IOT Based Power Consumption Controller (PCC)

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***Abstract-* This paper considers energy management for Internet of Things (IoT) device, which is the most important distributive technology in the present era. The use of power is very essential in day to day life and the proper utilization of this is a challenging task. We can properly consume the electricity as well as calculate the electricity consumption by using the Power Consumption Controller.For the monitoring purpose we will use IOT for monitoring home appliances.In order to accomplish this goal, a complete front-end to back-end system that includes a smart device application (Android platform), a cloud-based database, an Application Programming Interface (API), and a hardware development is proposed. A small programmable computing device (e.g., Raspberry Pi or Arduino) for preliminary testing. This Microprocessor was chosen due to familiarity, and its capabilities, such as general purpose pins(GPIO pins) and built-in Wi-Fi chip module.In this process we ,current sensor and voltage sensor is placed at electrical load to sense the current and voltage , so it calculates the power consumption of electrical appliances. After that data will be transmitted wirelessly using Wi-Fi access protocol to the Ethernet shield. The transmitted data is monitored and analyzed remotely using IOT. This enables user to have flexible control mechanism remotely through a secured internet web connection. This system helps the user to control the electric devices automatically, manually and remotely using smart phone(android) or computer. Power Consumption Controller is very efficient, cheaper and flexible in operation and it can save electricity expense of the consumers.**

KeyWords : IOT, Energy management, Raspberry Pi, Arduino, Ethernet Shield, Android, current sensor.

1. INTERRODUCTION

Though electricity is very essential in day to day life, the proper utilization of it must be done. We can properly consume the electricity as well as calculate the electricity consumption by using the electric meter. The vulnerability about the supply of energy can tell the working of whole economy, especially in creating financial aspects. It is the necessity to manage consumption of electricity due to limited availability of resources. So the aim of this paper is to recognize and eliminate the misuse of electricity. Internet of The United States, the largest economy in the world, consumed 12.96 million watt-hours per capita in 2014[4].Despite energy consumption having a strong positive correlation with the economic development within a country, energy is not a free resource and has many environmental, social, and political dimensions associated. Data from March 2017 indicates that the United States energy consumption came primarily from petroleum and natural gas, sources that contribute to greenhouse gas things has helped many organizational systems to improve efficiency, increase the speed of processes, minimize error and prevent theft by coding and tracking the objects.According to researchers, "The IoT is a system of interrelated computing devices, mechanical and digital machines, objects, animals, or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human to computer interaction"[1]. Computing and communications has its future in the technological transformation brought by the IOT.Many researchers have been studying the concept of IoT, its applications, and security of these applications using IoT [2,3]. Power consumption can be reduced to a great extent if we can monitor our daily power usage and switch off appliances which are unnecessary consuming electricity. This paper focuses on developing a monitoring system using the concept of Internet of Things.

Internet of Things (IoT) is a recent revolutionary technology which consists of integration of sensing as well as communication capabilities to common things, in order to gather useful data. Such IoT enabled devices can be used to monitor various important physical, electrical or environmental parameters. This information is then used to analyze, identify and solve different problems related to everyday life . Electrical power management for efficient use of electricity is one such important problem. IoT enabled power monitoring devices can help solve this problem by providing granular information about electricity consumption. In present Indian scenario, conventional electric meters supplied by electricity suppliers measure power consumption of the whole building. Consumer has no means to monitor power utilization of individual appliances. These meters also lack storage feature as well as any option to analyze data. Due to absence of any communication facility in the meter, power consumption has to be noted down manually at each meter location for billing purpose. This process itself is prone to human error.

2. LITERATURE SURVEY

emissions, which have been proven to increase global warming [5,6].This project is conducted at the Punta Leona Hotel y Club, Costa Rica, a resort and country devoted to the natural ecology of their region. Costa Rica aims to run primarily on renewable energy sources, where in 2016, 98.1% of electricity came from renewable sources [7,8].

Sean Dieter Tebje Kelly, Nagender Kumar Suryadevara, and Subhas Chandra Mukhopadhyay reported an effective implementation for Internet of Things used for monitoring regular domestic conditions by means of low cost ubiquitous sensing system. The description about the integrated network architecture and the interconnecting mechanisms for the reliable measurement of parameters by smart sensors and transmission of data via internet is being presented. The longitudinal learning system was able to provide a self-control mechanism for better operation of the devices in monitoring stage. The framework of the monitoring system is based on a combination of pervasive distributed sensing units, information system for data aggregation, and reasoning and context awareness. Results are encouraging as the reliability of sensing information transmission through the proposed integrated network architecture is 97%.

Francesco Benzi and Lucia Frosini reported electricity Smart Meters Interfacing the Households. They addresses this topic by proposing the definition of a local interface for smart meters, by looking at the actual European Union and international regulations, at the technological solutions available on the market, and at those implemented in different countries, and, finally, by proposing specific architectures for a proper consumer-oriented implementation of a smart meter network. Pedro Cheong and Ka-Fai Chang describes a ZigBee-based wireless sensor network node for the ultraviolet (UV) detection of flame. The sensor node is composed of a ZnSSe UV photodetector, a current-sensitive front end including a high-gain current-to-voltage amplifier with 120 dB and a logarithm converter, and a transceiver operated at a 2.4-GHz industrial, scientific, and medical band. A passive photodetector is designed to have a cutoff at 360 nm and convert the UV emission of flame into picoamperes. Including mixed signal processing and ZigBee transmission, the speed of flame detection is as fast as 70 ms. The sensor node consumes only an average of 2.3 mW from a 3.3-V supply. The performance of a prototype sensor node was verified when the luminous flame was imaged onto the sensor node with different angles ranging from $-30^\circ$to $30^\circ$and distances of 0.1, 0.2, and 0.3 m enabling effective fire safety applications. Melike Erol-Kantarci and Hussein T. Mouftah reported Wireless Sensor Networks for Cost-Efficient Residential Energy Management in the Smart Grid. The performance of in home energy management (iHEM)is compared with an optimization-based residential energy management (OREM) scheme whose objective is to minimize the energy expenses of the consumers. It shows that iHEM decreases energy expenses, reduces the contribution of the consumers to the peak load, reduces the carbon emissions of the household, and its savings are close to OREM. On the other hand, iHEM application is more flexible as it allows communication between the controller and the consumer utilizing the wireless sensor home area network (WSHAN). This paper evaluate the performance of iHEM under the presence of local energy generation capability, prioritized appliances, and for real-time pricing. We show that iHEM reduces the expenses of the consumers for each case. Furthermore, we show that packet delivery ratio, delay, and jitter of the WSHAN improve as the packet size of the monitoring applications, that also utilize the WSHAN, decreases[9].

Using the smart power meters, the power consumption by various electrical appliances can be automatically measured, logged and analyzed.

3. PROPOSED SYSTEM

Current sensor and voltage sensor are interfaced to the home appliances for measuring electrical parameters of the appliances. Power consumed by each device is calculated using measured current and voltage.The hardware aspect of this project requires a variety of components that had to be tested before ordering and implementing into the system. A small programmable specialized computing device, the Raspberry Pi v3, was used for preliminary testing.

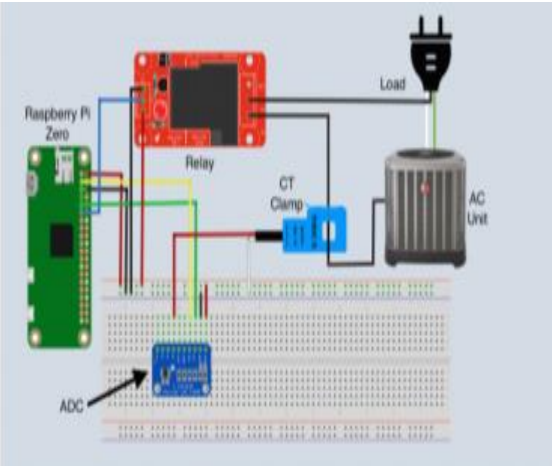
3.1 RASPBERRY PI

The Raspberry Pi v3 was chosen due to familiarity and its built-in capabilities for all aspects of the project, including general purpose pins and Wi-Fi capabilities. The Raspberry Pi v3 also had a variety of external attachments for monitoring and control purposes. Following the preliminary testing phase of the project, this computational device was changed to the Raspberry Pi Zero Wireless due to its affordability, similar features, and smaller size, as seen in Figure I below.

The electrical relay, an electronic switch that is activated by a current or signal between circuits, used in the preliminary testing was the SparkFun Beefcake mechanical Control kit which would attach to the Raspberry Pi v3 directly and become an intermediary for the electrical energy to flow through to the testing devices.The relay was later changed to 25 amp and 60 amp solid state relays due to variance in target appliances. The monitoring aspect involved a Current Transformer (CT) clamp, which uses a magnetic field to measure the current traveling through a wire. The analog signal output from the CT clamp was converted to digital signal by attaching it to a breadboard and then through a 4-channel Analog-to-Digital-Converter.Furthermore, once the hardware development was fully functioning in the

ISSN: 2278-0181
NCRAEM - 2019 Conference Proceedings

testing phase, AC to DC, 5W power converter modules (transformers) were implemented to supply power to the Raspberry Pi via the source from the lighting, or A/C units. The completed preliminary hardware configuration is shown in Figure II below

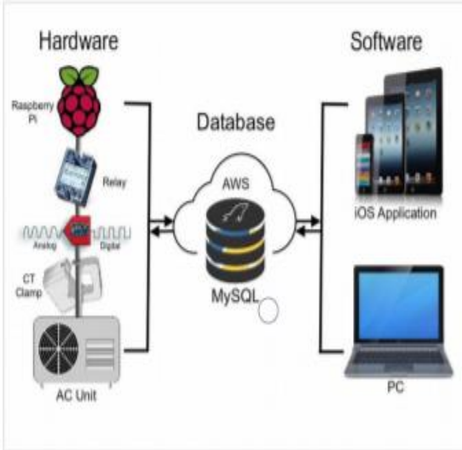


The CT clamp measurements were calibrated against a clamp ammeter that measures current. The current was varied using a light dimmer serving as a potentiometer. The measurements were recorded, and a calibration curve was generated, as shown in Figure III. The calibration curve formula was implemented within the Python code on the Raspberry Pi for monitoring purposes. The python code written for the Raspberry Pi also referenced the voltage of the device to be monitored/controlled to generate an energy consumption power rating seen in formulas (1) and (2) [10].

Power=Current*Voltage (1)
Power=[Calibration Factor*CT Clamp ReadingOffset]*device_voltage_rating (2)\

The smart nodes were designed to communicate with the various hardware components for the intention of sending energy data in hourly intervals to a MySQL relational database instance hosted on Amazon Web Services. Once the data is inserted and stored in the database, it can then be read from the Android application. Additionally, the Android application has the functionality of sending data to the database to change a device's status (e.g., On/Off), which the smart nodes can then interpret and respond in order to satisfy the request.

for the installation [11,12]. This process also involved making inquiries for extra hardware components that would be required for the installation to be successful. This inquiry was conveyed to the electrician that worked at the resort about some of the unit specifications and with the IT staff about the networking configuration before proceeding. Prior to the installation, mock wiring schemes were developed in order to fully understand how the various electrical components would be interconnected.The implementation consisted of 18 total units, which included 8 A/C units with energy monitoring capabilities, 4 lighting units that did not

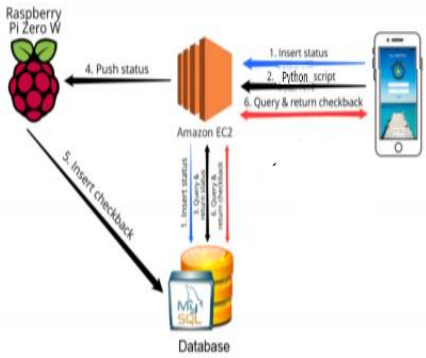


THE ARCHITECTURE DIAGRAM OF THE IoT MONITORING AND CONTROL SYSTEM

3.2 INSTALLATION AND DEPLOYMENT

Information was gathered about the Wi-Fi reliability, A/C unit specifications, equipment/tools and materials necessary

include energy monitoring capabilities, and 6 spare units in the event of malfunction or damage to a smart node. All units were switchable through an iOS application from any location. The data flow for controlling any specific device can be seen in Figure below.[13]



DATA FLOW DIAGRAM

3.3 MOBILE APP INTERFACE

The android mobile application is the primary graphical user interface (GUI) for the product. This interface allowed users to manipulate the power status of electronic devices. The application provided the component status and check-backs on whether or not the component was successfully able to respond to the requested change in power status. The android application is written in English.
The data can be viewed per unit and in an increase of hours for the duration of one day, week, or month.

MOBILE APP INTERFACE

3.4 WEB PAGE

The proposed system can be used to display load energy usage reading in terms of Watts. Every user would be able to access the information from anywhere on the earth. Thingspeak.com is one such web-page which takes the help of the MathWorks MATLAB analytics to present the device information in a more detailed analysis in both description and visualization. Thingspeak.com provides the user the ability to add any number of channels to one account and in each account information can be fed into 8 fields [14]. An account can be assigned to one division of an area and n channels can be created to a suite of n meters in the locality. The analytics can be viewed by both the consumer and service provider.

4. CONCLUSIONS

Power Consumption Controller using IOT is an innovative application of internet of things, developed to control home appliances remotely over the cloud from anywhere in the world. In the proposed project current sensor (CS) is used to sense the current and display it on web page or the android application using IoT. The system updates the information in every 1 to 2 seconds on the internet using public cloud THINGSPEAK.

In the present system, energy load consumption is accessed using Wi-Fi and it will help consumers to avoid unwanted use of electricity. IoT system where a user can monitor energy consumption.We can make a system which can send SMS to the concerned meter reading man of that area when theft is detected at consumer end. Also using cloud analytics we can predict future energy consumption.

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