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PREPAID ENERGY METER WITH DATA ACQUISITION USING IOT

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Abstract - *Households usually have postpaid energy connections. Consumers face several issues as a result of postpaid connections, including the fact that their energy usage is not tracked, and they are often surprised when they receive large bills. The aim of this project is to develop a prepaid electricity recharge unit that will function as an electricity recharge device that will integrate with standard household energy meters and be capable of counting down energy consumption and cutting off the main supply once the energy usage countdown reaches zero, as well as a data acquisition system using IOT. The recharge information and electricity usage from the recharge station is stored in a Data Acquisition System, which can be connected to the circuit integrated to energy meters for controlling main supplies..*

Key Words: *prepaid, energy meter, IOT, data acquisition.*

1. INTRODUCTION

The customer faces several issues as a result of post-paid connections. Prepaid electricity connections are frequently recommended as a feasible solution to this problem. Consumers will need to recharge the amount of energy they need to consume in this prepaid electricity meter circuit. The household electricity meters must be fitted with a device that can recognize the amount recharged by the user and count down the electricity usage from the amount recharged to zero in order for this system to work. When the meter count reaches zero, the main supply is automatically turned off, and it can only be turned back on after the next recharge.

This device is being built with Arduino and a GSM board and node MCU. We may use an online portal to recharge our energy balance. If the balance is poor or zero, the power supply link to the house is automatically disconnected. This device is also programmed to send energy consumption notifications from the meter to the substation at regular intervals through the node MCU module, while also alerting consumers about low balance, cutoff, and other issues.

2. MOTIVATION TOWARDS THE WORK

Electromechanical or electrical energy meters are used in India. The biggest flaw in this scheme is that a utility employee would go from area to area, reading each house's energy meter and handing over the bills. The bill was charged, according to that reading. Even when bills are paid on time, errors such as an extra billing sum or a notice from the utility are common. To get around this issue, we've come up with a few ideas.

3. EXISTIG SYSTEM

The current method is time consuming and labour intensive. On a regular basis, the device receives data on energy usage. Consumers are often given billing information on a monthly basis. If a consumer's energy consumption reaches a critical level, an alarm system is provided. The energy dissipated by the traditional electromechanical meter was higher. An electromechanical meter is also available.

Fig. 1 Existing System

4. PROPOSED SYSTEM

The proposed system prepaid energy meter with data acquisition using IoT. This proposed meter helps to track the energy consumption and calculate bill. This data is stored in server and send to consumer by using GSM module application. Data is transmitted to server through nodeMCU module. The user interface created can be used by consumer to track his electricity consumption information.

Fig. 2 proposed frame work

5. RELATED WORK

A. HARDWARE REQUIREMENTS:

- Arduino Mega
- LCD
- GSM Module
- Node MCU Module
- 3200 imp/kwh Energy Meter
- Optocoupler
- LED
- 5v Relay
- Lamp

B. SOFTWARE REQUIREMENTS:

- Arduino Programming
- HTML
- PHP

C. BLOCK DIAGRAM:

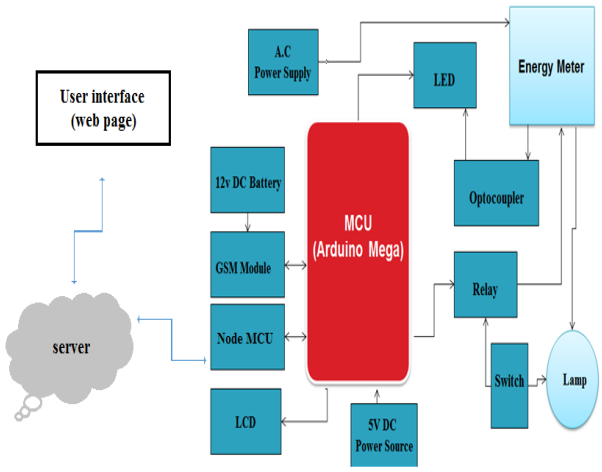

Fig. 3 Block diagram of proposed system

D. COMPONENT DESCRIPTION:

ARDUINO MEGA:

- The Arduino Mega is a microcontroller board based on the ATmega2560.
- It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.
- It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Fig. 4 Arduino MEGA

LCD DISPLAY:-

- LCD display module with BLUE Backlight
- Operate with 5V DC
- SIZE : 16x2 (2 Rows and 16 Characters Per Row)
- Can display 2-lines X 16-characters Wide viewing angle and high contrast.

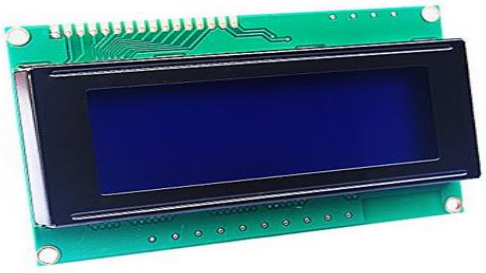

Fig. 5 16*2 LCD DISPLAY

GSM MODULE:-

GSM means global system for mobile which is a mobile communication modem. It is mainly used in mobile communication for data transfer throughout the world. A GSM modem is a special type of modem that accepts a SIM card, and which operates over registering to a mobile

operator, just like our mobile phone. GSM modem devices works in full duplex mode for sending and receiving SMS. It is an open cellular technology used for communicating mobile voice and data services which operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands.

Fig. 6 GSM modem

NODE MCU MODULE:-

NodeMCU is an open-source Lua-based firmware and development board designed specifically for Internet of Things (IoT) applications. It includes firmware that runs on Espressif Systems' ESP8266 Wi-Fi SoC and hardware based on the ESP-12 board.Since it is simple to use, the NodeMCU Development Board can be easily programmed using the Arduino IDE. It will take no more than 5-10 minutes to programme NodeMCU using the Arduino IDE. The Arduino IDE, a USB cable, and the NodeMCU board are everything you'll need. To prepare your Arduino IDE for NodeMCU, see this Getting Started Tutorial for NodeMCU.

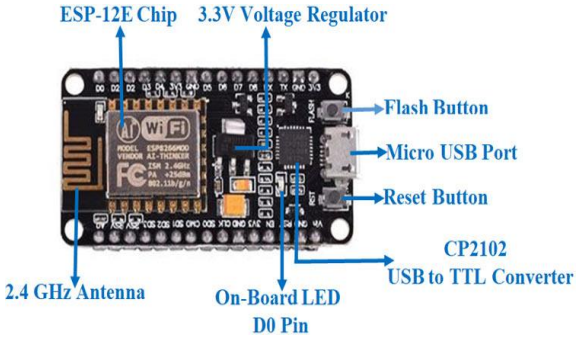

Fig. 7 Node MCU

3200 IMP/KWH ENERGY METER:-

In this meter a pulse LED blinks in response to the load. If this LED blinks 3200 times, 1 KWH has been consumed. This is known as the meter constant, and it is used to measure the accuracy of a meter during production based on its class.

Fig. 8 Energy meter

OPTOCOUPLER:-

Opto-isolators (also known as opto couplers, photocouplers, or optical isolators) are electronic components that use light to transmit electrical signals between two isolated circuits. High voltages are prevented from influencing the circuit transmitting the signal by opto-isolators.

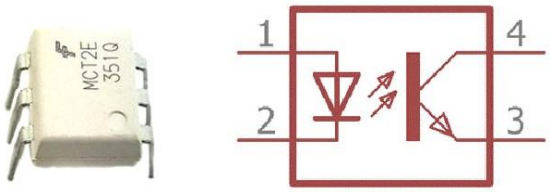

Fig. 9 opto coupler

RELAY MODULE:-

A relay is a switch that is regulated by electricity. A set of input terminals for a single or multiple control signals, as well as a set of operating touch terminals, make up the unit. The switch may have any number of contacts in any contact type, like make contacts, split contacts, and combinations of the two.

Fig. 10 Relay module

6. WORKING ALGORITHM

Step 1: In a prepaid electricity connection, consumer would need to recharge the amount of electricity they want to consume through SMS or IOT.

Step 2: The Recharge Plan Displayed on LCD of Consumer.

Step 3: The household electricity meters need to be equipped with a system that could be acknowledged of the amount recharged by the consumer and could count down the electricity consumption from the recharged amount to zero and pass the same information to server.

Step 4: Once the meter reaches zero, the main supply would be automatically cut off and could be resumed only after the next recharge.

Calculation of Pulses and Units: Before going for calculations, we have to know the pulse frequency of energy meter. There are two rates first is 1600 imp/kwh and the second is 3200 imp/kwh. Here we use 3200 imp/kwh pulse rate energy meter. First we need to calculate the Pulses for 100watt, **i.e. the count that Pulse LED will blink in a minute**, for the load of 100 watts.

Pulse= (Pluse_rate*watt*time)/ (1000*3600)

So pulses bulb in 60 seconds for 100 watt, with energy meter of 3200 imp/kwh rate can be calculated as below:

Pulses=3200*100*60/1000*3600

Pulses = ~5.33 pulse per minute

Now we have to calculate the Power factor of single pulse, i.e. how much electricity will be consumed in one pulse**?**

Power Factor= watt/ (hour*Pulse)

Power Factor=100/60*5.33=0.3125 watt for single pulse

Units= Power Factor*Total pulse/1000

Total pulses in an hour is around 5.33*60=320, So Units = 0.3125*320/1000 = 0.1 per hour

Let us assume that 100 watt bulb is lighting for a day then it will consume

No of Units =0.1*24 = 2.4 Units

And suppose unit rate is at our region is 5 rupees per unit then we have to pay for 2.4 Units Rs: Rupees= 2.4*5 = 12 rupees

7. ADVANTAGES

- To reduce wastage of energy.
- Prevent electricity shortage during dry seasons.
- Make every customer a self-interested guardian of the power (energy) supply.
- Real time bill monitoring
- Time reduced receiving bill.

8. APPLICATIONS

- Residential and commercial building in a public energy supply system
- Municipal corporation
- Public power sources
- Govt. Energy plan0t

9. RESULTS

Fig. 11 Figure showing prepaid energy meter system

Fig. 12 Figure showing prepaid energy meter recharge status SMS alert

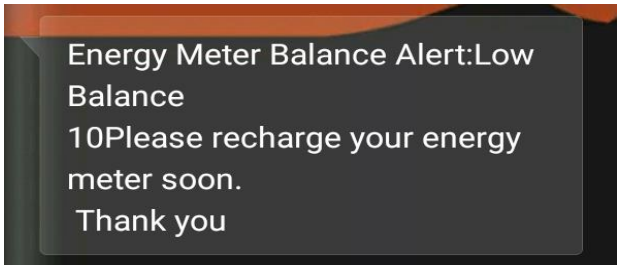

Fig. 13 Figure showing prepaid energy meter low balance sms alert

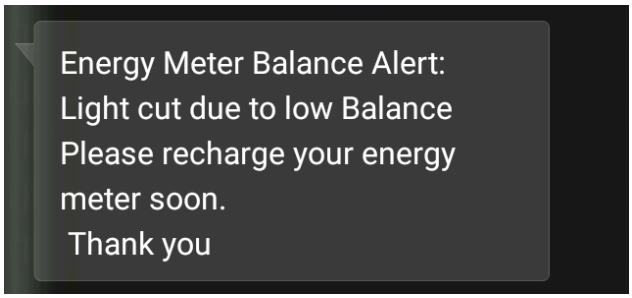

Fig. 14 Figure showing prepaid energy meter connection cut sms alert

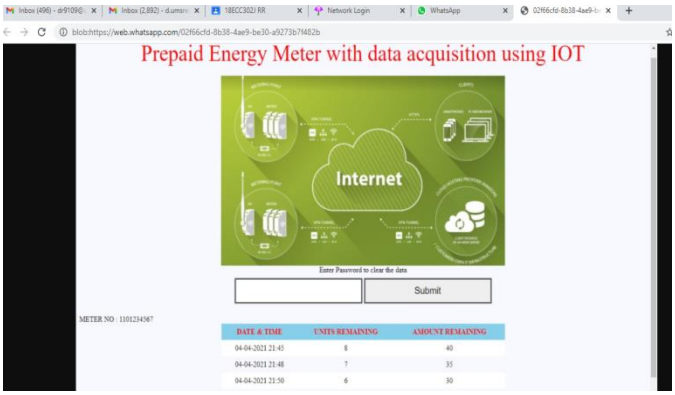

Fig. 15 Figure showing data acquisition system

CONCLUSION

Without any human intervention, the device was able to transfer and query energy units in real time, making the monitoring process easier. Other functions, such as sending notifications based on the rate of energy units used, are proposed to be integrated into the system. In addition, energy units are computed based on tariff rate, top-up number, and the amount of energy used for energy conservation.

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