IOT Based Grid Cutoff System for Unpaid Bill of Consumers

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Abstract-The electricity consumption in household is Increasing rapidly through a time due to many issues. Automated and intelligent electricity meters are being Introduced around the world to monitor and assess electricity use in every home and workplace. This is the application of smart electric meters is very Important to track and record the real-time electricity Consumption of a household. The system helps the electricity provider to reduce the operation cost as the system Could cut off electricity automatically when the usage limit is exceeds. Utility can cut off and reconnect the customer connection by short message service (SMS). In some areas consumers can't pay bills when MSEB officials visit to the particular site for Disconnecting the supply of electricity some consumers try to bypass the connections of the meter and also some consumers Try to settle down the matter by giving bribes ultimately it regards to electricity power theft. Furthermore, the customer can check the Status of electricity (load) from anywhere.

Key words- Internet of things (IOT), GSM Module, Short Messaging System (SMS), Energy Monitoring System.

INTRODUCTION

In recent decades, the global energy crisis has increased very rapidly. As a result, many new technologies are being Introduced to meet the needs of our users. In addition to power generation, demand can also be met by automating energy Distribution to improve people's living standards.The traditional method of electricity billing system is complicated. There Are many problems with this method, and the system needs to be further developed and automated [1].It causes shortage of power supply to residential as well as commercial premises. The aim of the project is to design and control a system which will automatically cut-off the electricity connection directly from the electricity pole for those consumers who fail to pay electricity bill on time. When M.S.E.B officials arrive at that particular site to cut-off the supply, some consumers argue with the officials and try to settle the matter by giving bribes. Even if after disconnecting the supply, some consumers may bypass the system and connect the home appliances from the service mains. So to overcome all these issues a prototype is proposed which includes WemosESP8266, relays through which it will automatically cut-off the electric supply as per given instruction by microcontroller from the pole itself for that particular consumer who does not pay electricity bill within a specific given period. Also power theft will be taken care by this proposed Smart energy controlling system [2]. A current sensor which Senses a current between the transmission line and energy meter and provides advanced theft monitoring in this System. Hence this system is very useful as it can detect / monitor and overcome all the issues of power theft. The cost of this system is economical without compromising the functionality and accuracy of the system.The Paper proposes automated billing of energy meter. It is just like postpaid mobile connection. In the proposed Work, the

front end is user friendly and one can work on this software with minimum knowledge of computers And can read the meter by sitting in the office. This is useful for billing purpose in electricity board authority. A GSM modem is connected to the energy meter. Each modem will be having its own SIM (usual mobile phone SIM).

CONCEPT GENERATION

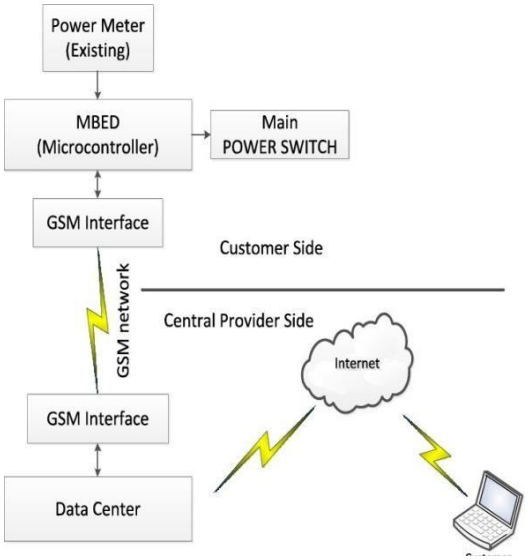


Fig.1 Iot Based Grid Cutoff System USing GSM

Proposed Design:In this paper we proposed a system to improve TNB services efficiency by implementing the automatic cut off system once the customers power consumptions reach to the limit. The system consists of network embedded devices which are integrated with the main management system in data center. The management system includes billing module, alert module and application module. This system consists of two subsystem; Central provider side and Customer side as shown in Figure 1.
Meanwhile at customer side, the subsystem, which is themeter reading, is done by a MBED microcontroller. TheMBED Microcontrollers are a series of ARM-based microcontroller development boards designed for fast,flexible and low-risk professional rapid prototyping . By summation of the energy meter readings they calculate the Energy Power theft. In order to overcome all the drawbacks of conventional system we are designing " Smart energy controlling system".The system architecture of Smart energy controlling system consists of Wemos ESP8266, c and Relays. The energy consumptions was calculated by MSEB person monthly. And if any consumer not pay the bill then the online system will turn OFF the grid and SMS will send to the consumer.[4]

DESIGN AND CALCULATION

PCB DESIGNING:

Following are the steps for PCB designing:

- Designing of actual material.
- Procurement of material.
- Layout of PCB.
- Preparation of PCB.
- Assembling of components.
- Testing.

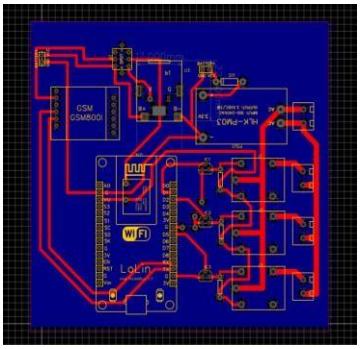


Fig.2 Project PCB Layout Diagram

Etching of PCB:

Etching is the process of chemically attacking and removing the unprotected copper from thecopper plate to yield the desired conductor pattern. The most common enchant used in the industry is ferric chloride.

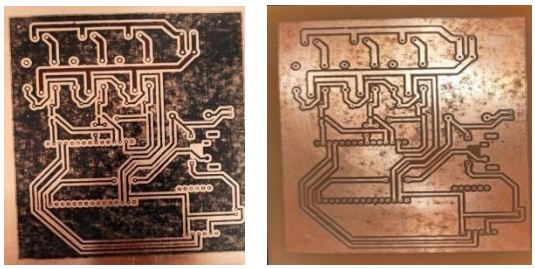


Fig.3 Project PCB Etching Process

Drilling:

Drilling is performed with the help of drilling machine. While doing drilling needles waschange according to the required diameter of the hole is to be made

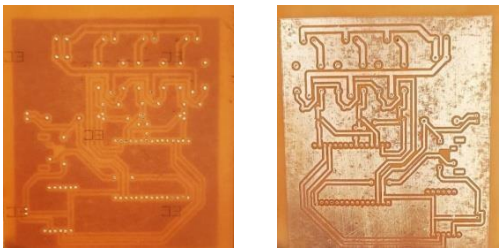


Fig.4 Drilling In PCB

Mounting:

After drilling mounting, of the component is done. On PCB respective component was placed imperfective holes and finally soldered. After soldering the PCB was ready to be connected to the respective relays and supply. Before than wiring diagram areas draw which decide the external wire connection to the PCB.

Testing:

Testing is the main event, which has its own importance in the electronics field. Testing is the process to find the output performance and fault of the circuit in the various forms. The main objective of the testing is to check the output performance as per our assumption.

TOOLS / EQUIPMENTS OR COMPONENTS USED :

NODEMCU ESP8266:

The board we are using is called "NodeMCU" and has an ESP8266 module on it, which we will be programming. It comes with the latest version of MicroPython already setup on it, together with all the drivers we are going to use.

The D0, D1, D2, numbers printed on the board are different from what Micro python uses – because originally those boards were made for a different software. Make sure to refer to the image below to determine which pins are which.

It has a micro-USB socket for connecting to the computer. On the side is a button for resettingthe board. Along the sides of the board are two rows of pins, to which we will be connecting cables.

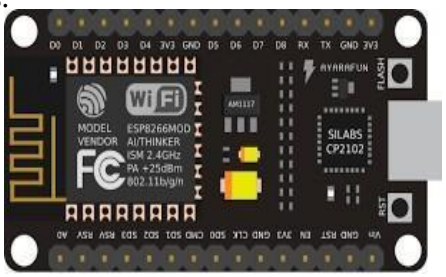


Fig.5 NODEMCU ESP8266

ARDUINO IDE:

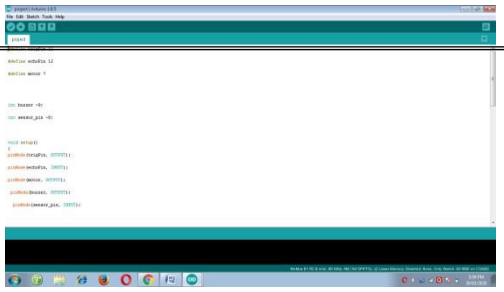


Fig.6 ARDUINO IDE

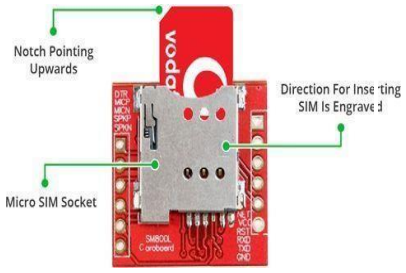
Arduino IDE is programming environment that allows the user to draft different kind of programs and load them into the ESP8266 microcontroller. Arduino uses user-friendly programming language, which is based on programming language called Processing. After the user has written his code, IDE compiles and translates the code to the assembler language. After translating the code, the IDE uploads the program to the ESP8266 microcontroller. Arduino IDE has a built-in code parser that will check the user written code before sending it to the Arduino. IDE software includes the set of different kind of programs that are ready to be tested on the device. After testing the program, it can be uploaded to the ESP8266 by USB cable that varies in different models The Arduino Programming Language is basically a framework built on top of C++.

SIM800L GSM MODULE:

Fig.7 GSM MODULE

SIM800L GSM/GPRS module is a miniature GSM modem, which can be integrated into a great number of IoT projects. You can use this module to accomplish almost anything a normal cell phone can; SMS text messages, Make or receive phone calls, connecting to internet through GPRS, TCP/IP, and more! To top it off, the module supports quad-band GSM/GPRS network, meaning it works pretty much anywhere in the world.

The module needs an external antenna to connect to a network. The module usually comes with a **Helical Antenna** and solders directly to NET pin on PCB. The board also has a U.FL connector facility in case you want to keep the antenna away from the board.



There's a SIM socket on the back! Any activated, **2G micro SIM card** would work perfectly. Correct direction for inserting SIM card is normally engraved on the surface of the SIM socket.
This module measures only 1 inch² but packs a surprising amount of features into its little frame. Some of them are listed below:

- Supports Quad-band: GSM850, EGSM900, DCS1800 and PCS1900
- Connect onto any global GSM network with any 2G SIM
- Make and receive voice calls using an external 8Ω speaker & electret microphone
- Send and receive SMS messages
- Send and receive GPRS data (TCP/IP, HTTP, etc.)
- Scan and receive FM radio broadcasts
- Transmit Power:
  - Class 4 (2W) for GSM850
  - Class 1 (1W) for DCS1800
- Serial-based AT Command Set
- FL connectors for cell antennae
- Accepts Micro SIM Card

Selecting Antenna:

Fig. 8 Antenna

An antenna is required to use the module for any kind of voice or data communications as wellas some SIM commands. So, selecting an antenna could be a crucial thing. There are two waysyou can add an antenna to your SIM800L module.
The first one is a Helical GSM antenna which usually comes with the module and solders directly to NET pin on PCB. This antenna is very useful for projects that need to save space but struggles in getting connectivity especially if your project is indoors.

Wiring – Connecting SIM800L GSM module to Arduino:

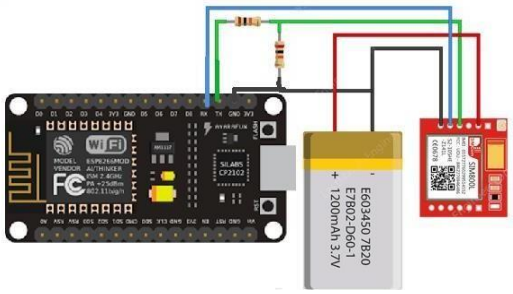


Fig. 9 Wiring Connection To Arduino

Start by soldering/connecting the antenna, insert fully activated Micro SIM card in the socket. Now, connect Tx pin on module to Rx pin on Arduino as we'll be using software serial to talkto the module.

We cannot directly connect Rx pin on module to Arduino's Tx pin as Arduino uses 5V GPIOwhereas the SIM800L module uses 3.3V level logic and is NOT 5V tolerant. This means the Tx signal coming from the Arduino must be stepped down to 3.3V so as not to damage the SIM800L module.

There are several ways to do this but the easiest way is to use a simple resistor divider. A 10K resistor between SIM800L Rx and Arduino Tx, and 20K between SIM800L Rx and GND would work fine.
Now we are remaining with the pins that are used to supply power for the module. As you have multiple choices for powering up the module, we have provided two example schematics. The one uses 1200mAh Li-Po battery.

RELAY:

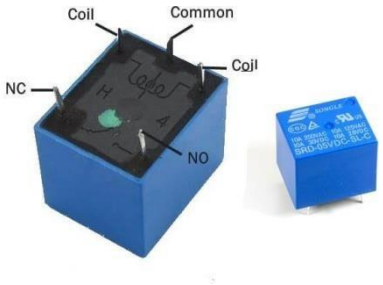


Fig. 10 Relay

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations. A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are

performed by digital instruments still called "protective relays".

BATTERY:

Fig. 11 Battery

A battery is a device consisting of one or more electrochemical cells with external connections for powering electrical devices such as flashlights, mobile phones, and electric cars. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode. The terminal marked negative is the source of electrons that will flow through an external electric circuit to the positive terminal. When a battery is connected to an external electric load, a redox reaction converts high-energy reactants to lower-energy products, and the free- energy difference is delivered to the external circuit as electrical energy.
Historically the term "battery" specifically referred to a device composed of multiple cells; however the usage has evolved to include devices composed of a single cell.

CAD Modeling and Drafting

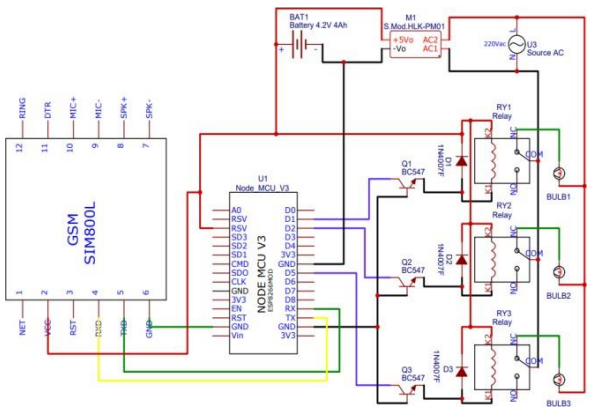


Fig .12 Smart Circuit Diagram

Conventional system includes the electricity meters which are installed at consumer's premises and the electricity consumption information is collected by meter-readers on their fortnightly or monthly visits to the premises. For an Electricity Power theft existing system had energy meters connect on each phase of line. By summation of the energy meter readings they calculate the Energy Power theft. In order to overcome all the drawbacks of conventional system we are designing "IoT Based Grid Cut-Off System for Non-Bill Paid Consumer". The system architecture of Smart energy controlling system consists of NodeMCU ESP8266, SIM800l and Relays. The energy consumptions was calculated by MSEB person monthly. And if any consumer not pay the bill then the online system will turn OFF the grid and SMS will send to the consumer switching power is through the step down transformer. NodeMCU is wifi for continuous online monitoring. It online monitors the system and also trips the circuit via relay after getting signal command through NodeMCU. SPDT relay will disconnect and reconnect the supply as per the microcontroller's instruction .When the consumer fails to pay a electricity bill after a given period the NodeMCU will automatically disconnect the supply of that particular consumer through relays and when the consumer pays the electricity bill it will reconnect the supply of that particular consumer. Basically a circuit will be fitted i.e. System in consumers home so from that we will acquire data and after acquiring we will upload/update the data on cloud service so that owner of smart grid (MSEB) and customer can access that data. The system consist of Esp8266 module which is a microcontroller and it controls the whole system. The system is connected in between the Mains Line and the Home incoming supply to the energy meter. In the circuit, we give 230V supply as AC input to meter. Input part and Output part of meter each have one phase and one neutral port this output phase wire

connected to load (bulb) through relay. Relay by default is in close condition. Circuit starts working when relay is in close condition.

PRODUCT MANUFACTURING :

- First design the PCB (printed circuit board) on designing software.
- Then after designing start the main fabrication of PCB As the PCB made start drilling in PCB circuit as per the mounting areas of semiconductor components on PCB layout.
- After drilling is done start mounting of components on their designed path then fix the components with the help of shouldering.
- After the fabrication is done put the programing in the circuit with the help of arduino uno.
- As the PCB fabrication and programing is done start testing of circuit board.
- After completion of testing finalize the project and installed it on inside the box.

Final Fabricated Model

Fig .13 Fabricated Model

RESULT :

This project proposed an IoT Based Grid Cut-Off System for Non-Bill Paid Consumer which is helpful to track the energy consumption for the user & Control grid status when he/she not pay electric bill using remote location . This data can be accessed by the user through a web page. So there is no need of human intervention. This system also provides a facility to send SMS to consumer. When they not pay bill and grid supply is cut-off by MSEB user will get an alert notification. This feature helps control the energy consumption. Hence, it reduces the wastage of energy and helps in creating the awareness about energy consumption.

CONCLUSION:

The project model reduces the manual manipulation work. Use of Esp8266 in our system provide the numerous advantages of wireless network systems. In this project we proposed a system to provide early warning to the users of electric power which provided by government. In the present situation all costumers are using manual communication. To reduce the manual efforts and human errors, we need to have some kind of automated system monitoring all the parameters and functioning of connections between the customers and electricity board .Also by implementing this system we can control the usage of electricity on consumer side to avoid wastage of power.

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