

## IoT Based Energy Metering And Theft Detection

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*Abstract:* In this connected world, the expansion of the intelligent devices has created a new start to the machine to machine communication at any time and at any place. As intelligence spreads beyond devices to anything, this connectivity has created a more noteworthy vision on Internet of things. The Internet of things has made a virtual network between the human and this physical world and has drastically changed the way business works[1]. Numerous associations are finding the inventive approaches to make information trade with more protection and decreased expenses. The way to pick up the genuine business esteem from Internet of things is viable end-to-end correspondence. This compelling correspondence can be accomplished by sending the ideal stage between the both gadgets that are included in trading the information. This Paper describes the design and implementation of energy meter utilizing IoT concept. The Proposed System takes out the human involvement in the power administration. The consumer needs to pay for the use of power on the calendar, in the event that the user couldn't pay, the electricity distribution can be turned-off from the distant server. The user makes any unauthorized usage of power i.e., if any theft detection is found the power goes off automatically from the remote place. GSM module sends energy meter data on to the webpage thus performing IoT operation.

keywords: machine to machine communication, connectivity, Internet of things, Energy meter, electricity management, power transmission, Theft detection, GSM module, Web page.

### I. Introduction

Internet of Things term was first composed by Kevin Ashton in 1999[1]. Internet of Things is the network of physical devices embedded with the electronics, Software, Sensors, Activators and network connectivity with the objective of exchange data or collects the data. The IoT enables the articles to be detected or controlled

remotely crosswise over existing system framework making the direct integration of physical world into PC based framework. The Internet of Things (IoT) includes frameworks of sensors joined to articles and concentrated contraptions, giving data that can be poor down and used to begin motorized exercises. The properties of this web of things may be depicted by low imperativeness usage, auto-setup, embeddable articles, et cetera. The data similarly makes basic learning for organizing, organization, plan, and essential authority[2]. Today the world is confronting such a situation, to the point that offers challenges. The energy crisis is the fundamental issue confronted by our general public[4]. A pertinent framework to control and screen the power utilization is one of the answers for this issue. One approach through which today's energy crisis can be tended to is through the diminishment of energy utilization in family units[5]. The Consumers are expanding quickly and furthermore, trouble on power offering divisions is strongly increasing. The Consumers must be encouraged by giving them a perfect arrangement: - i.e. the idea of IoT (Internet of Things) meters and then again specialist co-op end can also be educated about power robberies utilizing Theft detection unit and Arduino[6]. By keeping above factors, the concept of IoT meters thrived consisting of 3 units: Power supply unit, Arduino unit, GSM modem unit. The paper describes arduino based design and implementation of energy meter using IoT concept.

### 2. Literature Survey

#### 1. Minimizing Electricity Theft by Internet of Things

As there is restricted non-inexhaustible assets are available in our day by day life, Electricity is one of them which used in each nation that outcomes bottomless misfortunes because of power burglary. Power theft will be the key difficulties. A smart meter is utilized to limit the power theft. Fundamentally energy meter is a device that

computes the cost of power devoured by homes, business, or an electrical device. It diminishes the theft of power. In this paper an administration individual can locate the dishonest client by demonstrating the status of energy meter at the back end of power office. To accomplish this, energy meter communicate with raspberry pi through GPIO pins. GPIO pins get the effective information from energy meter and it send compelling information to the raspberry pi and interface raspberry pi with the web. At the backend, government individual can see the status of energy meter as graph.

2. IoT Based Electricity Energy Meter Reading, Theft Detection and Disconnection using PLC modem and Power optimization

PIC18F46k22 Microcontroller based design and execution of energy meter utilizing IoT is portrayed here. The proposed framework configuration disposes of the human contribution in Electricity support. The Buyer needs to pay for the utilization of power on plan, on the off chance that that he couldn't pay, the power transmission can be turned off from the distant server. The buyer can screen the energy utilization in units from a web page by giving device IP address. Theft detection unit associated with energy meter will tell organization side when meter tampering happens in energy meter and it will send theft detection data through PLC modem and theft identified will be shown on the terminal window of the organization side. Wi-Fi unit plays out the IoT operation by sending energy meter information to web page which can be accessed through IP address.

3. ARM-Based Energy Management System using Smart Meter and Web Server.

ARM - based energy administration framework is proposed here. It is considered as a feature of a circulated framework that measures the principle control framework amounts and give the likelihood to deal with the entire power plant. An integrated Web Server permit to gather the insights of energy utilizations, control quality and can interface device for stack removal. The device is described by simple access to the data and the blend of a energy meter and information correspondence ability permit nearby and remote access. Along these lines it is conceivable to deal with the power utilization of the power framework prompting a general diminishment in utilization and expenses.

4. Internet of Things for Smart Cities

The Internet of Things (IoT) might have the capacity to consolidate transparently and flawlessly an expansive number of various and heterogeneous end frameworks, while giving open access to those subsets of information for the improvement of a plenty of computerized administrations. Building a general design for the IoT is consequently an exceptionally complex undertaking, for the most part

due to the to a great degree extensive assortment of devices, interface layer advances, and administrations that might be engaged with such a most advanced communication technologies to help involve esteem administrations for the organization of the city and for the natives. Subsequently gave exhaustive study of the empowering advancements, conventions, and engineering for an urban IoT.

3. Project Description

A smart way to manage power and energy meter eliminating human involvement is proposed here. It reduces the burden over EB to manage the consumers. It helps consumer to manage his power usage in house. The Arduino is programmed using embedded C, such that if any theft is found then power will automatically goes off due to relay connected between load and power supply. The data i.e., the number of units used and total amount is loaded on to cloud using GSM module. The on-off buttons on web page are operated on Arduino commands transferred through GSM module.

It is smart, if the number of units usage is 9 units per day at home, as per the US government research. If the usage goes beyond 9 units then the consumer need to pay extra money than the normal payment[8][9]. In the house the circuit is designed such the power goes automatically after the usage of 9 units, so that the theft can be detected. If the consumer don't pay the bill in time the EB person can cut the power through On- Off button on the Web page. When the person presses On- Off button then it mean that he is giving the command to arduino, so that the arduino works on its program related to the given command. The arduino is programmed based on the requirement of user.

4. Project Implementation

In this project, Arduino, SIM 800, Relay, IR Emitter and Detector, electromechanical induction type energy meter are used. The project mainly focuses on Theft Detection and power distribution to consumers. The following block diagram shows the outline of project implementation:

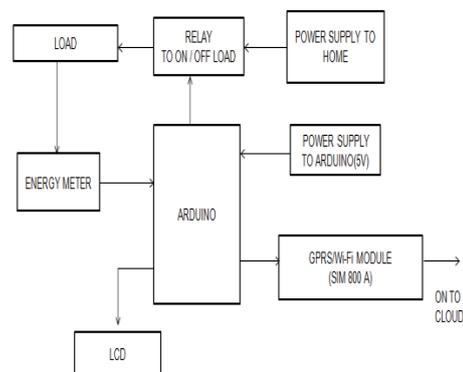


fig1. Block diagram

In power supply unit, a step-down transformer (Secondary 12V, 1A) is used to convert 230V to 12V from main supply. Usage of bridge rectifier helped to convert Alternating current to direct current. The capacitor is used to smoothen dc and to remove any sort of ripples. Usage of heat sink to ICLM7812 and LM7805 for safeguarding devices from overheating. Power supply unit distributes power to all the components which requires Power. The arduino module takes the data from the energy meter and performs the necessary control operations and sends the required information like number of units through GSM / GPRS module. LCD module is used to get visual information like no. of units and total amount.

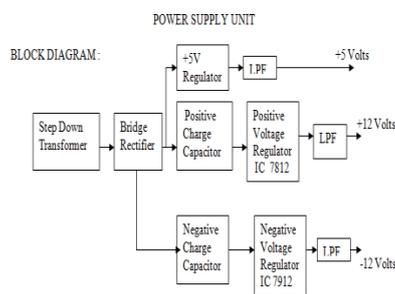


fig 2. Power supply circuit

The Power supply circuit is connected to the arduino. The Arduino is programmed in embedded C. Arduino is programmed such that when we press buttons on webpage then the required operation is carried out. Arduino takes the data from energy meter depending on rotations. If the number of units consumed crosses certain limit then the power supply is switched off automatically as the theft is found. Here we have used 200W bulb to detect the theft. If the usage of electricity crosses certain limit then the consumer need to pay extra amount to the EB, otherwise it comes under theft. As per US government, how smart the home it uses only 9 units per day. Here using 200W bulb instead of 100W increases the number units consumed, so depending on arduino commands the relay connected to load goes off automatically. The Webpage consists of four buttons A,B,C,D and two other buttons refresh and clear details. Here button A is to clear the previous data or command, button C is to off the power supply to home and button D is to distribute power to home. Refresh button is used to refresh the webpage and clear details button is used to clear the details like number of units and total amount. Gsm module SIM 800 pushes

the data like number of units used and the total amount onto the cloud.

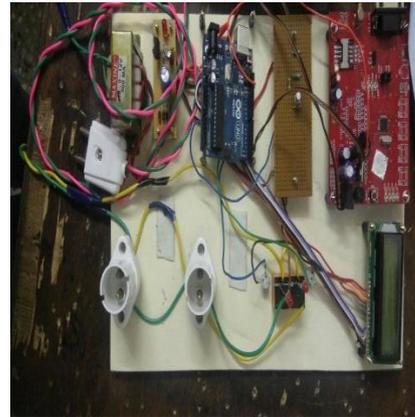


fig 3. Project implementation

## 5. Results

The resulting pictures express the outcomes of whole proposed project can get after well ordered execution of the considerable number of areas of the whole unit.

STEP 1:

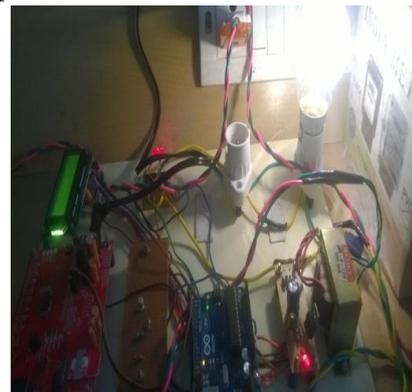


fig 4. initial step after connection

Required connections are made and power supply is given to kit in fig 4.

STEP 2:

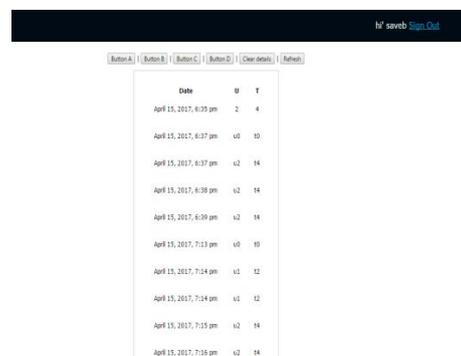


fig 5 IoT Energy Meter Webpage

Fig 5 is the web page the webpage where the energy meter reading is loaded and buttons A,C,D are used to control the power supply to home by giving commands to arduino.

*STEP 3:* If the customer doesn't pay the bill then power distribution can be off from the distant server by pressing button 'C' on the webpage. The program written for button C in arduino will off the relay connected to the load.



fig 6 Disconnection of Power Supply to Load/Home

*STEP 4:*

If the customer has paid the bill then power is distributed to his house by pressing button 'C' on the webpage. The program written for button D in arduino will on the relay connected to the load.



fig 7. Power supply to Load/Home

*STEP 5: THEFT DETECTION*

When the bulb of 200W is used in the project then it shows as theft detected and the circuit goes off automatically. The arduino is programmed such that relay connected to the load will be off when power theft is found.



fig 8 Theft Detection Extra Load



fig 9. Theft Detected and Automatic Power Off

## 6. Conclusion

In the proposed work, IoT and Arduino based meter reading system is designed to monitor the meter reading and service provider can disconnect the power source when the customer does not pay the monthly bill and also it eliminates the human involvement in Energy meter management.

The Project has achieved following goals, Theft detection at buyer end in real time, LCD displays energy consumption units and amount and Disconnection of service from remote server.

*Future enhancement:*

- To design an IoT framework where a client can screen energy utilization continuously and to send SMS, when the deadline to pay the power charge is over.

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