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AN EFFECTIVE MONITORING AND CONTROLLING OF THE SMART POWER SYSTEM USING UNIQUE CLOUD DATA STORAGE WITH INTERNET OF THINGS

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Abstract - *Energy efficient Technologies play a vital role in our day –to-day life. Lack of resources is the major problem faced in implementing these technologies in an effective way. Since electricity consumption is increasing day-by-day ,power is one of the resource which needs to be monitored and controlled .The effort of human is reduced by the IoT(Internet of things) by introducing the machine- to- machine interaction. Our work is designed to monitor and control our smart power system through IoT using cloud data storage. The consumed Power is monitored by ARM based controller interfaced with current sensors which is stored in a AWS-S3 cloud data base. Power control in our home is achieved through actuators which can be controlled by the client which uses the web server .The system we designed enables client to monitor and control the electrical appliances in our home from anywhere by availing the IoT features thereby the wastage of energy is reduced and sends the alert message to the person monitoring indicating the extra power that is consumed and it waits for the reply message, if not answered it automatically shuts down the power system when not in use for long time.*

Keywords: *Energy, Home Automation, IoT, Xively*

1. Introduction

In this physical world the most need for human being is Electricity. Nowadays consuming the energy is also increased. The use of power is increasingly grown in addition to that it provides energy efficient technologies which can be intended for renewable energy sources. Since prevention is better than cure awareness of energy consumption should be brought into every place before resources get extinguished.

The total energy consumed by the industrial users is about 37%, for personal & commercial transportation is 20%, for residential appliances 11%. The total energy consumed by commercial users is about 5%, the lost occurs due to energy transmission & generation of world's energy contains the rest 27% .

The devices are controlled by saving energy. Based on the needs, the appliances may be turn on and turn off by using Relays. Even though the user is not available for accessing system , the user will easily access it by using online system automation. In this paper, an IoT concept is used. IoT characterizes the devices that are integrated by using internet which means that they uses IP address as their unique identifier. For each mbed controller an unique IP address will be generated, while subject to Ethernet. The controllers are provided by the user Based on the availability of rooms present in house.

By using CPS(Communicating Power Supplies) concept, Steven Lanzisera[1] gives the solution for energy efficient and it transfers the information about energy and it also controls the information between device and building management system. mbed controller is one of the components of CPS which is used for controlling all the information and RF transceiver is another component of CPS which provides communication to user. In IoT the data obtained are stored under cloud database. The designed system has been tested by using three devices namely TV, Video player & LED light.

A hardware system which is supervised by QinranHuz[2] consists of Smart Home Energy Management System (SHEMS) that includes some applications like communication, sensing technology, machine-learning algorithm etc., Here sensors are used for detecting the human activities. In addition to that, by using those data the machine learning algorithm is executed. Due to the execution of machine learning algorithm the total electricity bills will be reduced for customers without the presence of human

Due to continuous monitoring and controlling of electrical appliances the wastage of energy will be reduced with the help of planned system. Since there are many microcontrollers, here mbed controller is used, because mbed controller has the feature of simplicity, comfortable start-up, online compiler. The Ethernet Compatibility for mbed microcontroller is about 10/100Mbit and it can be interfaced to Ethernet modem for IoT implementation. The sensors are used to monitor the values and those values are stored in cloud database continuously. The open source cloud platforms are Ubidots, Xively etc.. In mbed controller the libraries and BSP files are provided by Xively. Xively is called as storage platform because it continuously monitors the data which is measured from current sensors.

Smart home boundaries & device are proceeded by Dae-Man Han [4] besides interoperability about Zigbee device which is produced by different manufacturers of some electrical equipment ,meters and also smart energy enabling products. Here Zigbee is used for information transfer based on power and energy of home appliances. Power-line communication is used for monitoring solar panels. From RF radio the Kruskal's algorithm value is calculated which can be established by using power-line communication prorocol through wireless network.

The photovoltaic system management has been introduced by Jinsoo Han [5] inorder to improve the home energy management which is based on PLC that includes PLC modem, Renewable Energy Gateway and smart device source. By using power line, the PLC modems communicate with REG and it transmits the direct current power which is generated by using PV modules to the grind-connected inverter. The received status are processed and it is stored using Renewable Energy Gateway. For limiting the occurrences of failure the smart device application allows the client to store the entire status of PV system and fix them quickly.

2. System Architecture

2.1 Components Required

2.1.1 Hardware Components

Hardware system contains raspberry pi, current sensor, Ethernet Modem, RJ45 Ethernet cable, Ethernet break outboard, 2Channel relay and appliances such as 10W bulb and 12v DC fan. Relay needs 12v power supply.

2.1.1.1 mbed Controller

Home control and security system for field programmable array has been introduced by Mansour H. Assaf3 .Based on Altera cyclone-II ,the field programmable array provides hardware platform which is used for developing embedded systems. Here the proposed system is planned ,in addition that the correlation of hardware and software is taken .The controlling logics are intended using field programmable array in addition to that the user will communicate through the web server .The data stored in web server are written by using HTML script or java script. PHP is used for providing user alerts to the web server, and also some switching modules are placed for controlling the whole security system. Electricity sensor module builds on the TA12- 200 current transformer which has the ability to change huge alternating current into small amplitude. This sensor can measure alternating current up to 5A.

2.1.1.3 Two Channel Relay

Relay can control any machine consuming the magnetic circuit present in it. A two-channel relay can essentially control two machines. It wants 12v power supply. When relay gets activated it opens the magnetic circuit inside and turns off the device. Two channel relay can control two devices at a time. In this application, a two channel relay is used in each node.

2.1.1.4 Ethernet Router

Zyxel NBG-419N v2 wireless router is intended for LAN connection to provide Ethernet interface to mbed. It integrates 802.11n standard.

2.1.2 Software

2.1.2.1 mbed Online Compiler

The mbed Software Development Kit (SDK) enables the mbed C/C++ software platform and also offers an API-driven method to microcontroller coding.

2.1.2.2 Xively

Xively is software which facilitates the cloud data storage. It is open source software and has libraries for mbed. The NXP LPC1768 microcontroller is selected for this application meanwhile it offers peripheral support for Ethernet which helps to implement IoT part of the system. mbed has library files built for Xively (cloud platform) which helps to monitor

the values of sensors by using Internet. It consumes low power and low cost and also it operates up to 100MHz. It enables the Ethernet and USB to run at the same time without affecting the performance.

2.1.1.2 Groove Electricity Sensor

To measure the power spent in each purpose, current should be monitored.

2.2 Design Diagram

The proposed system is for setting in which there are two rooms. In each room, an mbed microcontroller and sensor-actuator units are designed. Both the controllers are connected to the Internet using Ethernet router.

3. Implementation

3.1 Flow Chart

The execution flow in Figure.1 and Figure.2 is used for checking the Ethernet connection. If Ethernet connection is proper, then IP address gets showed in serial terminal. If there is problem with Ethernet it displays error. If Ethernet connection is checked, then the server port is configured. If any problem occurs the error message is displayed in serial terminal. The server runs when the server port configuration is proper. TCP socket gets connected and RPC is established. User can give options in web server to control appliances. PPC commands inside appeal the microcontroller actions. When the TCP connection gets established, the HTTP server starts running. Then the HTML5 code also gets initiated. When the IP is given in the URL the background HTML5 code runs and webpage is displayed. when user gives signals the corresponding RPC gets initiated and the action will be performed by the microcontroller as per the signal given by the user.

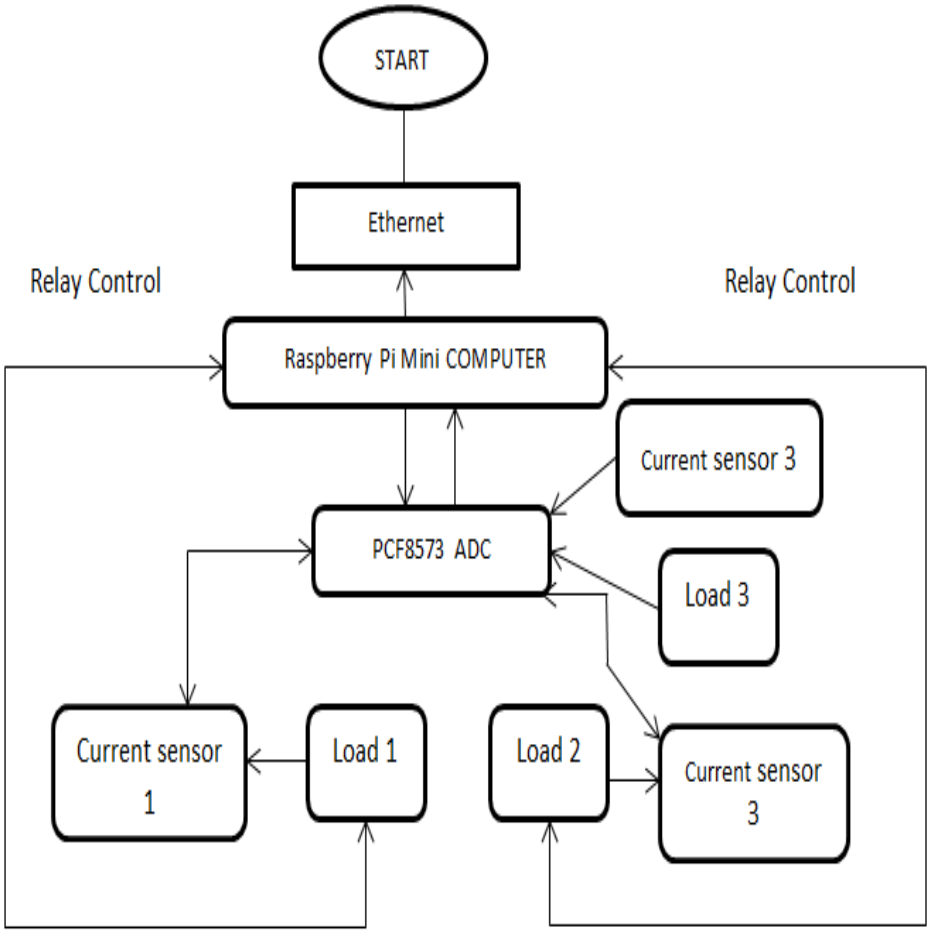


Fig 1.SYSTEM ARCHITECTURE

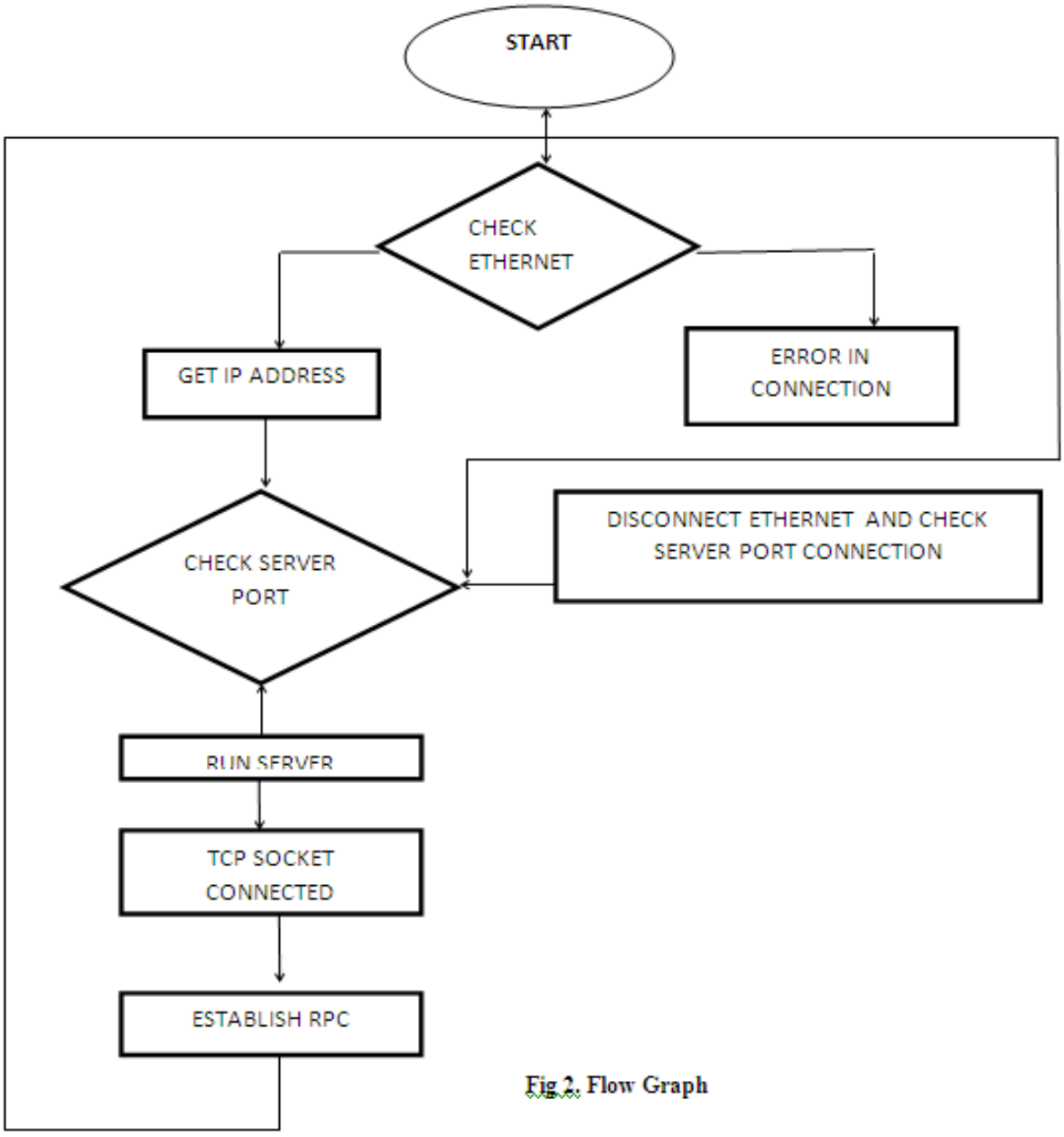
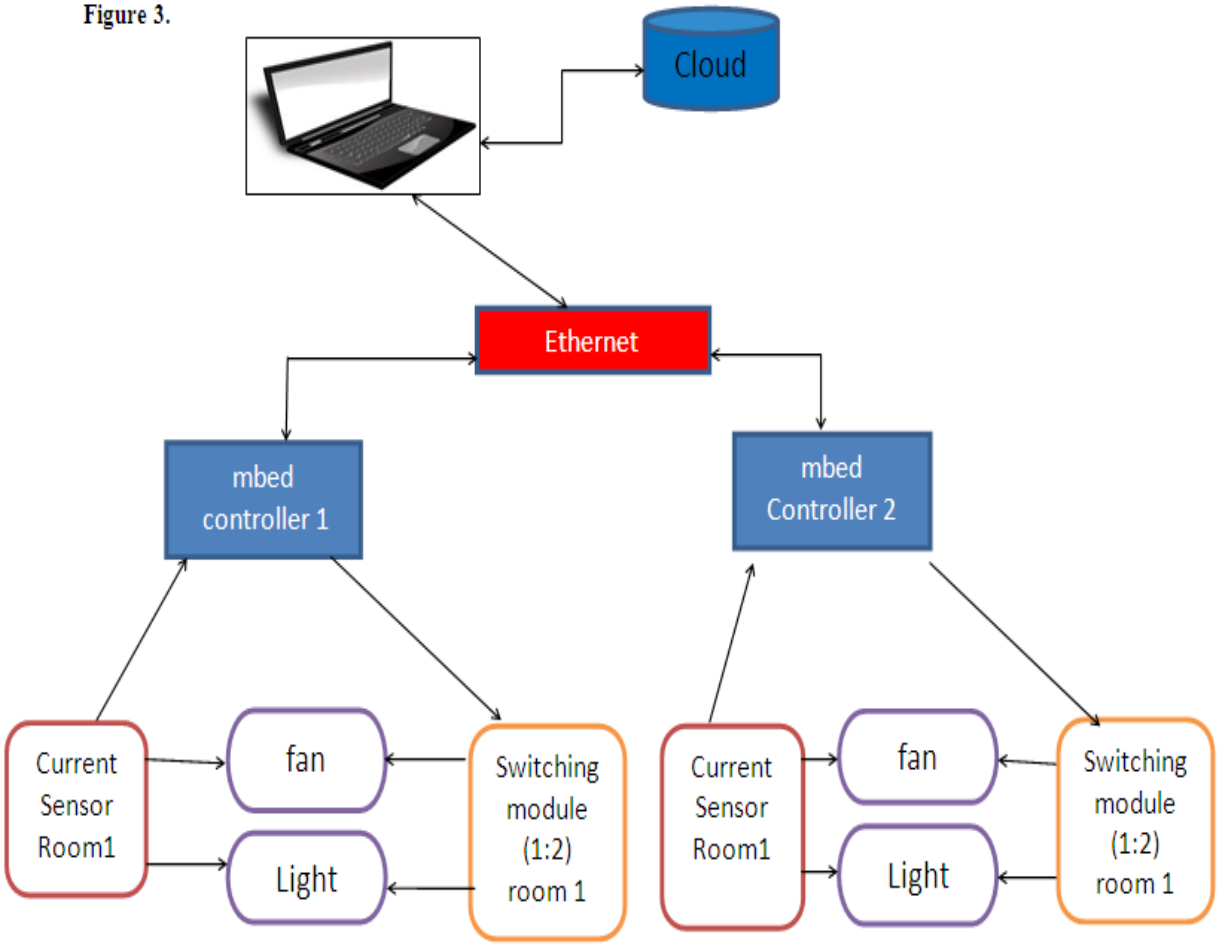


Fig 2. Flow Graph

3.2 Xively Implementation

Read the feed id and keep the feed data stream count as 1. The location of data stream is pointed to the feed data streams and copied to the Xively. Current location points to the orientation of data streams. Cosm library is formed. API key, HTTP, feed id is given to the Xively context. Now set the value to current location buffer. Send all the values to Xively server. Update the values in Xively. The flow of execution can be seen in Figure 3.

Figure 3.



4. Results

4.1 Experimental Setup

The system contains two nodes. Each node includes an update the values in Xively. The outputs in Xively can be seen in

4.3 Client-server Communication

The client-server communication is done through RPC (Remote Procedure Calls). HTTP is the communication protocol used. commands and arguments are passed in between client and server. The output of sending and receiving data can be figured out in

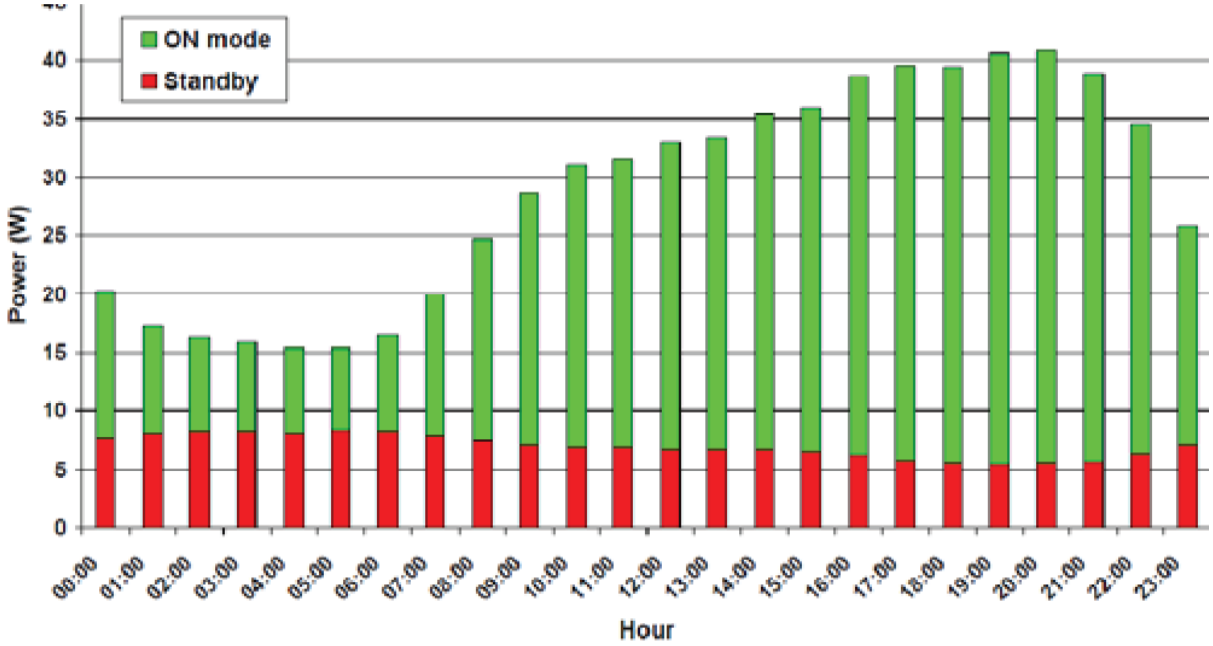
4.4 Web Server for Controlling Appliances

When mbed is interfaced with Ethernet, it produces a unique IP. So in this system two different IP's are created by two different mbed controllers. The webpage is planned so that when IP is delivered in the URL the control page as shown in Figure 4. The user can opens mbed interfaced to sensors and relays. Two appliances i.e. a 10 W LED bulb and 12v DC fan are controlled using two channels relay.

4.2 Monitoring the Current Values in Xively

The measured data from the sensors can be placed in Xively database. For each channel to be measured Xively gives a feed id and API key. Feed id and API key are delivered to mbed and then the code is executed in order to and control lights and fans by selecting button on or off. When the user selects the on or off button internally, RPC commands are originated for controlling channels of relays.

Figure 4. Control through web server.



5. Conclusion

The results displays that when designed system is tested , the average energy consumption of the machines is condensed since they are turned off when unused. The graph shown in Figure 8 shows the energy consumption 4 hours by home appliances in a day. By hiring the proposed automation system, the total energy consumption is condensed . On an entire year up to 15 % of energy can be saved in business building by implementing Smart Power monitoring and control System through IoT.

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