INVOLUNTARY POWER METER LECTURA SYSTEM

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ABSTRACT:

The present system of energy metering as well as billing in India which uses electromechanical and somewhere digital energy meter is error prone and it consumes more time and labor. As an alternative, in our proposed project, we used Digital energy metering system developed with Arduino, Wi-Fi Launchpad and necessary software. This will automatically read the energy meter data and sends it to the customer and service provider on reception of a specific message from service provider. So, this project reduces the man power and errors during billing. The system can also provide the facility to disconnect the supply of a customer in case of any payment related issue and also if the amount falls below certain amount and send a SMS to the customer. It also notifies the customers if the amount falls below 50%,75%and 90% through SMS using GSM module. User can also disconnect their heavy loads or light loads using customer mobile phones. The loads are separated and disconnected using the four channel or eight channel relay. The usage and current status of the customer amount is displayed on the LCD display which is placed near the Digital meter.

Keywords: Energy meter, Arduino, Relay, LCD

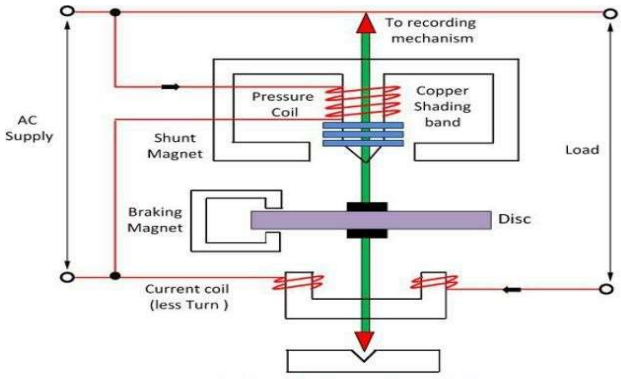
1.INTRODUCTION

Energy meters are used to measure the amount of energy consumed by domestic, commercial and sometimes industrial users. With the growing population of energy consumers, smart meters are timely innovation which eases the energy management system. The consumers can monitor their energy consumption in real time, recharge their accounts, monitor tariff rates and hence improves the demand response. Recharge System for prepaid metering was presented with focus on proffering solution to human error, processing error as well as electromechanical errors while aims at proposing a system that will reduce the loss of power and revenue due to power thefts and other illegal activities.

This paper is about a proposed design of 230V/5A single phase prepaid energy meter which consists of a digital energy metering device and a microcontroller used for billing and recharging. The proposed energy meter communicates with consumer through GSM technology, every consumer is provided with a mobile application to check their usage and remaining balance. They also get notification through SMS while they reach low balance (threshold value set by the consumer) and they can disconnect the heavy load which is directly connected to the relay through SMS. If the user forgot to recharge and the balance. comes to zero all the load will cutoff and consumer has to recharge to reconnect the supply. Analog meter has some disadvantages and difficult to interface with Arduino and other devices. So, we proposed to use the digital energy meter instead of existing electro mechanical energy meter.

2.EXISTING ENERGY METER TECHNOLOGIES

2.1 ELECTROMECHANICAL ENERGY METER



The energy meter has the aluminium disc whose rotation determines the power consumption of the load. The disc is placed between the air gap of the series and shunt electromagnet. The shunt magnet has the pressure coil, and the series magnet has the current coil.

The pressure coil creates the magnetic field because of the supply voltage, and the current coil produces it because of the current.

The field induces by the voltage coil is lagging by 90º on the magnetic field of the current coil because of which eddy current induced in the disc. The interaction of the eddy current and the magnetic field causes torque, which exerts a force on the disc. Thus, the disc is proportional to the current and voltage of the coil. The permanent magnet controls their rotation. The permanent magnet opposes the movement of the disc and equalizes it on the power consumption. The cyclometer counts the rotation of the disc. Then the unit consumed by the customer is increased according to the rotation of the aluminium disc in the meter.

The disadvantages of this type of meter is the meter may cause error due to change in temperature, waveform, frequency changes. Induction meter can use only for AC measurements. They have nonlinear scale.

3.SYSTEM HARDWARE

The basic hardware components used in the Project are listed below:

[1] Digital Energy Meter

[2] Arduino

[3] GSM Module

[4] ESP8266

[5] Relay Control Unit

3.1 DIGITAL ENERGY METER

The digital energy meter works based on the following principal. All the phase voltages and currents are stepped down to the acceptable levels of energy meter chip. It process the acquired signal and performs the signal processing such as digitizing, filtering and averaging to extract active power RMS value of current and voltage required computes the consumption of energy. The measured values are stored as bit streams in register.

These registers are accessed by serial interface using microcontroller. Microcontroller accesses the data from the chip and displays the various electrical parameters and energy consumption for the EB source with on hours on the LCD screen.

3.2. ARDUINO

Arduino is a prototype platform (open source) based on an easy-to-use hardware and software. Arduino boards are able to read analog or digital sensors and turn it into an output such as activating a motor, turning LED on/off, connect to the cloud and many other actions.

You can control your board functions by sending a set of instructions to the microcontroller on the board via Arduino IDE.

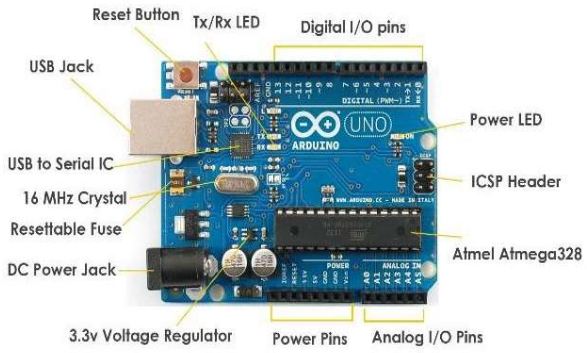


Figure 1. Arduino uno

Unlike most previous programmable circuit boards, Arduino does not need an extra piece of hardware (called a programmer) in order to load a new code onto the board. You can simply use a USB cable.

Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn the program.

Finally, Arduino provides a standard form factor that breaks the functions of the microcontroller into a more accessible package.

3.3.GSM MODULE

The Communication Module consists of GSM Modem. It is used to transfer the data of the user meter from Arduino controller to remote station by GSM wireless module. The serial communication with the modem is full duplex 8 bits, no parity, 1 stop bit and at 115200 bauds. We have used Subscriber Identification Module (SIM) in the modem.

Specifications:

- Tri-Band GSM/GPRS 900/1800/1900 MHz
- Supply voltage range is 3.4V to 4.5V
- Low power consumption
- Operating temperature is -20ºC to +60ºC
- Serial interface and debug interface
- LCD interface
- Keypad interface
- Antenna Connector and antenna pad

GSM makes use of narrow band Time Division Multiple Access (TDMA) technique for transmitting signals.

GSM was developed using digital technology. It has an ability to carry 64Kbps to 120Mbps of data rates.

Figure 2. GSM Module

Presently GSM supports more than one billion mobile subscribers in more than 210 countries throughout world.

GSM provides basic to advanced voice and data services including roaming services. Roaming is the ability to use your GSM phone number in another GSM network.

3.4 ESP8266-01(WIFI-MODULE)

The ESP8266 is a very user friendly and low cost device to provide internet connectivity to the microcontroller. This module can work both as a access point(can create hotspot) and as a station (can connect to wifi), hence it can easily fetch data and upload it to the internet making Internet of Things as easy as possible. It can also fetch data from internet using API's hence we could access any information that is available in the internet, thus making it smarter.

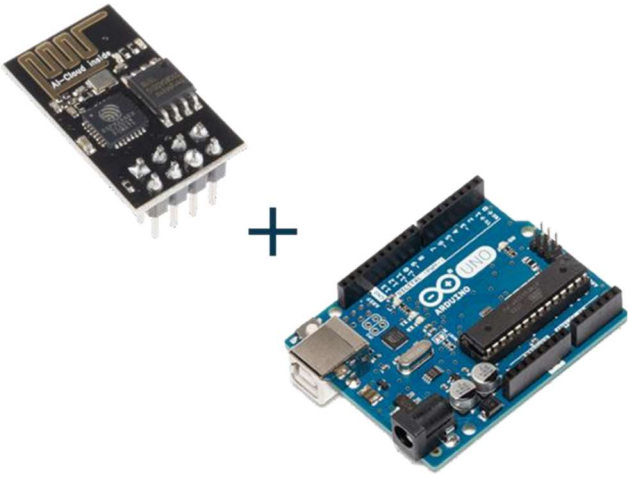


Figure 3. ESP 8266

Features:

- Supports 802.11 b/g/n
- Integrated low power 32bit microcontroller
- Integrated 10bit analog to digital convertor
- Supports Wi-Fi direct
- Supports Station, soft Access point, station + Access point modes
- 2.4 GHz Wifi with support for WPA/WPA2
- Deep sleep power is less than 10microA and power down leakage current is less than 5microA

Technical Specification:

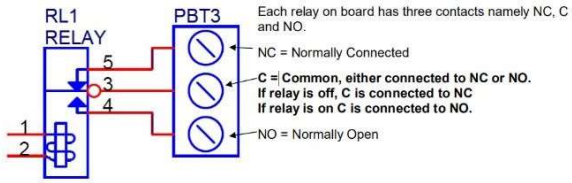
- Operating voltage: 3.0 – 3.6V
- Average Operating Current: 80mA
- 16 GPIO pins
- SPI, I2C, I2S
- UART-2x TX AND 1x RX
- Operating Temperature: 40ºC - 125ºC

3.5 Relay Control Unit

A 4-channel Relay interface board that allows you to control various appliances, and other equipment's with large current. It can be controlled directly by Microcontroller (Arduino)

Specifications:

- 4-Channel relay interface board, and each one needs 15-20mA Driver Current
- Both controlled by 12V and 5V input voltage
- Opto-Isolated inputs
- Equipped with high current relay , AC250V 10A; DC30V 10A
- Standard interface that can be controlled directly by microcontroller (Arduino)
- Indication LED's for relay output status



When you want to switch ON the load when relay comes on, then the load has been powered through C and NO contact.

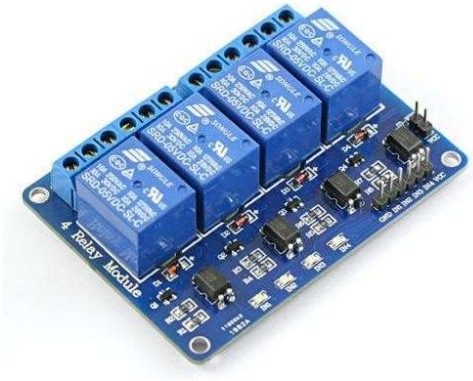
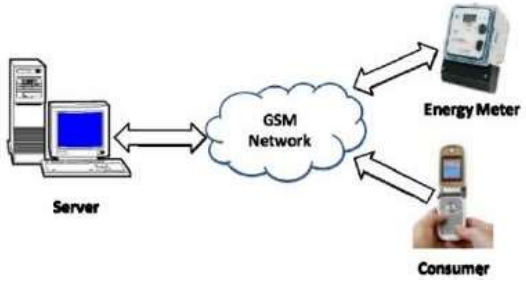


Figure 4. 4 Channel Relay

4.SYSTEM ARCHITECTURE

The high level block diagram of the involuntary power meter reading system is shown in Fig. The power supply section supplies all other components with required power. The Arduino microcontroller module takes the data from the energy meter and performs the necessary control operations like breaking circuits through Relay control unit and the required information to the mobile phone via the communication module GSM. The UART is a serial communication interface for the GSM modem for transmitting the data from the controller to the mobile phone .



The recharge unit is stored within the internal memory of Arduino which has a volatile memory and this recharge unit is display in Liquid Crystal Display (LCD) and a message "recharge successful" also display balance reaches the below the emergency limit then we should recharge our meter soon and the controller send the message to customers.

In this stage the ESP8266 Wifi module is helpful to transmit the data to the server. To store the data in the server ESP8266 provides internet to the Arduino microcontroller to transmit the measured readings which can be easily monitored by the customers.

5.BLOCK DIAGRAM

The Block Diagram for the proposed project of Involuntary Power Meter Lectura System is shown below

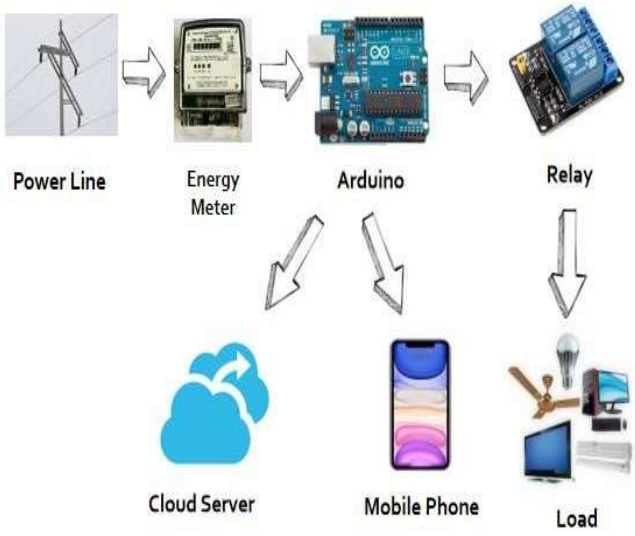


Figure 5 Block Diagram

6.CALCULATION OF PULSES AND UNITS

Before proceeding for the calculations, first we have to keep in mind the pulse rate of energy meter first is1600 imp/kwh and secondis 3200 imp/kwh. So let's calculate 3200 imp/kwh pulse rate energy meter. So first we need to calculate the Pulses for 100 watts, means how many times Pulse LED will blink in a minute, for the load of 100 watts.

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

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

Pulses=3200*100*60/1000*3600

Pulses=~5.33 pulses per minute

Now we need to calculate Power factor of a single pulse, means how much electricity will be consumed in one pulse:

PF=watt/(hour*Pulse)

PF=100/(60*5.33)

PF=0.3125 watt in a single pulse

Units=PF*Total Pulse/1000

Total Pulses in an hour is around 5.33*60=320

Units=0.1*24

Units=2.4 Units

And suppose unit rate is at your region is 2.5 rupees per unit then you have to pay for 2.4 Units is:

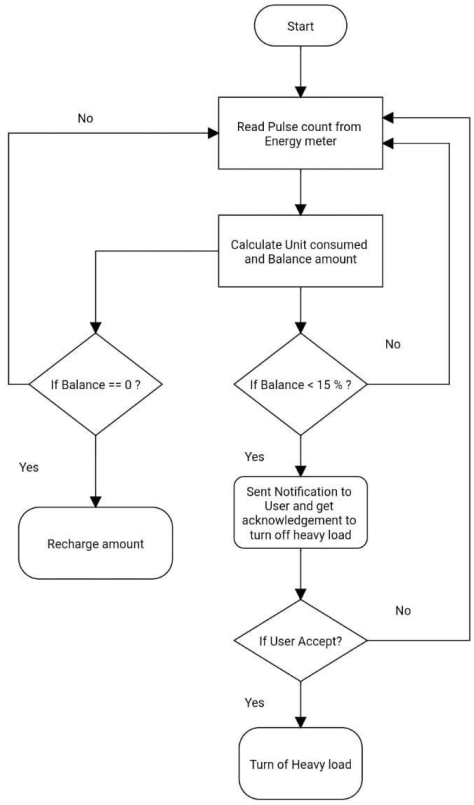
Rupees=2.4*2.5=6 Rupees

Consumption up to 100 units bi-monthly		Rupees/Unit	
100 unit free scheme	0-100 units	2.50	0
Consumption above 100 units and up to 200 units bi-monthly			
100 unit free scheme	0-100 units	2.50	0
	101-200 units		1.50
Consumption above 200 units and up to 500 units bi-monthly			
100 unit free scheme	0-100 units	2.50	0
	101-200 units		2.00
	201-501 units	3.00	3.00
Consumption above 500 units bi-monthly			
100 unit free scheme	0-100 units	2.50	0
	101-200 units	3.50	3.50
	201 – 500 units	4.60	4.60
	above 500 units	6.60	6.60

Figure 6 TNEB Tarrif

7.FLOW CHART

The Flow chart for the whole process of our project is shown below:



Initially the Pulse count is read from the Energy Meter

Then the Units and balance remaining is Calculated by using the program which is uploaded in Arduino controller.

Checks if the balance is less than 15%, if yes then a notification is send to the user and acknowledgement to turn off heavy loads.

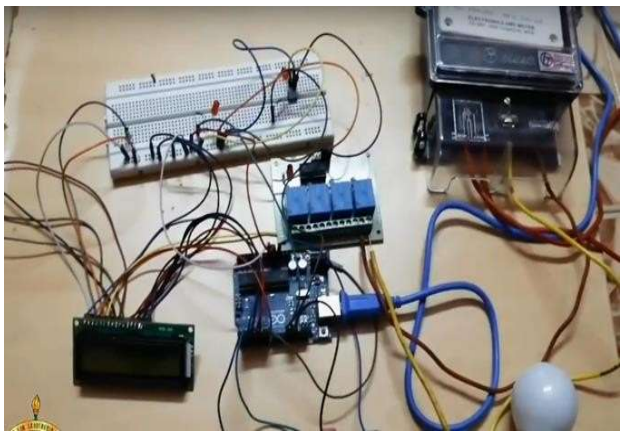
User can turn OFF their heavy loads if they want, otherwise the balance decreases normally.

Checks if the balance is zero, if yes then a notification is sends to the user as "Recharge the Plan". And it also disconnects the loads through the relay.

User can also monitor their energy consumption by means of cloud.

Also users gets notified in a regular interval about their energy usage through SMS by means of GSM module.

8. REAL TIME IMPLEMENTATION OF OUR RESEARCH WORK



9. CONCLUSION

The paper is intended to present an overview of Involuntary Power Meter, which can control the usage of electricity on consumer side to avoid wastage of power. Involuntary Power Meter is a concept to minimize the Electricity theft with a cost- efficient manner. From all these we can conclude that if we implement this Involuntary Power Meter then it can become more beneficial. The system designed reduces the efforts of manual data collection of energy meter. The users are not bound to pay excesses amount of money, users have to pay according to their requirement. Involuntary Power Meter is more reliable, accurate and user friendly.

10. ACKNOWLEDGEMENT

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