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IOT IMPLEMENTATION FOR EFFICIENT ENERGY CONSUMPTION AND MANAGEMENT

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Abstract - *The basic parameters in energy management are accurate measurement, power analysis, control and display of the load curve of the receiver. The lack of validity of the information obtained from traditional methods in the measurement model reduces the possibility of energy management. IoT-based energy management ensures the integrity and reliability of data and offers buyers flexibility by providing a workspace from which to manage home systems. The project plans a home plan to monitor the energy consumption of each device. Using the functionality of the microcontroller, consistent readings of power meters are collected and stored in the Node MCU, and then the data is sent to remote workers through the Thingers.io app, an Android application to monitor and control energy. This project provides real-world information about the categories most used by the buyer. You can then see the continuous review of electrical equipment through the Android application, and also evaluate the electricity bill paid by the person. Users can also turn off devices that use too much power. Therefore, energy consumption of the relevant products is saved. Moreover, this study can be extended to all energy consumption models and solve the problem of energy costs.*

Key Words: **IOT, Energy Management System, Energy Observing and Controlling, Node MCU.**

1.INTRODUCTION

Energy monitoring means providing customers with information about their usage habits; This is accomplished using an energy monitoring application that collects usage data, analyzes it, and then provides useful information directly to consumers. This tells people how much energy they use at each hour of the day and how they use it. The Energy Management Program allows customers to manage their energy using the Energy Management application, which will help them save on daily energy consumption. The main parameters in energy management are accurate measurement, energy analysis, control and obtaining a view of the customer's load. The project requires establishing a central building to monitor and control the energy consumption of each device. The actual usage or power consumption of each device can be controlled to minimize the usage of the devices that use the most power. By obtaining these monitoring reports, customers can be helped to take the necessary measures to reduce energy consumption. Use a portable app for continuous power checks. The app also works well in home management, allowing users to control devices remotely or based on user-specified conditions.

2. RELATED WORKS

Research is presented on the acquisition and analysis of different products and information provided to customers. Determining the customer's load is the main purpose. The tests provide real-world insight into the products consumers use most frequently in their homes, using statistical data to inform results from images. The view of the use of each material is drawn. The use of smart meters can provide accurate data readings and evidence for accurate calculations to monitor the energy consumption of each device. Data analysis extracts signatures from the graphs, giving the maximum and minimum usage of each device in each family. Therefore, help customers see, monitor and track to improve energy efficiency [1]. It has been proven that the integration of IoT and energy management can be more efficient and reliable than traditional energy management. The main feature of this system is not to collect data door-to-door, but to provide an easy way to collect data from servers over the internet. Information will be updated shortly after Wi-Fi [2]. Overcome all the shortcomings of current power meters. Arduino esp8266 microcontroller is programmed to make the target with the help of GSM module. All detailed information is sent to the user's mobile devices via IoT and GSM modules and displayed on the LCD screen [3]. Power analysis is designed to provide accurate power consumption results and calculate power consumption for each 1ms period. Therefore, detecting damage takes little time and users can control the load [4]. IoT smart meter with instant load control. Within the scope of this study, a mobile application was also developed to see the instant use of electricity and generate an electricity bill. The mobile application also allows remote control of the device [5]. Discuss how you can monitor the energy use of any device in your home from anywhere in your home without changing your home's wiring. Now we can easily understand the electricity usage in our home with the questions in the questions because we can now understand it in a readable and understandable

way on our mobile phone. This system also allows us to monitor the equipment remotely [6]. It is aimed to create a simple, compact and low-cost security WiFi-based energy monitoring sensor. It has been successfully completed and tested at IITH facilities. Accuracy of voltage measurement proves essential for reliable use as an energy monitoring sensor [7]. Smart energy monitoring systems have been developed to realize smart home. The system uses a wireless network to monitor and control the power of home appliances. and also protects the load from high voltages [8]. The concept of combining IoT and blockchain technology is proposed to monitor the energy consumption of home appliances and control unnecessary energy loss. A smart meter that constantly monitors electrical equipment has been developed. Create an Android app where users can set price limits. Using the Android app, customers can also see all the rewards the device is currently redeeming. It also receives a notification when ninety percent of the threshold is reached. Using this message, it can be extended to initiate or use protection to control power. The two readings from the Android app and the smart meter are stored in a database using blockchain technology. These results are compared and if the energy consumption exceeds the limit set by the user, the device turns off or switches from the original mode to energy saving mode. The biggest disadvantage of this system is the need for the internet to provide communication between electronic devices [9]. An internet-connected energy monitoring and control system aims to improve equipment and user experience in energy use. Energy awareness allows users to control the power of devices as needed, thus reducing energy consumption [10].

3. PROPOSED SYSTEM

The main parameters in energy management are correct meter usage, energy monitoring and monitoring the customer's load. This can be done using smart meters. The project aims to create a home system that tracks the energy consumption of each device and displays its usage graphically. The power of real-time readings from smart meters is being brought back to the THINGERS.IO app with new content. The interface was designed so that users can constantly monitor the consumption of all devices in their home, anytime, anywhere. This project offers a safe, environmentally friendly, accessible and manageable home automation solution. According to the current situation, we chose the Android platform so that most people can benefit from it. The tool is easy to use and suitable for people without a background.

4.MATERIAL USED

1. ESP8266 WIFI Module: ESP8266 is an excellent and low-cost device that provides network connectivity for your project. The module acts as both an access point (can create an access point) and station (can connect to Wi-Fi) so it can easily receive and send data to the internet, making IoT as easy as possible. You can also use APIs to retrieve data from the Internet, so your project can access all the data available on the Internet, making it smarter. Another nice thing about this switch is that it can be operated using the Arduino IDE, which makes it more useful. However, this version of the mod only has 2 GPIO pins (you can use up to 4 by hacking this), so you will need to use it with another microcontroller (like Arduino), otherwise you will need an optional additional ESP-12 or ESP-32 versions. So, if you are looking for a mod to start using IoT or provide internet connectivity for your projects, this mod is a good choice for you.

2. 16 Channel Multiplexer: CD74HC4067 High Speed CMOS 16 Channel Analog/Digital Multiplexer Breakout Module is a board for a simple 16 channel analog/digital multiplexer/multiplexer. The die works like a switch - one pin (COM on the schematic, SIG on the board) is connected to one of 16 pins (CHANxx). It works with both digital and analog signals (no voltage higher than VCC) and the connection works on both. To check this, connect the 4 digital outputs to the chip's address select pins (S0-S3) and send the binary address to the desired channel (see documentation for details). This allows you to connect up to 16 sensors to your body using only 5 pins!

3. 4 Channel Relay Module: The Four Channel Relay Module features four 5V relays and interrupt switching and isolation components so it can be easily interfaced with a microcontroller or sensor using small components and connections. There are two terminal blocks with six terminals each, and each terminal block is divided by two relays. The terminals are screw type, making connection to the power block easy and flexible. 4. ACS Current Sensor: ACS712 module uses the famous ACS712 IC to measure current using the Hall effect principle. The name of this module comes from the IC used in the module (ACS712), so use the IC instead of the module for your final product.

5. ZMPT101B Voltage Sensor: The voltage sensor is a simple and effective device that uses a voltage divider to reduce power consumption by 5 times. This allows us to use the microcontroller's analog input pins to monitor input voltages above its capacity. For example, you can measure voltages up to 25V using the 0V - 5V analog input range. The module also includes convenient screw terminals for easy and secure connection of cables.

6. Arduino Nano: Arduino Nano is a microcontroller board based on AT mega 328P. It has a combination of 14 digital I/O pins and 6 analog input pins with a 16 MHz frequency crystal oscillator, a USB port for power input and drain code, an ICSP connector and a reset button. It can be powered initially and later using the AC-DC adapter or battery.

7. Potentiometer: Potentiometer, also known as POT, is nothing but a floating variable. They can give a different look by turning the button on their head. It can be divided into two main parts. One is the resistance itself (R ohms), the other is the power rating (P watts). The charge or resistance determines how much it contributes to the flow of electric current. The larger the load, the smaller the current flowing through it. Some values of potentiometers are 500Ω, 1K, 2K, 5K, 10K, 22K, 47K,50K, 100K, 220K, 470K, 500K, 1 M.

5. IMPLEMENTATION

5.1 Hardware Implementation

Figure 5.1 shows the completed cabling in our project. ESP 8266 is the brain of our project as it handles the control and monitoring part of the system. The 16-way relay module is connected to the MCU node and is used to initiate the load connection, that is, to turn the load connection on and off. AC current sensor.

5.2 Software Implementation

i. Arduino IDE: The open sources Arduino software (IDE) makes it easy to write code and transfer it to the development board. It runs on Windows, Mac OS X and Linux. The environment is written in Java and is based on Office and other open sources software. The software can be used with any Arduino board. Arduino's development environment includes a script for the code, a text area, a text editor, a toolbox with commonly used buttons, and various menus. It connects to the Arduino hardware to load programs and communicate with it. Software written using Arduino is called sketch. This draft is included in the text. Drawings are saved with the .ino file extension. It has cut/paste and search/replace functions. The native language provides feedback and error messages when saving and exporting. The console displays output from the Arduino environment, including error messages and other information. The current card and serial port appear in the upper-right corner of the window. Toolbar buttons allow you to define and install programs, create, open and save charts, and view system views. ii. Thingers.io App: Thingers.io is an iOS and Android app platform for controlling Arduino, Raspberry Pi, and more over the web. It is a digital control panel that allows you to create interactive graphics for your projects by dragging and dropping widgets. Thingers.io is not tied to a specific card or card expansion. Instead, it supports the device of your choice. Whether your Arduino or Raspberry Pi is connected to the internet via Wi-Fi, Ethernet, or the new ESP8266 chip, Things.io will help you connect and prepare for the Internet of Things. Things.io is designed for the Internet of Things. Thingers.io can remotely control devices by viewing the current image, viewing sensor data, recording data, displaying data and many other cool features displayed in the app. Since Esp-8266 has only 1 analog pin, only 1 sensor can be connected. To solve this problem, connect the 16-channel multiplexer to the MCU and then connect the current and voltage meters to the multiplexer. Since Arduino is also connected to Node MCU and Multiplexer, current and voltage values are also stored in Arduino and with the help of these values, the value of the connected components is calculated and displayed on the 16x2 LCD screen. Arduino is included mostly for security measures. If only Node MCU is used and the system runs 24/7, the load on Node MCU will increase and eventually damage the Node MCU. Therefore, by using Arduino and Node MCU, it is possible to share work and make it secure even if the device operates 24/7. Things .io platform on smartphones and hardware. You can use our Thingers.io cloud or run your own Thingers.io server locally. It's open source, can easily control thousands of devices, and can be built from a Raspberry Pi. The Thingers.io library is available on all popular hardware platforms, provides communication with the server and manages all incoming and outgoing commands. iii. IFTTT: IFTTT stands for “If This, Then That.” It's a free website for creating simple scripts (called applets). These practices are caused by changes to other web services such as Gmail, Facebook, Telegram, Instagram, Google Assistant or Pinterest. For example, if a user tweet using a hashtag, the app can send an email; If someone saves the user in the photo, the app can copy the photo from Facebook to the user's profile. These services are available for IOS and Android as well as web-based applications. iv. Google Assistant: Google Assistant is an artificial intelligence-supported virtual assistant developed by Google and can be used on mobile devices and smart home devices. Google Assistant can be a two-way conversation when assigned as a virtual assistant. It is also available in multiple languages for customer’s convenience.

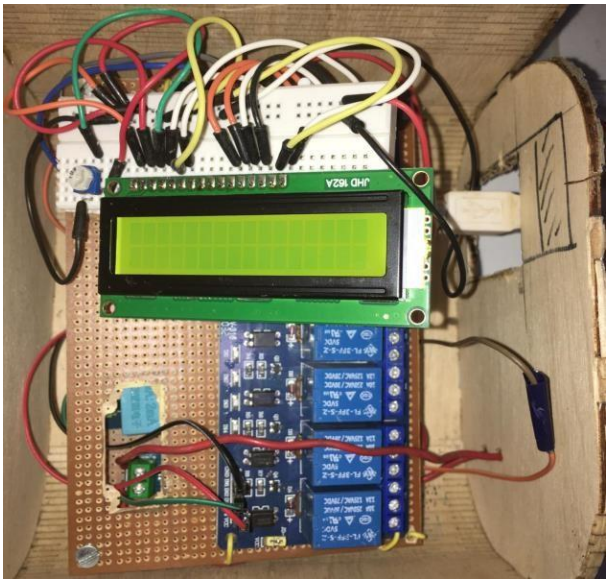

Fig -5.1: Main hardware circuit.

Fig -5.2: Power Reading on the Lcd Display.

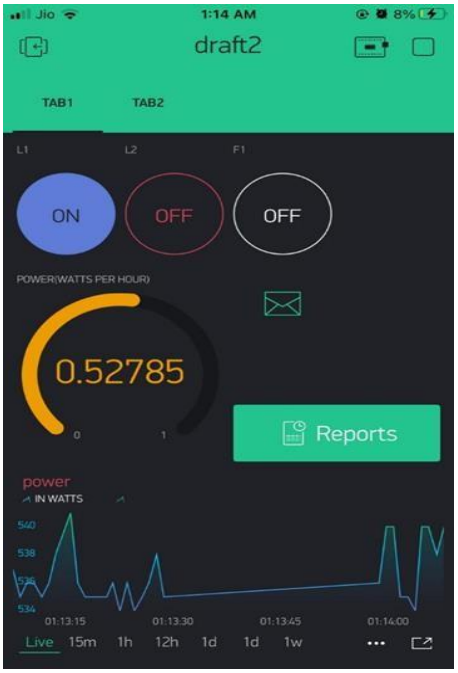

Fig -5.3: Screenshot of the Thingers.io application showing the graph of the power consumed and the On & Off Buttons to Control the connected load.

Fig -5.4: Average Price/hr reading on the Lcd Display.

Fig -5.5: Serial Output of Arduino IDE

6. CONCLUSIONS

Try to create a "IOT IMPLEMENTATION FOR EFFICIENT ENERGY CONSUMPTION AND MANAGEMENT" model. The emitted model is used to calculate the energy consumption of the building and even take the energy reading. Therefore, it reduces electricity wastage and increases everyone's awareness. Even book intervention will be cut. This project provides a secure, global access control solution for home automation. According to the current situation, we chose the Android platform so that most people can benefit from it.

7. FUTURE SCOPE

This project puts all the power of reading at your fingertips. The project can be continued for the purpose of measuring the scale. Smart apps can be designed to provide various notifications based on device readings. Following the Digital India initiative, consumers will be able to provide a unified platform to view their electricity usage and pay their bills online. In the future, the effectiveness of the design can be increased by making some adjustments in design thinking, and by utilizing intelligence, a sensor can be made that measures, warns and informs the user at the same time.

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REFERENCES

[1] Suvidha Biradar1, Prof. Rahul Hiware2, IOT Based Data Analytics and Web Monitoring of Energy Load Profiling for the Households, Vol. 5, Issue 5, May 2017.

[2] Md. Rakibul Hasan, Eklas Hossain, Hossain Mansur Resalat Faruque, Tipu Sultan, IoT Based Smart Energy Management in Residential Applications, 1st International Conference on Advances in Science, Engineering and Robotics Technology 2019 (ICASERT 2019).

[3] Prathik.M, Anitha.K, Anitha.V, Smart Energy Meter Surveillance Using IoT, International Conference on Power, Energy, Control and Transmission Systems (ICPECTS), 2018 IEEE.

[4] Bandi Narasimha Rao, Reddy Sudheer, Energy Monitoring using IOT, Proceedings of the Fifth International Conference on Inventive Computation Technologies (ICICT-2020) IEEE Xplore Part Number:CFP20F70-ART; ISBN:978-1-7281-4685-0

[5] Sai Shibu N B, Aravind Hanumanthiah, Sai Rohith S, Yaswanth CH, Hemanth Krishna P, J VS Pavan, Development of IoT Enabled Smart Energy Meter with Remote Load Management, 2018 IEEE International Conference on Computational Intelligence and Computing Research.

[6] Anket Narkar1, Karan Kunnumal2, Sagar Kanteliya3, Suvarna More4, Vikrant More5, Power Consumption Monitoring and Home Automation using iot, International Conference on Innovative and Advanced Technologies in Engineering (March-2018).

[7] Jalpa Patel1, K. Avinash Reddy2, M. Kirti3, Dr. D. B. K. Kamesh4, Dr. J. Sasi Bhanu5, MEASURING ELECTRICITY CONSUMPTION OF APPLIANCES AND MONITORING THEM USING IoT AND MACHINE LEARNING, International Research Journal of Engineering and Technology (IRJET), Volume: 05 Issue: 04 | Apr42018.

[8] Akshay Ramesh Jadhav, P. Rajalakshmi, IoT Enabled Smart and Secure Power Monitor, Department of Electrical Engineering, Indian Institute of Technology Hyderabad, India Email: ee16resch01002, raji@iith.ac.in , 2017 IEEE.

[9] 1Dr.P V Rama Raju, 2G. Naga Raju, 3G V P S Manikantah, 4Abdul Vahed, 5A L Bhavyaw, 6Ganesh Reddy, IOT Based Power Monitoring System and Control, Journal of Emerging Technologies and Innovative Research (JETIR), November 2017, Volume 4, Issue11.

[10] V. Subbulakshmi , D. Aiswarya, A.R. Arulselvi, Monitoring and Controlling Energy Consumption Using IOT and Blockchain, Special Issue Published in Int. Jnl. Of Advanced Networking & Applications (IJANA).