Cost Effective Energy Monitoring System

Manasi Pendse[1], Prof. Vaishali. S. Jadhav[2]

[1]M.E. (second year): Electronics and Telecommunication Engineering, Alamuri Ratnamala Institute of Engineering and Technology (ARIET), Thane- Maharashtra, India

[2]Ramrao Adik Intitute of Technology (RAIT) Nerul, Navi-Mumbai, Maharashtra, India

Abstract— *Remote energy meter monitoring is an advanced energy meter formulated by our own which will overcome the problems faced in conventional metering system such as human interference which leads to incorrect billing. In this energy meter advanced technologies such as ARM microcontroller, Raspberry Pi, ADC, Seven segment display (SSD), Cloud (Thing Speak) have been used. This is the new device which is using CY8C4247AZI-M485 ARM Microcontroller and will display voltage, current, and power on SSD and send data on IoT cloud Platform through Raspberry Pi. It can be implemented for residential as well as for industrial purpose. The developed system replaces traditional meter reading methods and enables remote access of existing energy meter by the energy provider. Also it can monitor the meter readings regularly without the person visiting each house. The system collects and manages energy consumption data and provides billing information for the user. A user can easily monitor, manage, and control energy consumption and achieve energy cost saving using the proposed scheme.*

Keywords— *ARM Microcontroller, Automatic Meter Reading System, Electronic Metering, IoT Cloud, Raspberry Pi 3b Model, Smart Meter.*

I. INTRODUCTION

Now a days traditional manual meter reading was not suitable for longer operating purposes as it spends human power. It brings additional problems in calculation of readings and manual billing. In the near future total energy demand is expected to become double the current demand. In view of this situation adopting proper energy management steps and accuracy in billing has become very important.The purpose of project is to develop the 'Remote energy meter monitoring' for single phase. ARM processor is one of the devices which handle entire sub devices connected across it [14]. The energy management technique will eliminate waste, measure and monitor current level of energy use and improve the existing operating procedures in the industry as well as in homes.

Here a new method of post-paid electronic energy metering is introduced in this paper which will automatically sense the used energy, records these reading continuously, then sends it to the IoT cloud through the Raspberry Pi and we can store, retrieve and processed data using Thing speak Cloud Platform which is one of the IoT Cloud Platform [13]. This meter will monitor the usage of electricity as well as it will keep track of real time consumption. This metering system will display voltage, current, power on seven segment display which will allow user to see how much energy is consuming for a particular power tools and this data is send to consumer by using Raspberry Pi and IoT cloud technology. This system will help in reducing the man power and also it will reduce unnecessary hassles over incorrect billing at industries as well as at homes. [11]

II. HARDWARE DESCRIPTION

As shown in Figure 1 Voltage and current which is to be measured is applied to current transformer and voltage transformer. To step down current, current transformer is used and to step down voltage, voltage transformer is used and these parameters are given to microcontroller for the purpose of measurement.

This Analog signal is converted into digital by using inbuilt ADC from PSoC4 which is using a 32bit ARM microcontroller. Measured value of current, voltage and power is displayed on seven segment display and similarly this energy consumption information saved on IoT Cloud through the Raspberry Pi 3b model using serial communication. Keys are used for calibration purpose.
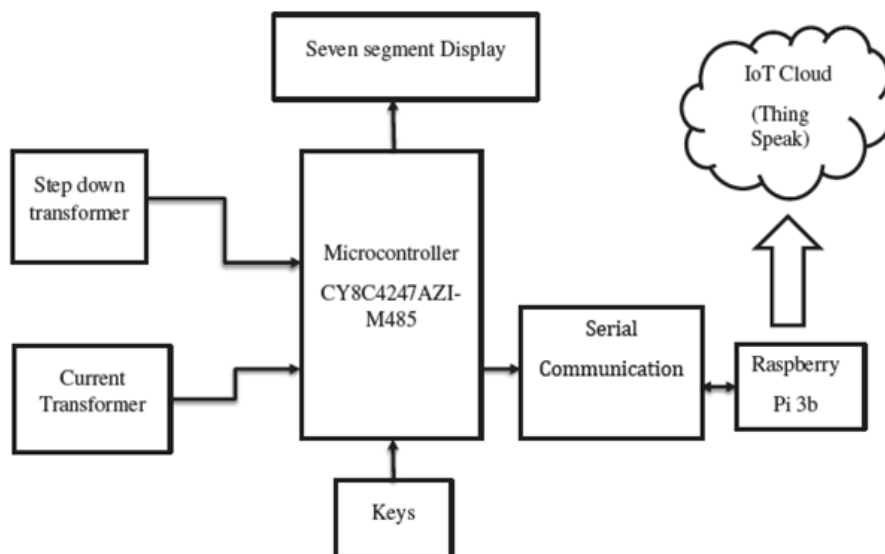
**FIGURE 1: Block Diagram of remote energy meter monitoring**

III.   SOFTWARE DESCRIPTION

3.1   PSoC Creator

PSoC Creator is an Integrated Design Environment (IDE) that enables concurrent hardware and firmware editing, compiling and debugging of PSoC 3, PSoC 4, PSoC 4 BLE, PRoC BLE, PSoC5LPsystems with no code size limitations.[7]

PSoC Creator is a free Windows-based IDE that includes: Hardware design with complete schematic capture.[3]

➢   Over 120 pre-verified, production-ready Components.

    ○   Full communications library including I^2C, USB, UART, SPI, and Bluetooth Low Energy.

    ○   Tools to develop custom components in Verilog or via state machine diagram

    ○   Dynamically generated API libraries.

➢   Integrated C source code compiler and editor.

➢   Built-in debugger.
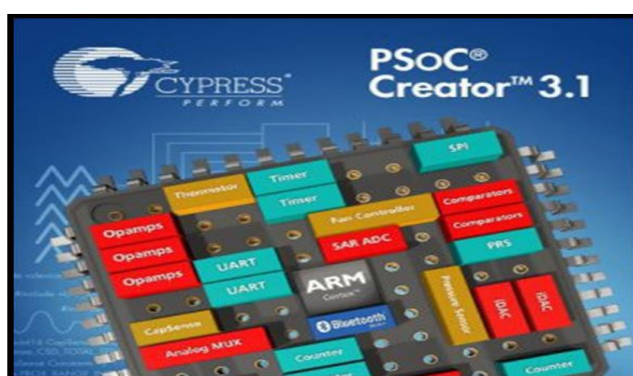
FIGURE 2: PSoC Creator Icon [3].

### 3.2   PSoC creator Download and Install [8]

If you search "Download PSoC creator software" in searchengine like Google, Yahoo, you will find easily. PSoC creator can be downloaded by click on the following link.

http://www.cypress.com/file/318611

IV.   DATABASE ACCESSING METHOD

In this method we can access data globally and also we can store, retrieve, processed data. So that's why we used this new method.
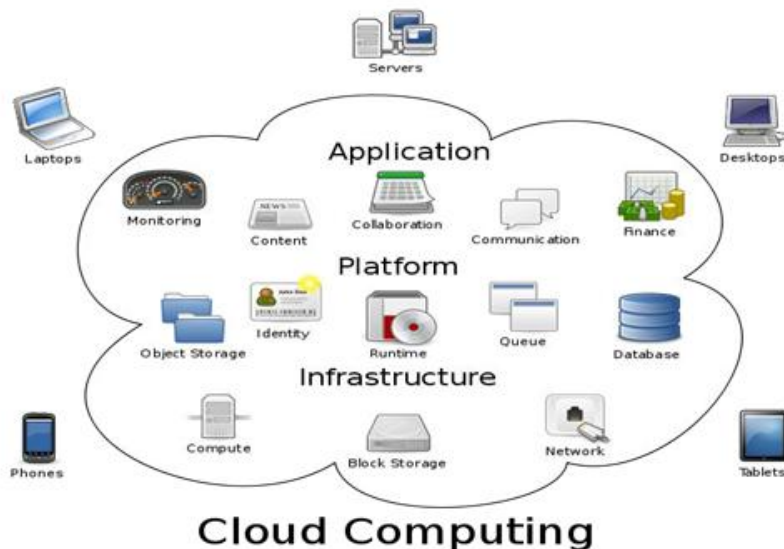
FIGURE 3: Block Diagram of Cloud Computing Services

IoT Cloud is a platform is designed to store and process Internet of Things (IoT) data. The IoT Cloud is a real-time event processing engine. The platform is built to take in the massive volumes of data generated by devices, websites, applications, customers and partners and imitate actions for real-time responses. [5]

For that we required cloud computing services. Cloud computing is the delivery of computing services—servers, storage, databases, networking, software, analytics and more—over the Internet ("the cloud"). Companies offering these computing services are called cloud providers and typically charge for cloud computing services based on usage, similar to how you are billed for electricity at home. So we used IoT cloud platform to store, retrieve and processed energy consumption information on it. [5]

4.1   Thing Speak Cloud Platform

FIGURE 4: Thing Speak Application

Thing Speak is a platform providing various services exclusively targeted for building IoT applications. It offers the capabilities of real-time data collection, visualizing the Collected data in the form of charts, ability to create plugins and apps for collaborating with web services, social network and other APIs. [6]

We will consider each of these features in detail below. The core element of Thing Speak is a 'Thing Speak Channel'. A channel stores the data that we send to Thing Speak and comprises of the below elements:

➢ 8 fields for storing data of any type - These can be used to store the data from a sensor or from an embedded device.
➢ 3 location fields - Can be used to store the latitude, longitude and the elevation. These are very useful for tracking a moving device.
➢ 1 status field - A short message to describe the data stored in the channel.
➢ To use Thing Speak, we need to sign up and create a channel. Once we have a channel, we can send the data, allow Thing Speak to process it and also retrieve the same. [6]
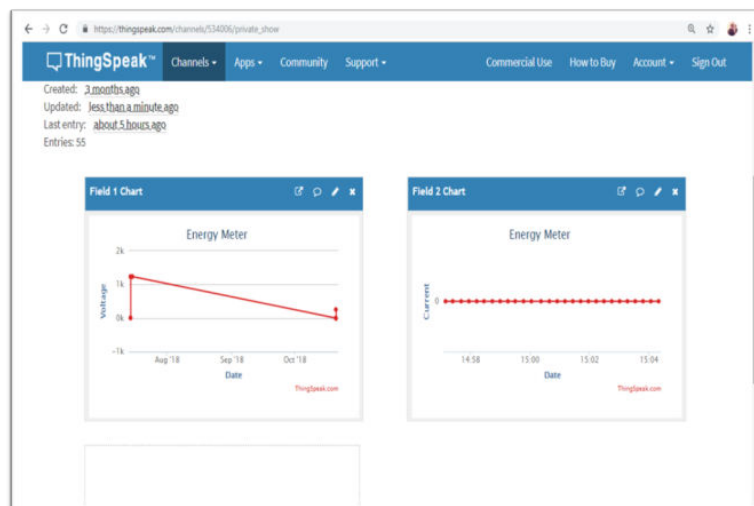
4.2   Why we use Thing Speak Cloud Platform?

Using Thing Speak application we can collect ,analyses and act on the data globally .So that's why we use thing speak Cloud Platform for store, retrieve and processed energy consumption data on this platform. So we get energy consumption information from anywhere and in any condition and also we can generate energy consumption bill

V.   RESULT
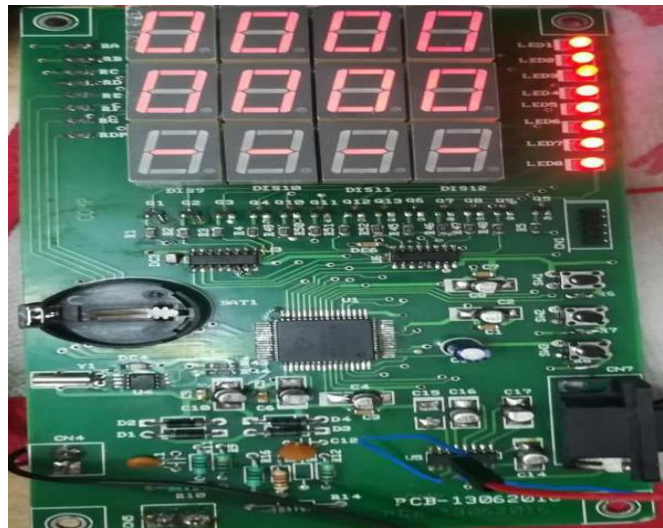
FIGURE 5: Energy Meter Hardware

FIGURE 6: Output Window of Thing Speak Cloud Platform

➢ Current value display on first row of seven segment display.
➢ Voltage value display on second row of seven segment display.

➢ So finally we get output of energy consumption.

➢ The first field chart display voltage graph which gives voltage value.

➢ The second field chart display current graph which gives current values.

➢ This energy consumption data can be access from anywhere and in any condition which gives information about how much energy used.

VI.   CONCLUSION

The 21st century has brought Great Discoveries and advancement in the field of technology. These advancement also brought many challenges and required approaches to handle these challenges. Smart metering system is one of such approaches. In our project we explained all concept of smart metering.

The developed system provides application which will be connected and provide user with useful information. All the information or data processed by user as well as admin will be automatically saved and update in the system. We are also providing application for our system which will be connected to our system and provide user with useful information. We will do testing for the system and make sure that prototype is functional.

FUTURE PROJECT SCOPE

➢ We can use this system as prepaid energy meter, which will empower the consumer to manage energy consumption.

➢ This meter can be used as 3 phase metering system by doing very few modifications in the hardware and more in software of this meter.

➢ We can use this meter for different loads by simply selecting the appropriate current transformer.

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