND RESULTS

The hardware components and software are connected properly. After giving the power supply, the ultrasonic sensor detects the distance and the output is given.

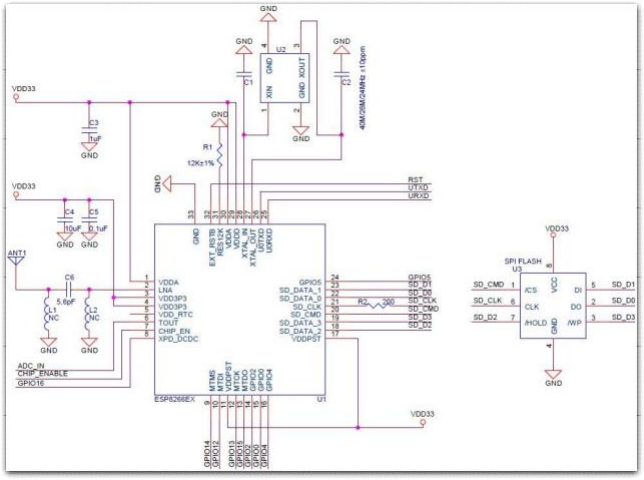

**Fig.8Circuit diagram**

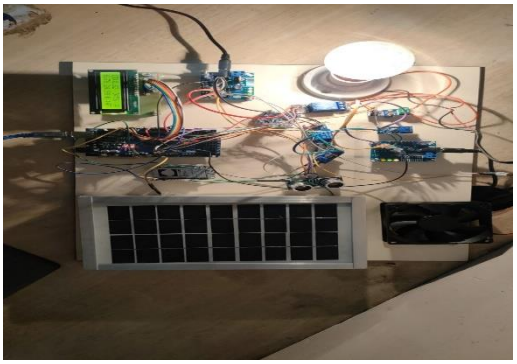

**Fig.9 Prototype of renewable energy system**

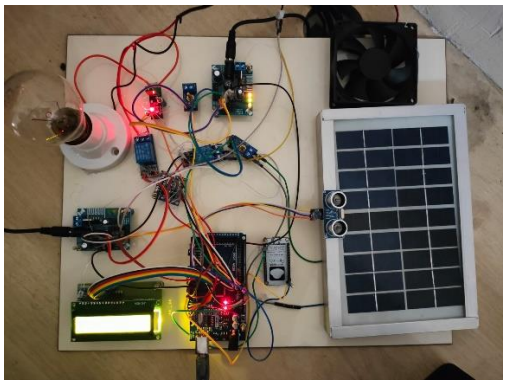

**Fig.10 Prototype with solar panel**

## VII. CONCLUSION

Many smart-enabling technologies (e.g.the IoT, cloud computing, big data analytics, etc.) and management strategies (e.g. source separation, standardization, points rewards, etc.) improve the timeliness. A smart energy hub is presented for smart cities which has its own communication platform while having the ability to communicate with existing communication facilities.

In future, the proposed system can be implemented in real time in smart cities.

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