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# E-Urja

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**Abstract -** *Electricity supply and its consumption is becoming more complex now-a-days. Reduction of energy usage in households can become a solution to deal with today's energy problem. This paper presents an IoT based smart electric energy meter named as E-Urja that generates an automatic bill through power consumption. Arduino and Node-MCU are used to provide the meter reading. The proposed system can transmit the data at the head organization to provide the services among the customers with an automatic system.*

***Key Words***: **IoT, Arduino, NodeMCU, Energy, Meter**

## 1. INTRODUCTION

In today's world, the maintenance and use of electric meter requires much manual work. Power consumption can be tampered easily through the wired system leading to less amount of bill. Currently every organization or residential buildings have a central electric meter through which people cannot get their daily readings.

We introduce a Smart Electric Energy Meter, which is a device through which we can get daily readings of our power consumption using IoT. This device sends a message to the user on a registered mobile number or Email ID. The system is completely wireless and automatic. The system also gives an alert about high power consumption by using the threshold value. The system also generates bill on the basis of power consumption.

The fundamental characteristics of this system are Interconnectivity, Heterogeneity and Safety. The proposed system is used for any household appliances as well as in the organizations were huge power consumption takes place. It has eliminated the manual work required to take the meter readings

We have used electric current sensor for the values of consumed power. Arduino UNO and NodeMCU are used for calculating the power consumption and to generate the bill. The Bill and Power consumption values are sent to the user through Adafruit cloud and MQTT (Message Queuing Telemetry Transport) Dashboard.

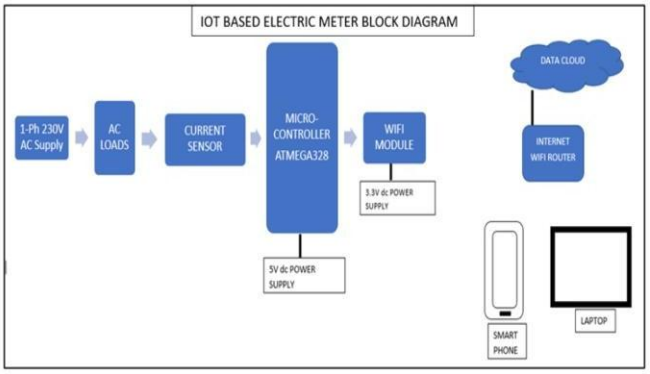


**Fig -1**: System Block Diagram

### 1.1 Existing System

As a part of literature survey, we investigated some research papers regarding the Smart Electric meters. The aim is to analyze these papers and see how the existing systems can be improved.

A server-based load analysis of Smart Meter Systems: This system analyzes the performance of the smart meter systems, the power consumptions and its benefits to the consumers by monitoring energy consumption. Other features of the system are remote monitoring and efficient transmission [1].

Advanced smart metering infrastructure for smart homes: This system is developed in such a way that helps a consumer to lower his/her energy consumption. Since there is no manual meter reading required, it saves the man power required. Other features are an AMI (Advanced Metering Infrastructure) system and different variables can be monitored [2].

Smart energy metering and power theft control using Arduino: This system helps in increasing efficient use of power. Easy and fast to monitor. This system also generates the price according to the demand of the power. It also reduces labor work and is more accurate system [3].

Design and Implementation of IoT based Smart Energy Meter: The system functions in both web server and web client. It reduced the cost of electricity and amount of load on the system [4].

Wireless IoT based metering system for energy efficient smart cities: This system generates the bill automatically. It helps in determining power and supply and also reduces blackouts. It improves efficiency of the power generating companies. Other features are it is low cost, low power and user friendly design [5].

Smart Energy Meter Surveillance using IoT: The system uses GSM (Global System for Mobile) Module and the values are displayed on LCD. It is a time saving process. Details are displayed on user's mobile system [6].

### 1.2 Limitations of Existing System

From the literature survey, we have found that the traditional meters have some limitations such as lot of manual work is needed for bill evaluation, electric bills are not maintained properly, automatic power shutdown, complex setup, if the system fails it is difficult to get the data, cannot be monitored from different locations and the traditional meters cannot control the electricity limits in industries and homes.

## 2. MOTIVATION

To design a Smart Energy Monitoring System that addresses industrial clients and provides profiling of energy usage for factories including at plant level and equipment level which helps the clients to monitor and manage power consumption from any location.

### 2.1 Objectives

To gain insight into small-scale users and electricity consumption. To design an application that fulfills customer demands. To identify and calibrate power detection. To identify and calibrate wireless communication that best suits the system. To provide energy as cheaply as possible.

The data is being appropriately monitored by the electric meter users. One can easily handle the power consumption rate if it is exceeding. Communication between the meter and the user makes it more reliable. Due to live monitoring, there are less chances for any kind of theft. It also gives live updates on MQTT dashboard Application.

## 3. METHODOLOGY

### 3.1 Proposed System

The proposed system is designed in such a manner that it eliminates the limitations of the existing systems. The design meets industrial requirements and calibrates power detection. Our system also monitors and assess the wireless communications.

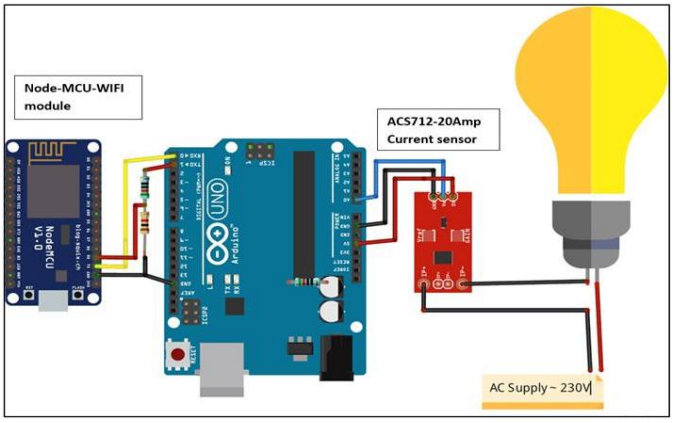


**Fig -2**: Circuit Diagram

### 3.2 Hardware Requirements

The proposed system of Electric meter requires Arduino UNO, NodeMCU, Electric current sensor, Bulb, Wires and Resistors as hardware components. Bulb is connected to power supply from one end and to current sensor from other. Electric current sensor detects the electric current of the bulb or any other device with the limit 30A. The electric current values are send to Arduino UNO board through connecting it to the electric current sensor. Arduino calculates the power consumption by getting the values of current from current sensor. Arduino UNO board is connected to the NodeMCU through a 3V circuit using the resistors. The NodeMCU runs on WiFi network and is used to send the power consumption and bill to the registered mobile number or E-mail ID through the interface which are mentioned in software requirements. The bill is generated in accordance with the power consumption values using proper calculations. An alert can also be sent through NodeMCU when the power consumption is higher than the defined threshold value.

### 3.3 Software Requirements

The software requirements for electric meter are Arduino IDE, MQTT (Message Queuing Telemetry Transport) broker as Ada-Fruit IO platform and IFTTT (If-This-Then-That). Arduino IDE is a software provided to write code and upload it to Arduino. It can also be used for different microcontrollers. All the libraries are included in this IDE for each microcontroller compatible with Arduino IDE. This IDE runs on java platform. It supports C language. It works on operating systems like Windows, Mac OS and Linux. In this project, we have coded Arduino and NodeMCU using Arduino IDE.

MQTT (Message Queuing Telemetry Transport) decouples the publisher from the subscriber, client connections are always handled by a broker. It is an important protocol in IoT. Basically, used to monitor energy uses over the internet.

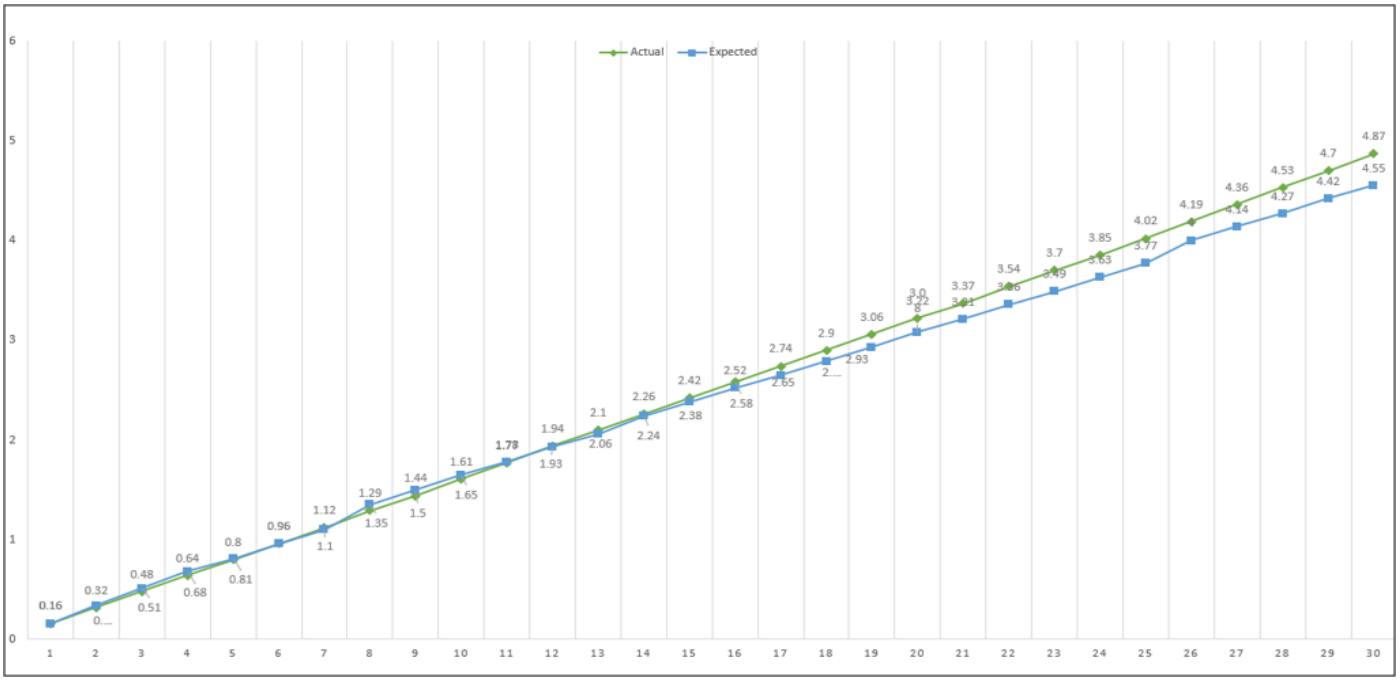


**Fig -3: Analysis of Power Consumption**

In this project, we will be using MQTT dashboard app for all the readings that are required in electric meter including bill too.

Adafruit IO is a system that focuses on ease of use and allows simple data connections with little programming required.

IFTTT (If This Then That) connects to variety of services. IFTTT is the most flexible service when it comes to Notification services. It is a free platform that helps you do more with all your apps and devices. It is used to link Adafruit IO to SMS/E-mail. IFTTT then sends an email and message when you get the desired output from your electric meter to keep user updated about the readings and the bill.

## 4. ANALYSIS

Analysis of power is done on the basis continuous thirty values of power in fig.3. X-axis represents thirty observations of expected and actual power values and Y-axis represents power values. From the observed data, we can conclude that the expected and actual value is almost same.

## 5. IMPLEMENTATION

Arduino is connected to electric current sensor and electric current sensor is connected to an AC supply where electric current sensor can calculate both AC and DC. Arduino is then connected to NodeMCU, NodeMCU is connected to IFTTT which helps to generate email and Adafruit live monitors the power consumption.

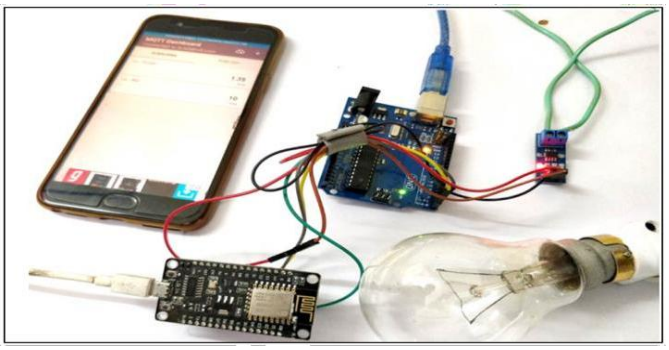

**Fig -4: Working of the System**

## 6. RESULT AND CONCLUSION

We developed an electricity consumption measuring, monitoring, analyzing and predicting system embedded as a smart electric energy meter named E-Urja. The system measured power (using electric current sensor) consumption of the customer.

The MQTT Dashboard is connected to adafruit platform and gives live update about power consumption and bill through MQTT app on your phone. After crossing a limit that has been set, it will generate an email and send it to desired email address.

The propagated model is used to calculate the energy consumption and helps to make the energy unit reading flexible. Hence, it aids to reduce the wastage of energy and brings awareness among all. The system substituted manual intervention to improve cost efficiency.

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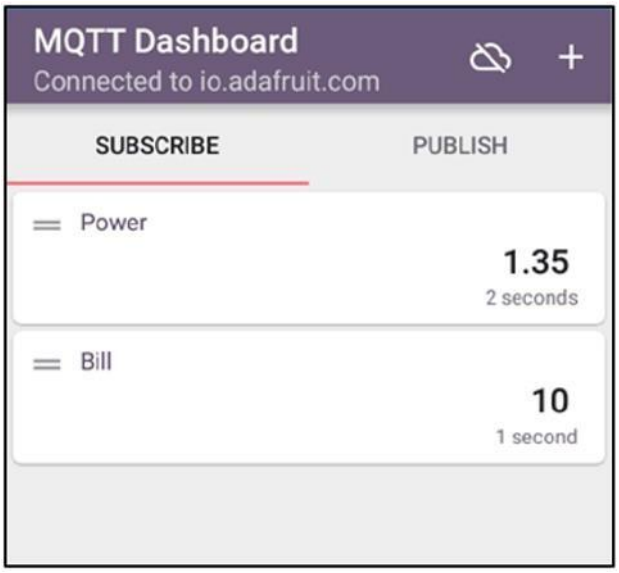


**Fig -5: MQTT Dashboard**


**Fig -6: Generated Email**

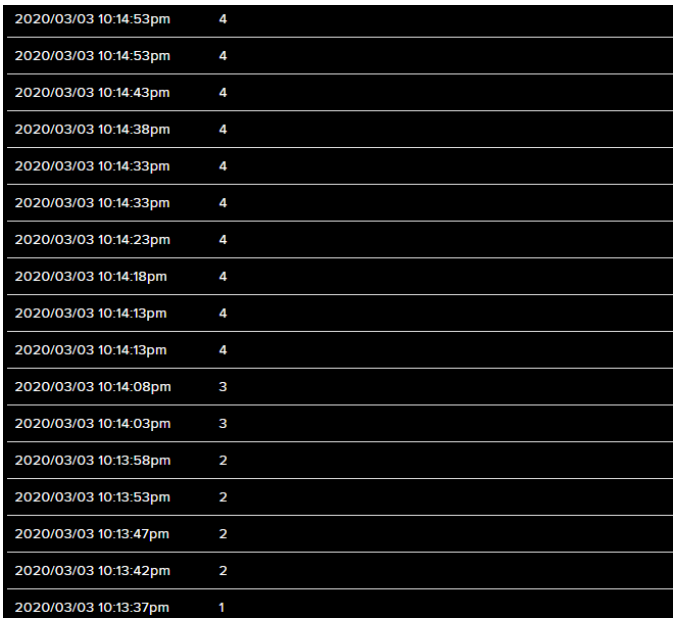


**Fig -7: Live Monitoring of Bill**

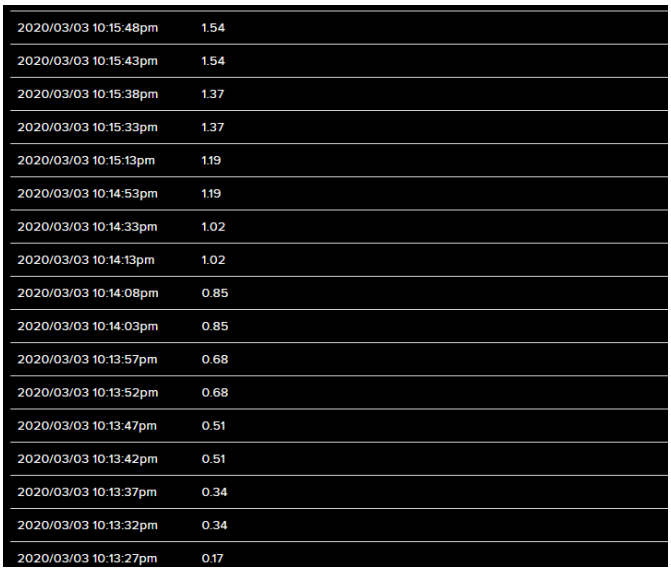


**Fig -8: Live Monitoring of Power**

## 7. FUTURE SCOPE

In this project, the data which is stored or monitored in Adafruit MQTT Platform can be used in Data Science Machine Learning to perform analysis such as how much power consumption can take place and how much it can cost.

Also, remote recharging and modification system as per user requirement can be implemented.

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