

## Advanced Energy Management And Theft Detection

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**Abstract :** *This paper deals with the effective solution to problems which we face in our daily lives. The purposes are energy efficient management, monitoring, controlling and data acquisition, wireless integration, cost effective solutions and many more. The main transmitter and receiver is based on Zigbee module and Arduino microcontroller.*

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**Keywords-**zigbee microcontroller, arduino, energy meter, energy saving, GSM, energy data storage

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### I. INTRODUCTION

“Time” is a very precious thing in today’s world. No one wants to waste his time in doing unnecessary work. Our team observed the time and money loss of the person who comes to our house to note down the meter reading, and finally the great loss of time and money of the electricity board member who comes to our house to note down the meter reading and appall which a consumer has to face at the end of the month when he/she receives the electricity bill and the most important thing theft of the electricity, all these problems have lead us to the idea of our project i.e. “Advance energy optimization using Zigbee and IOT”.

The main three phase energy meter the total amount of electricity send by the distribution center will be indicated and also the total consumption of each house will be known to us. If the total amount of electricity used by all the houses doesn’t matches with the main three phase energy meter reading than it indicate the energy is stolen by someone. This serves energy efficient management, monitoring, controlling and data acquisition, wireless Integration, cost effective solution.

### II. REQUIREMENT OF SYSTEM

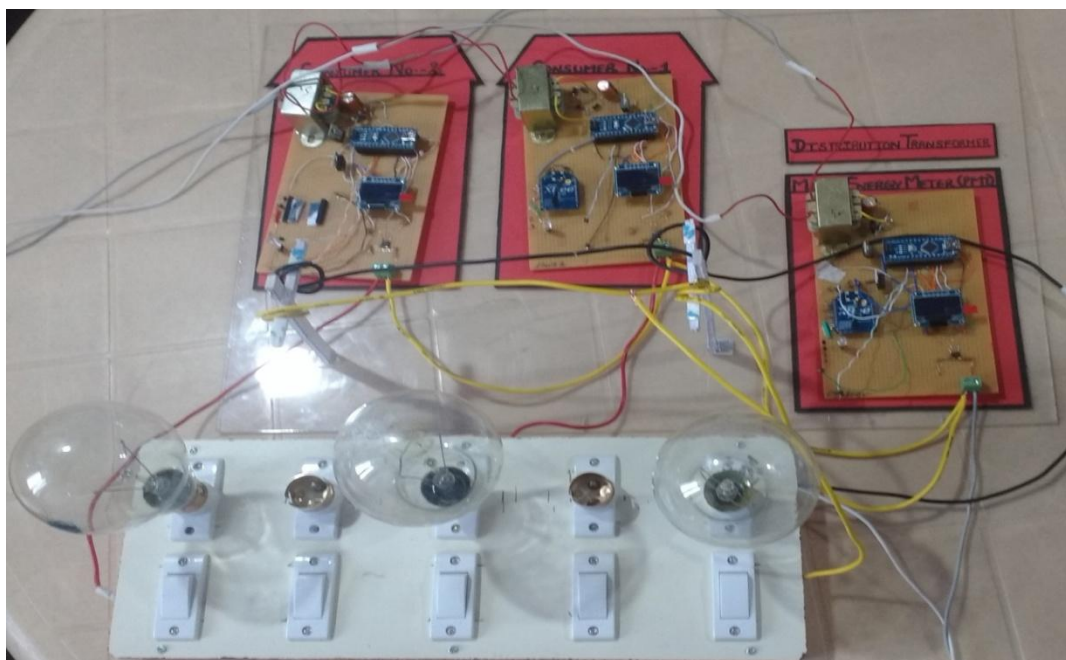
Energy is stealed by means of illegal connections, meter tampering, billing irregularities and Electricity theft is related with higher levels of theft indicators in countries without effective accountability governance, political instability, low government effectiveness and high levels of corruption. For reduce this some control or management system is needed. This system provides energy efficient management, monitoring, controlling and data acquisition, wireless integration, cost effective solutions and many more.

### III. WORKING OF ENERGY METER BASED ON ARDUINO WITH XBEE & ETHERNET CONNECTIVITY

#### IV.

It consists of three energy meters which are connected to the load circuit. Out of three meters two are consuming 200 watts power.

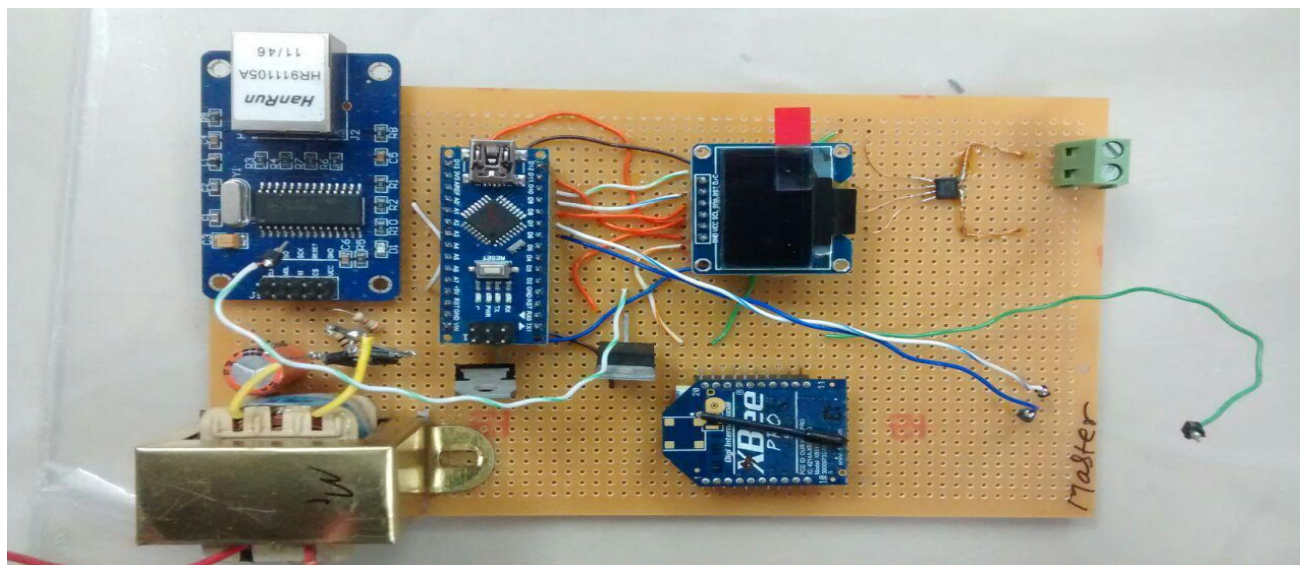
One energy meter is working as the main three phase energy meter. The data consumed by the two energy meters will be sent to the main energy meter using the XBee communication, and from the main energy meter it will be sent to the internet using GSM or fiber optics. From the internet the consumer and distribution companies both can analyze the data.



**Figure 1. Energy meter system**

The main energy meter will show the total power sent to the houses and the total consumption of each house will be known to us. If the power sent by the main energy meter does not match with the total consumption of each house then it indicates that theft of electricity has been done. In this way the problem of theft can be reduced. Hence our system can reduce the two problems it will save time and money of the distribution companies and it will also indicate about the theft of electricity.

The data collected by the arduino will be sent to the Zigbee module of our energy meter and from that Zigbee it will be sent to the main Zigbee, which is located at the main distributor transformer.



**Figure 2. Energy meter connected with Arduino, Zigbee module with Ethernet connectivity**

## V. SYSTEM AND CONTROLLER USED

### 5.1. Arduinonano (ATmega328) :

Arduino is an open-source prototyping 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. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

**Inexpensive** -Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduinomodule can be assembled by hand.

**Simple, clear programming environment** - The Arduino software (IDE) is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the processing programming environment



Figure 3.Arduinonano

**Open source and extensible hardware** - The plans of the Arduino boards are published under a creative commons license, so experienced circuit designers can make their own version of the module, extending it and improving it. Even relatively inexperienced users can build the breadboard version of the module in order to understand how it works and save money.

### 4.2. X-Bee Module (Zigbee):



Figure 4. X-Bee Module

This is the very popular 2.4GHz XBee XBP24-AWI-001 module. The pro-series have the same pinout and command set of the basic series with an increase output power of 60mW. These modules take the 802.15.4 stack (the basis for Zigbee) and wrap it into a simple to use serial command set. These modules allow a very reliable and simple communication between microcontrollers, computers, systems, really anything with a serial port. Point to point and multi-point networks are supported.

## VI. COMPONENT AND METHODOLOGY USED

### 6.1. CT Sensor :

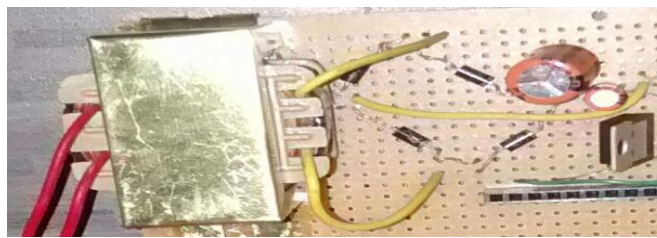
Current transformers (CTs) are sensors used to measure alternating current. They are particularly useful for measuring whole building electricity consumption (or generation for that matter). The split core type, such as the CT in the picture above, is particularly suitable for DIY use as it can be clipped straight on to either the live or neutral wire coming into the building without having to do any high voltage electrical work.



*Figure 5. CT sensor typical application diagram*

### 6.2. PT Sensor :

An AC voltage measurement is needed to calculate real power, apparent power and power factor. This measurement can be made safely (requiring no high voltage work) by using an AC to AC power adaptor.

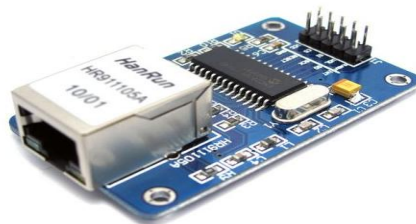


*Figure 6. AC To AC Adapter (PT) Connection to Arduino Microcontroller*

The transformer in the adapter provides isolation between the high and low AC voltage. AC to AC power adapters can come in many different voltage ratings. The first thing that is important to know is the voltage rating of your adapter

### 6.3. Ethernet Module (ENC28J60) :

The ENC28J60 Ethernet Module utilizes the new Microchip ENC28J60 Stand-Alone Ethernet Controller IC featuring a host of features to handle most of the network protocol requirements. The board connects directly to most microcontrollers with a standard SPI interface with a transfer speed of up to 20MHz. ENC28J60 is widely used network chip. ENC28J60 is also widely used due to its stable and reliable.



*Figure 7. Ethernet Module (Enc28j60)*



#### 6.4. OLED Display :

An OrganicLightEmittingDiode (OLED)isa lightemittingdiode (LED)inwhichthe emissive electroluminescent layer is a film of organic compound which emits light in response to an electric current. This layer of organic semiconductor is situated between two electrodes; typically, at least one of these electrodes is transparent. OLEDs are used to create digital displays in devices such as television screens, computer monitors, portable systems such as mobile phones, handheld game consoles and PDAs.

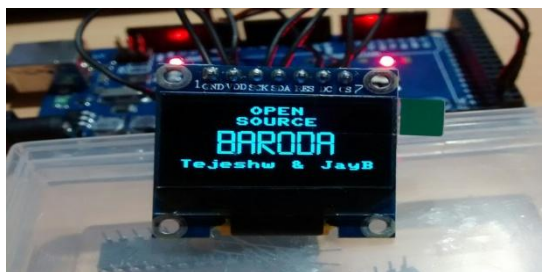


Figure 8.OLED display

A major area of research is the development of white OLED devices for use in solid-state lighting applications.

### VII. DATA COLLECTION WITH ENERGY METER BASED ON ARDUINO WITH XBEE & ETHERNET CONNECTIVITY

We have made the CT through ACS712 IC (CURRENT SENSING IC) and PT through 230\12 V transformer and has provided a bridge rectifier to convert ac into dc. We have also created a type of potential divider using two resistors respectively of values 100K and 82K .Across the 82 K resistor we are getting the 5V voltage that we have to provide to the Arduino.The data collected by the Arduino will be sent to the Zigbee module of our energy meter and from that Zigbee it will be sent to the main Zigbee, which is located at the main distributor transformer. The whole connection of CT, PT, Arduino and the Zigbee module is as follows---

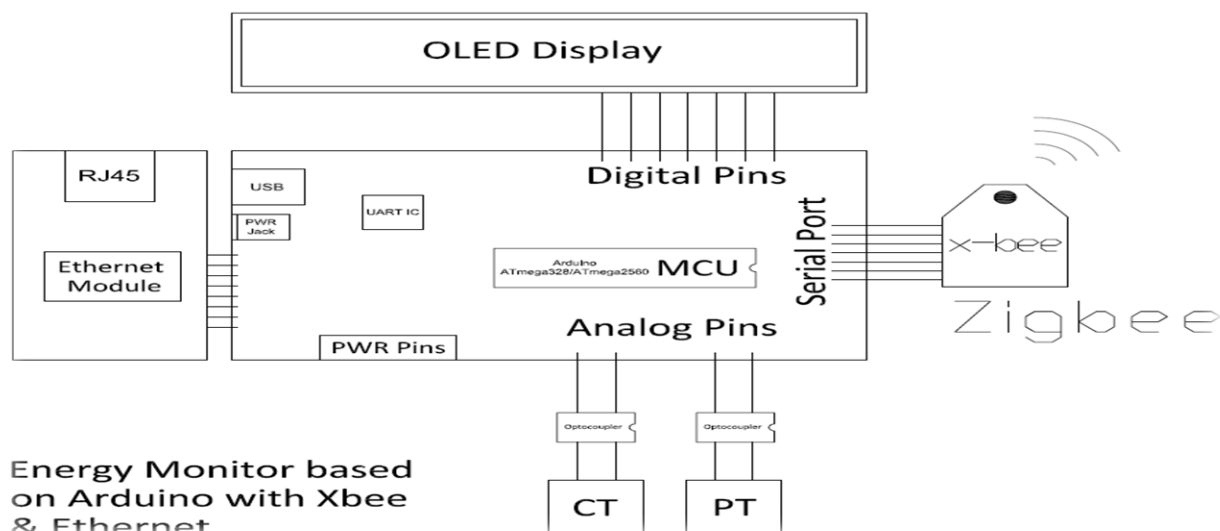
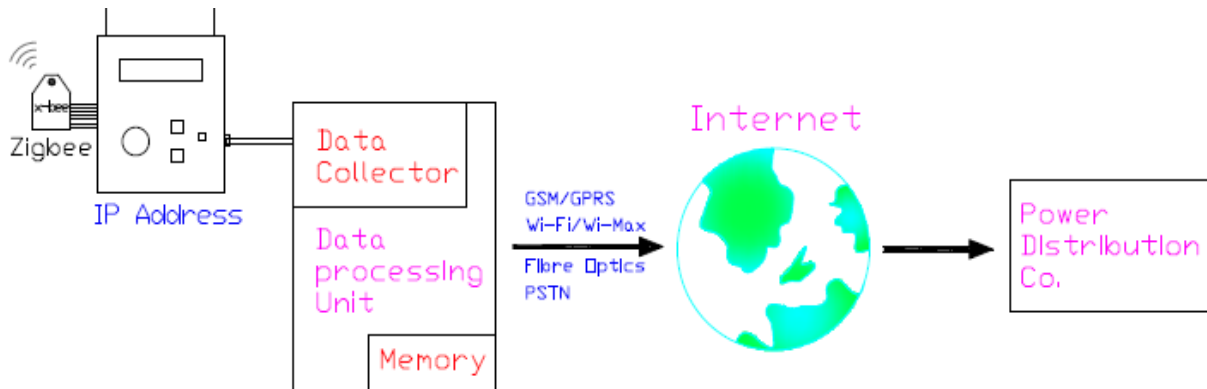


Figure 9.Energy Meter Based On ArduinoWithXbee& Ethernet Connectivity

The data transfer part of our project. From the main distribution transformer a data collector will collect all the data and using GSM/GPRS/Fiber optics it will send the data to the internet and from the internet the distribution company will collect all the data by entering the static IP address.



*Figure 10. Energy data collection system at the main distribution transformer*

At the end on combining all the parameters discussed above like construction of energy meter using Arduino and Zigbee, home energy management system and the data collection system, we will come across a new system which will transfer the data to the distribution companies and also to the home network, which fulfills the reason why we made this system.

### **VIII. ADVANTAGES**

**This energy protection system can be serves important functions Like**

- Power saver
- Extendable & upgradable
- Security & safety
- Cloud storage
- Multitasking
- High system stability
- programmable

### **IX. APPLICATION**

This system can be useful for the common peoples to use it like

- House holders
- Habitant
- Enthusiasts
- Hobbyists

### **X. CONCLUSION AND FUTURE SCOPE**

The main aim of creating this system, which are reducing the time and money loss of the distribution companies, reducing the theft of electricity and the home network system. our system is reliable because once the system is initialized, it can be considered as a future investment because using our system we can calculate per hour unit consumption of our house, So if we want to save our money then this is a very cost effective solution. In future it may be manufactured on large scale and can be provided for each user to use, for better protection against energy theft.

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