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Power Saving Smart Energy Meter

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Abstract: ***The effort of collecting electricity utility meter reading. Internet of Things (IoT) present an efficient and co-effective to transfer the information of energy consumer wirelessly as well as it provides to detect the usage of the electricity the main intention of this project is measure electricity consumption in home appliances and generate it's bill automatically using IoT. The cost and the regular usage of Power consumption are informed to the user to overcome high bill usage. The Energy meter shows the amount of units consumed and transfers the data to both the customer and to the electrical board so this helps in reducing man-power.***

Keywords: power, smart, energy, meter, IOT, Sensor, Automation, NodeMCU

1. Introduction

The advancement of the Internet of Things has been emerging day by day. The Internet of Things (IoT) revolves connection between M2M that embedded with electronics, software, sensors, actuators that assist users in monitoring and controlling devices remotely and efficiently. In the IoT based system object and living being are provided with unique identifiers with the ability to transfer data. The area of IoT has amplified from the convergence of wireless technologies, microelectromechanical systems and the Internet. Nowadays IoT technology is being applied in many areas like electricity, gas, water etc. to make our life automated. Nowadays due to the excessive use of the internet, these areas become computerized and online payment system makes possible. But accessing meter reading is a manual process and has the possibility of error which causes high revenue cost [3]. Automatic Meter Reading (ARM) technology facilitates the assessment of energy consumption and analysis of data for billing and payment. ARM technology requires to bring the device online and connecting device with the internet which is in other term Internet of Things. ARM technology using wireless communication is cheaper than wired medium. Hence, WiFi is more suitable for the proposed system as it is very common in every residence.

2. Literature Survey

2.1 Articles Reviewed

In recent years enormous research and papers have proposed the design and development of Energy meter monitoring system. In the author proposed a Wi-Fi based single-phase smart meter based on IoT. The author used a digital meter, ESP8266 Wi-Fi module and a web application for the user interface. The ESP8266 Wi-Fi module has attached into the meter.

The ESP8266 Wi-Fi Module has been implemented by TCP/IP protocol has the means of communication between the meter and web application. The proposed system is secured and open source but costly. In an Automatic Meter Reading (ARM) based Power Meter with Wi-Fi Communication Module scheme has been proposed and developed software based on Linux. In the author presented a survey report on the utilization of smart electricity meters and some key aspects of the metering process. As well as opportunities arising due to the advent of big data and the increasing popularity of the cloud environments challenges are highlighted by the author. In [10] the author proposed a system where Arduino Uno has been developed with an Ethernet shield that can monitor all the necessary activities in the flow of electricity, the use of current and Electricity costs and mentioned hope of reducing the problems associated with payment, calculate the cost of the unit of electricity. In the author proposed a real-time monitoring system for residential energy meter. The presented system provided inclusive and continuous access to energy consumption to the consumer by exploiting the advancement of IoT technology.

2.2 Problem Statement

The effort of collecting electricity utility meter reading. Internet of Things (IoT) present an efficient and co-effective to transfer the information of energy consumer wirelessly as well as it provides to detect the usage of the electricity the main intention of this project is measure electricity consumption in home appliances and and generate it's bill automatically using IoT for the user reference by our project. PSSEM Project needs to be implemented in a household appliance because we have to know which appliances are consuming more power and what is the cause of electricity bill hike. We have to identify the more power consuming appliance and connect them to the Power saving smart energy meter.

3. Schematics

3.1 Block Diagram

Block diagram Block diagram represents the Node MCU are connected to an web application and to the Mobile app. The Multiple loads can be monitored in a Single app also the load can be controlled. The in current sensor will monitor the total load. And the Voltage sensor will be ensure the constant 230V input is available in the circuit. The current sensor 1 and current sensor 2 will be monitoring specific loads. The Relay 1 will be controlling the load 1 and the Relay 2 will be controlling the Load 2. The Neutral circuit will be directly connected to the load and the phase will be travelled towards the main current sensor and phase will be splitted and run through the Current sensor 1 and current sensor 2. The same way the load 2 will be connected through with load 2. The feedbacks of the current sensors are connected to the node MCU which all already has been programmed for calculating the wattage of each load. Add Sir result through node mcu v weekend CD load consumed of an each load and also we can control the load as we need through the web application on mobile app.

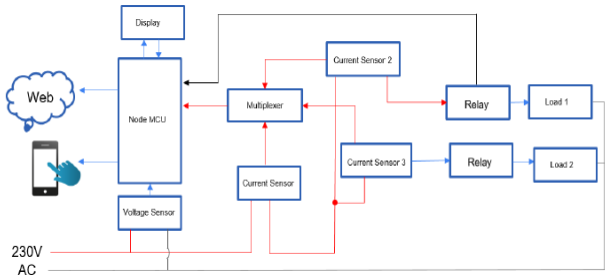
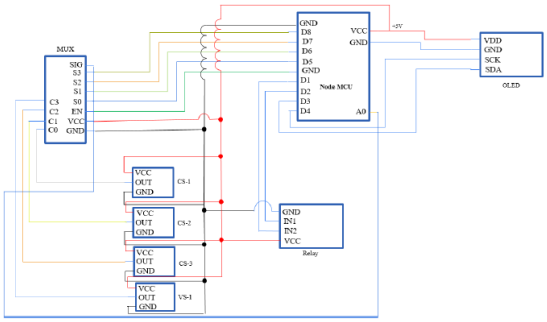


Figure 3.1: Block diagram

3.2 Circuit Diagram



Here, The Node MCU is powered up with the 5V input volt and the Node MCU is powering up the Current sensors, voltage sensor, multiplexer, and OLED and those Node MCU pins are connected with the Respective pins of each sensors and components and mobile app called Blynk is virtually connected with Node MCU and a Web application is also Connected. The Input current will be passing through the voltage sensor and also with respective current sensor. And multiplexer is used to get input of multiple inputs and to convert the inputs into a single analog input. The input of NodeMCU will be through the A0. Finally all calculation will be done internally and the output will be displayed in the OLED Display. The Total watts consumed and the watts consumed to each load will be displayed. . The system makes use of Arduino will be sending the Data to the specified Server. Each ESP8266 Module comes pre-programmed with an AT command customary firmware. The ESP8266 module is an extremely price effective board with an enormous, and ever increasing, community.

4. Hardware Requirements

4.1. Node MCU

Node MCU is a low-cost open source IoT platform. It initially included firmware which runs on the ESP8266 Wi-Fi SoC from Espress if Systems, and hardware which was based on the ESP-12 module. Later, support for the ESP32 32-bit MCU was added. Node MCU is an open source firmware for which open source prototyping board designs are available. The name "Node MCU" combines "node" and "MCU" (micro-controller unit). The term "Node MCU" strictly speaking refers to the firmware rather than the associated development kits. Both the firmware and prototyping board designs are open source. The firmware uses the Lua scripting language. The firmware is based on the Lua project, and built on the Espress if Non-OS SDK for ESP8266. It uses many open source projects such as lua-cjson and SPIFFS. Due to resource constraints, users need to select the modules relevant for their project and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented. The prototyping hardware typically used is a circuit board functioning as a dual in-line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna. The choice of the DIP format allows for easy prototyping on breadboards. The design was initially was based on the ESP-12 module of the ESP8266, 9 which is a Wi-Fi SoC integrated with a TensilicaXtensa LX106 core, widely used in IoT applications.

Figure 4.1: Node MCU

4.2 Relay Module

This is 2 Channel 5V Relay Board Module for Node MCU PIC AVR DSP ARM. A wide range of microcontrollers such as Arduino, AVR, PIC, and ARM and so on can control it.

Figure 4.6: Relay

Each one needs 15mA-20mA driver current and Equipped with high current relay: DC 5V / 10A, AC 250V / 10A. Standard interface that can be compatible with microcontroller.

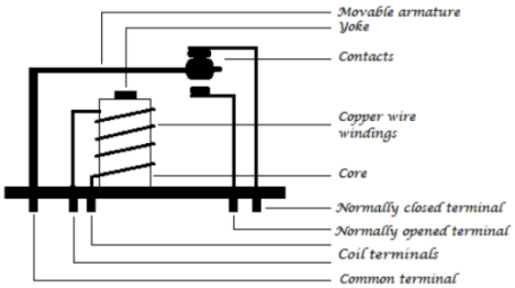


Figure 4.7: Relay Working

4.3 Current Sensor

Current flowing through a conductor causes a voltage drop. The relation between current and voltage is given by Ohm's law. In electronic devices, an increase in the amount of current above its requirement leads to overload and can damage the device.

Measurement of current is necessary for the proper working of devices. Measurement of voltage is Passive task and it can be done without affecting the system. Whereas measurement of current is an Intrusive task which cannot be detected directly as voltage.

Figure 4.11: Current Sensor

For measuring current in a circuit, a sensor is required. ACS712 Current Sensor is the sensor that can be used to measure and calculate the amount of current applied to the conductor without affecting the performance of the system.
ACS712 Current Sensor is a fully integrated, Hall-effect based linear sensor IC. This IC has a 2.1kV RMS voltage isolation along with a low resistance current conductor.

4.4 Voltage Sensor

This sensor is used to monitor, calculate and determine the voltage supply. This sensor can determine the AC or DC voltage level. The input of this sensor can be the voltage whereas the output is the switches, analog voltage signal, a current signal, an audible signal, etc. Some sensors provide sine waveforms or pulse waveforms like output & others can generate outputs like AM (Amplitude Modulation), PWM (Pulse Width Modulation) or FM (Frequency Modulation). The measurement of these sensors can depend on the voltage divider. This sensor includes input and output. The input side mainly includes two pins namely positive and negative pins. The two pins of the device can be connected to the positive & negative pins of the sensor. The device positive & negative pins can be connected to the positive & negative pins of the sensor.

Figure 4.14: Voltage Sensor

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The output of this sensor mainly includes supply voltage (Vcc), ground (GND), analog o/p data. Voltage sensors are used to monitor or measure, calculate and determine the supply of voltage. With the help of this sensor, we can determine the AC or DC voltage level. The input of this sensor can be voltage. While the output can be output switches, analog voltage signal, a current signal, audible signal, etc.

4.5 Multiplexer

A multiplexer (sometimes spelled multiplexor and also known as a MUX) is defined as a combinational circuit that selects one of several data inputs and forwards it to the output. The inputs to a multiplexer can be analog or digital. Multiplexers are also known as data selectors. A multiplexer is useful for transmitting a large amount of data over the network within a certain amount of time and bandwidth.

Figure 4.15: Multiplexer

Multiplexers that are built from transistors and relays are termed as analog multiplexers which are used in analog applications and Multiplexers that are built from logic gate termed as digital multiplexers which are used in digital applications. The inverse of a multiplexer is known as a de-multiplexer.

4.6 OLED

OLED technology is still relatively new compared to similar, long-established technologies such as LEDs and LCDs (both of which were invented in 1962). Broadly speaking, you can use OLED displays wherever you can use LCDs, in such things as TV and computer screens and MP3

and cellphone displays. Their thinness, greater brightness, and better color reproduction suggests they'll find many other exciting applications in future. They might be used to make inexpensive, animated billboards, for example. Or super-thin pages for electronic books and magazines. How about paintings on your wall you can update from your computer? Tablet computers with folding displays that neatly transform into pocket-sized smartphones? Or even clothes with constantly changing colors and patterns wired to visualizer software running from your iPod!

Samsung started using OLED technology in its TVs back in 2013, and in its Galaxy smartphones the following year. Apple, originally dominant in the smartphone market, has lagged badly behind in OLED technology until quite recently. In 2015, after months of rumors, the hotly anticipated Apple Watch was released with an OLED display. Since it was bonded to high-strength glass, Apple was presumably less interested in the fact that OLEDs are flexible than that they're thinner (allowing room for other components) and consume less power than LCDs, offering significantly longer battery life. In 2017, the iPhone X became the first Apple smartphone with an OLED display.

4.7 Internet of Things

The internet of things, or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

A thing in the internet of things can be a person with a heart monitor implant, a farm animal with a biochip transponder, an automobile that has built-in sensors to alert the driver when tire pressure is low or any other natural or man-made object that can be assigned an Internet Protocol (IP) address and is able to transfer data over a network.

Increasingly, organizations in a variety of industries are using IoT to operate more efficiently, better understand customers to deliver enhanced customer service, improve decision-making and increase the value of the business.

5. Software Description

5.1 Arduino

The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards.

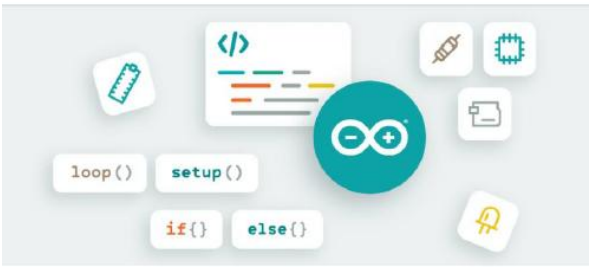

Figure 5.1: Arduino

The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub *main ()* into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program *avrdude*to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware. By default, avrdude is used as the uploading tool to flash the user code onto official Arduino boards.

6. Experimental Results

Power will be Lively Monitored Using Blynk App and Web Application.

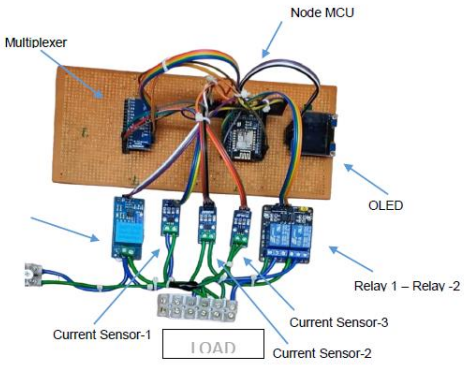

Figure 6.1: Full Kit

6.2 Product Connected with Load

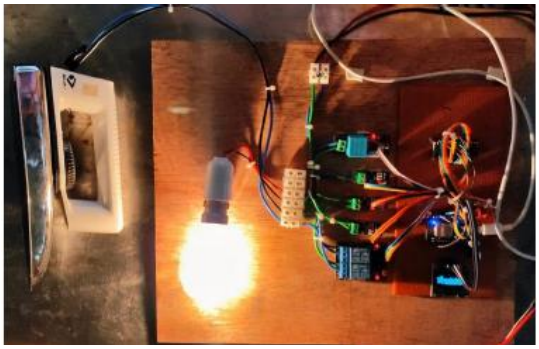

Figure 6.2: Product Connected with Load

6.3 Ouptut Through web application.

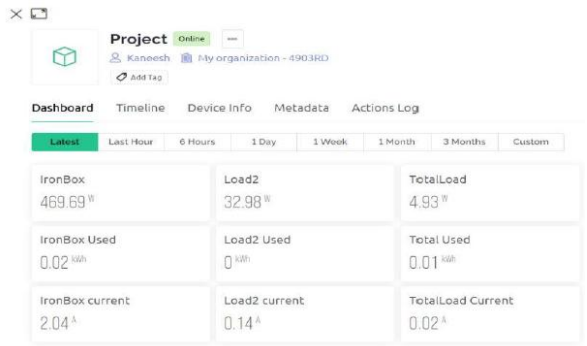

Figure 6.3: Output monitored in Web application

7. Conclusion

The proposed system is able to reduce the sufferings of the customer and make users concern about the excessive consumption of electricity as well as faulty devices at home. Through this system, customers can easily view total pulse, total units and total costs of electricity. The system is easily readable and reliable. The data stored in the cloud has great importance in future energy meter data mining. In a large sense, energy distribution company such as DPDC able to observe the pattern of consumption of an area. Consequently, this observation can help in load distribution in a certain area.

We can receive monthly energy consumption from a remote location directly to centralize office. In this way we reduce human effort needed to record the meter reading which are till now recorded by visiting the home individually.

8. Future Scope

The Project is intended to calculate the Electricity bill and to control the load specifically and Each. The Limit will be given to the NodeMCU when the load reaches the limit the load will be automatically tripped. Smart energy monitoring system includes Arduino, WI-FI, energy meter. The system automatically reads the energy meter and provides home automation through an app developed and power management done through this application. The proposed system consumes less energy and it will reduce manual work. We can receive monthly energy consumption from a remote location directly to centralize office. In this way we reduce human effort needed to record the meter reading which are till now recorded by visiting the home individually.

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