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IOT BASED SMART ENERGY METER

Pranav Singhal[1], Sakshi Upadhyay[2], Sheenam[3] Annurudh Pratap Upadhyay[4]

Student,Dept. of Electronics & Communication Engineering, IMS Engineering College, Ghaziabad,U.P, India

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Abstract - *It is a very tedious job for the electricity board officials to record the meter readings manually and calculate the bill of the consumer. This procedure not only consumes the time but also man power along with more chances of human error. Energy consumption for all the consumer is not uniform but varying so it is a difficult job for electricity board official to manually go and take the meter readings of big industrialists and reset their maximum demand after recording it. Tampering is an issue that is very prominent regarding energy meters.*

Key Words: **IOT, Digital Energy Meter, Arduino UNO, ESP8266, Relay**

1. INTRODUCTION

Considering all the above mentioned aspects it is possible to design an energy meter that is tamper proof, supports automatic metering and billing system, and at the same time helps in finding the fault location of transmission lines. This meter can be used to take the readings of industrialist which sends these readings to a secured data location and automatically reset it after recording it. Keeping in mind all these features we have implemented a single energy meter referred to as Smart Energy Meter.[1]

Even the present day electronic energy meters used by electricity board is not completely tamper proof. The proposed energy meter also have the feature of detecting faults in the distribution system, made by checking the status of supply at distribution transform and that at consumer. So there is a technological advancement needed, hence we develop a system with faster and advanced technology i.e. IoT. Nowadays we have a burning concept of IoT i.e. Internet of Things. Through this concept or technology the objects are sensed controlled remotely in the existing network infrastructure. The existing energy meter did not perform two way communications. MESB employee would come and take a photo of the energy meter or jot down the reading from the energy meter and would submit this data to the utility. Then there would be a approximation of energy bill and the consumer is asked to pay the bill .Internet of Things is a new information processing acquisition technology, also referred to as the third wave of information technology after internet, mobiles and computer network. In IoT everything is configured with internet protocol address and it can monitor and access remotely in accordance with web technology.[2]

2. MODULE & CIRCUIT DIAGRAM

In this project, we have made use of a digital energy meter that consist of a blinking LED signal. It flashes 3200 times for 1 unit. It is then interfaced with a microcontroller using Optocoupler(4N35). As shown in Figure 2.1 The microcontroller takes this reading and sends it to IOT Platform using a Wifi module. The Wifi module used in the project is ESP8266. It provides internet connectivity for microcontroller. Arduino UNO is used as a microcontroller in this project. ESP8266 transmits the data serially to the IOT platform for display where the energy meter readings are globally accessible.

The IOT Platform used in this project is ThingSpeak. The Arduino is provided with a 3.3V supply and ESP8266 is powered using a 7.5V adapter. Arduino is programmed using Arduino IDE and the wifi module is programmed using AT commands in the same Arduino IDE. The consumed power reading is displayed in both, the digital and analog format, on the website page of ThingSpeak platform. The reports of the energy consumption are generated daily and can be monitored 24/7 , 365 days.

For all this, human involvement is not needed. It provides privacy since it avoids the need of reading entry and bill calculation by a person from TNEB at our homes.

Apart from IOT implementation, the project contains some added features. A user can set some threshold value on the energy meter to warn him regarding the energy consumption in his house. As soon as the energy meter reaches that value, the buzzer will start beeping. The user can set another threshold value at which the power supply will be automatically cut. He can set/reset the value depending on his need.[3]

These features were added keeping in mind the issues faced by people where they have no idea regarding energy consumption in the house. This feature also eliminates the possibility of any short circuit in the house. The user will get notified about the energy consumption and using this technique he can save as much energy as possible and mitigate its wastage to the minimal.

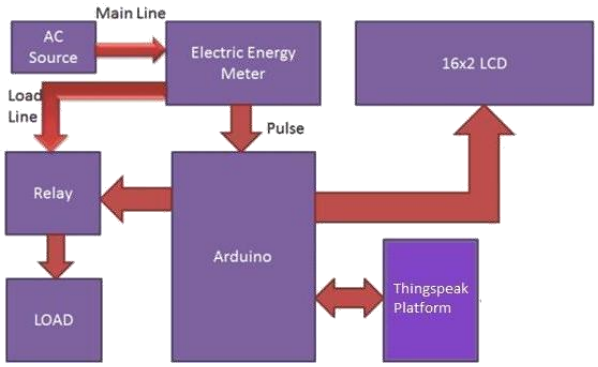

Figure 2.1: Block Diagram of IOT Based Smart Energy Meter

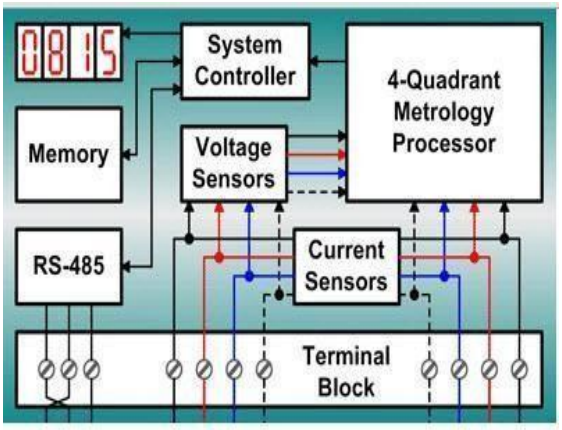

Figure 3.1: Internal Block Diagram of Energy Meter

3. COMPONENTS:

3.1 Energy Meter

An electricity meter is a device that is used to measure the amount of electricity utilized by a house or industry. It basically measures the energy in kilowatt hours(kWh).Figure 3.1 describes the internal circuit of Energy Meter. In the past 1880s the meters are started to be installed in the living areas . Instead of charging the homes based on how many electricity load they had, charging on how much electricity they used become more accurate.

There are basically two types of meters. The ELECTROMECHANICAL METER works by using the force generated by the current when passing through magnetic field to rotate the disk inside the meter And the ELECTRONIC METER directly converts electricity with an analog to digital convertor inside a microprocessor to get the exact electricity reading.[5]

The main parts of energy meter are

1. **Driving System**
2. **Moving System**
3. **Braking System**
4. **Registering System**

3.2 Arduino UNO:

The Arduino UNO is a microcontroller based on a microchip ATmega328P microcontroller. The board is designed with combination of digital and analog input/output(I/O) pins as shown in Figure 3.2 .The board has 14 digital pins and 6 analog pins and programmable with the Arduino Integrated Development Environment via USB cable .It works on the voltage of 5V by making use of the voltage regulator onboard. There is a crystal oscillator present to generate frequency of 16Mhz. The Arduino microcontrollers are preprogrammed with a boot-loader which helps in easy uploading of the programs on to the on-chip flash memory

There is a logical convertor and level shifter onboard to facilitate the logical conversion of voltages between RS232 and TTL voltages to make the device compatible for functionality .The Arduino board exposes most of its microcontroller I/O pins for the use by other circuits . Thus the Arduino board can be programmed to interface with the breadboard.[8]

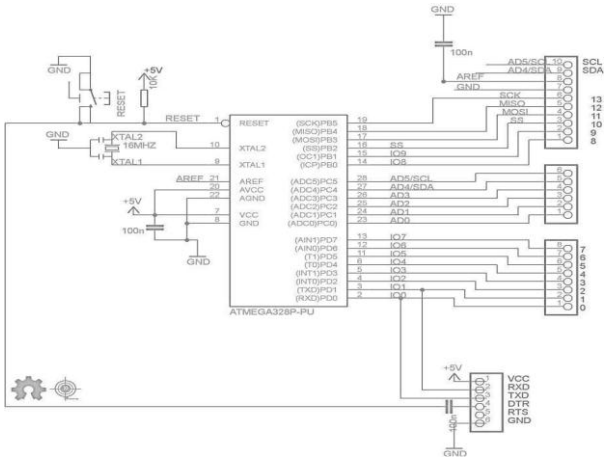

Figure 3.2 : Internal Block Diagram of Arduino UNO

3.3 ESP8266

The chip is first used by western makers in August 2014 with the ESP-01 module, and which is made by a third-party manufacturer Ai- Thinker. The small ESP8266 module as shown in Figure 3.3 allows microcontrollers to connect to a Wi-Fi network and make simple Transmission control protocol/Information protocol connections using Hayes-style commands. However, at first there was almost no English-language documentation on the chip and the commands it accepted.[6]

The pinout is as follows for the common ESP-8266 module:

1. VCC, Voltage (+3.3 V; can handle up to 3.6 V)
2. GND, Ground (0 V)
3. RX, Receive data bit X
4. TX, Transmit data bit X
5. CH_PD, Chip power-down
6. RST, Reset
7. GPIO 0, General-purpose input/output No. 0
8. GPIO 2, General-purpose input/output No. 2

The espress if systems is a major manufacturer of the wifi module ESP8266 which is a 32 bit microcontroller sample template format ,Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

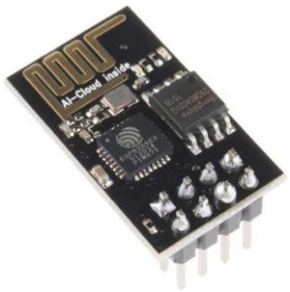

Figure 3.3: ESP8266

3.4 Relay

A relay is an electrically operated switch. Some relays use an electromagnet to mechanically operate a switch. The first relay was used in long distance telegraph circuits as an amplifiers: Basically the main work of relay is to repeat the signal coming in from one circuit and to re-transmit it on another circuit. A simple electromagnetic relay as shown in Figure 3.4 consists of a coil of wire wrapped around a soft iron core, an iron yoke which provides a low reluctance path for magnetic flux, a movable iron armature, and one or more sets of contacts

There are various types of relays

1. **Coaxial relay**
2. **Contractor**
3. **Force guided contacts relay**
4. **Latching relay**
5. **Mercury relay**

And many more…….

The application of relays was in long telegraph lines, where the weak signal received at an intermediate station could control a contact, regenerating the signal for further transmission. High-voltage or high-current devices can be controlled with small, low voltage wiring and pilots switches. Operators can be isolated from the high voltage circuit.[7]

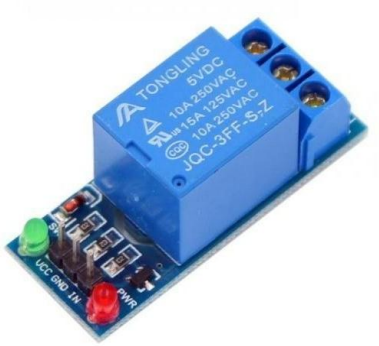

Figure 3. 4: Relay

1 IMPLEMENTATION:

The Arduino UNO is being used for processing all the gadgets and modules used in this project. As shown in Figure 4.1 The liquid crystal display is used for displaying the status of the units. Data pins of LCD namely RS,EN,D4,D5,D6,D7 are connected to Arduino digital pin number 7,6,5,4,3,2. And RX and TX pin of arduino is directly connected to the wifi module ESP8266. Relay is used for switching electricity connection which is connected at pin 12 of arduino through ULN2003 relay driver.

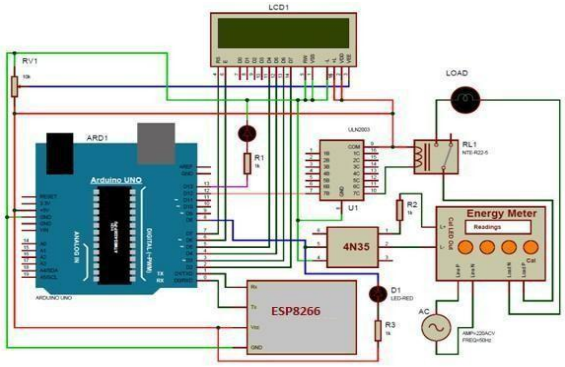

Figure 4.1: Internal Architecture of the IOT Based Smart Energy Meter

The pulse LED'S or the cal LED's terminal is soldered using two wires and taken out from the energy meter after which the energy meter is closed and tightly screwed. Then we have connected the anode terminal of LED at pin number 1 of optocoupler and cathode terminal to pin 2. Pin number 4 of optocoupler is directly connected to ground. The LED and the Pull- up resistor are connected at pin number 5 of optocoupler. The same terminal should go to the arduino pin 8 too.[4]

2 CONCLUSIONS

The smart energy meter is an improvement over the conventional prepaid energy meter in use today. It uses the IOT technology for energy monitoring and management. Unlike the conventional prepaid meters, this system offers an interactive interface for both consumers and utility companies. The system has been designed to resort to a local server and database, upon resumption of internet connection. Further improvement could also be made by interfacing the system with a cell phone in future.[4]

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