

Energy Consumption using Arduino & PZEM-004T

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Abstract - Every management system is trying to make an automatic, portable, accurate and reliable system to for measurement. This project work presents a novel smart meter for an automatic and monitoring. The integration of the Arduino and LCD provide the meter reading system with some automatic functions that are predefined. The proposed energy meter system can incorporate with an embedded microcontroller and PZEM-004T having the ability to measure Electrical parameters such as voltage, current, active power and energy, power factor and frequency. Measured parameters are directly transmitted with TTL serial interface with Arduino nano board and display on 16*2 LCD display.

1. INTRODUCTION

Smart electrical energy meter technologies have been investigated and developed for approximately 10 years. Various technologies have been developed and used to measure the electrical consumption. For the billing, the users will get the bill from the energy board after they generated and provided using the several methods. At the moment, most of the residences in Malaysia for examples use the traditional electro – mechanical watt meters and the readings are no automated. The users will have to wait the bill of energy consumption for every month to pay there energy bill. Normally, at the end of he month, a staff from the meter board billing will visit every house to read the meter reading and at the same time, give the bill to the users. An electricity meter or energy meter is a device that measures the amount of electricity energy consumed to residence or business. There are two types of Domestic Ordinary Power Consumers meters single phase and three phases. The energy consumption is measured by all electrical services using kilowatt-hours meter with refer o kilowatt-hours(kwh)

Then electronic meters was introduced with similar function with the electro-mechanical, but it replaces from analog to digital system. With this system users can note down the voltage, power reading unit, current and the time, date of he energy consumption. This system just gives some advantages over the previous meter reading. After the electronic ones, the meter reading developed with he Bluetooth based technology which is the wireless commnication and also known as Automatic Meter Reading (AMR). This system is wireless and he personal computer could be used to record the power consumption of energy meter . The reading meter will be saved to the database and bill will be generated.

2. LITERATURE SURVEY

In early years, electricity is available only to a specific section of affluent society. The advancement in technology over time encouraged meeting the demands of common people in all parts of the world. The history of electricity meter is well connected involving researches from past. The general usage of electricity in the early 1870's is only confined to telegraphs and arc lamps. With the invention of the electric bulb by Thomas Elva Edison, the power energy market became widely opened to the public in year 1879. Eventually, the progressive development in metering technology leads in enlightening the year 1888. Eventually, the progressive development in metering technology leads in enlightening the lives of many common people.

Types Of Energy Meters:

The energy meters are classified into two basic categories, such as:

- Electromechanical Type Induction Meter
- Electronic Energy Meter

Single Phase Electromechanical Induction Energy Meter:

It is well-known and most common type of age-old energy meter. It comprises a rotating aluminium disc placed on a spindle between two electromagnets. The rotation speed of the disc is proportional to the power, and this power is integrated by the use of gear trains and counter mechanism. It is made of two silicon steel laminated electromagnets: shunt and series magnets.

Electronic Energy meters:

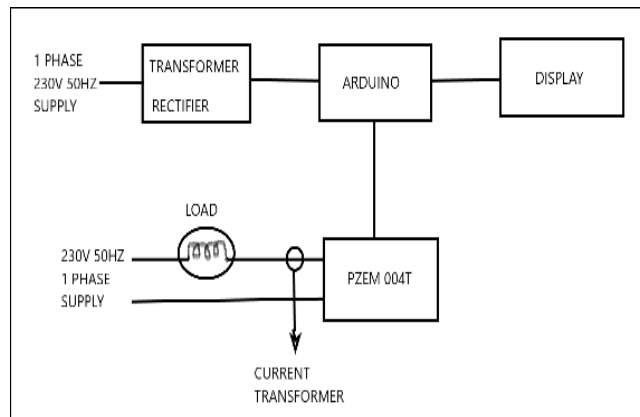
These are of accurate, high procession and reliable types of measuring instruments as compared to conventional mechanical meters. It consumes less power and starts measuring instantaneously when connected to load. These meters might be analog or digital. In analog meters, power is converted to proportional frequency or pulse rate and it is integrated by counters placed inside it. In digital electric meter power is directly measured by high end processor. The power is integrated by logic circuits to get the energy and also for testing and calibration purpose. It is then converted to frequency or pulse rate.

3. PROJECT OBJECTIVES:

Design and develop energy measurement system which is reliable, porable, accurate and low cost. Smart energy and

power monitor shows the amount of energy used by the consumer at particular amount of time. Knowing the energy usage consumer will come to know how he can use and save the energy.

4. BLOCK DIAGRAM



4. METHODOLOGY

A single phase 230 V 50 HZ supply is given to load which is further fed to PZEM-004t kit through current transformer. The PZEM-004t reads the current and voltage from load which is in analog form. The analog to digital form converter in PZEM-004t converts the analog input signal into digital form. The digitalised signal is sent to Arduino. The 9V supply from the step down transformer is given to the Arduino. The Arduino finds the power factor by using the current and voltage signals from PZEM-004t. The Arduino multiplies the V,I and Power factor to get power. And by multiplying real time to this power we get energy. This energy is displayed.

4. COMPONENTS REQUIRED

- Arduino Uno
- PZEM-004T
- Liquid Crystal Display
- Relay
- Power Supply

Arduino Uno

Arduino UNO ATMEGA 328 is chosen as MCU.. This is microcontroller board which uses the ATMEGA328P This Uno board is different than all other previous programming boards. The ATmega328 has 32 KB with 2 KB of SRAM and 1 KB of EEPROM. The module is programmed in such way that it transfers signals to the Arduino board. Arduino board will act as input source to the motor driver circuit (L293N) which drives motor and motion is achieved.

PZEM-004T

PZEM-004T is the best for the purpose of the DIY project, where we need to measure the voltage, current and power using Arduino/ESP8266/Raspberry Pi like opensource platform. In many electrical projects, engineer directly deals with measurements with few basic requirements like, High galvanic isolation, Parameter display, Direct communication with computer, Data acquisition and storage with subsequent viewing or copying to the computer.

Liquid Crystal Display

A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals combined with polarizers. Liquid crystals do not emit light directly,^[1] instead using a backlight or reflector to produce images in color or monochrome.^[2] LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and seven-segment displays, as in a digital clock.

Relay

A relay is an electrically operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals. The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts, or combinations thereof

Power Supply

It is basically consisting of the following elements: transformer, rectifier, filter and regulator circuits. Power supply units (PSU) are used in computers, amateur radio transmitters and receivers, and all other electronic equipment that use dc voltage as an input.

A transformer is a passive electrical device that transfers electrical energy from one electrical circuit to another, or multiple circuits. A varying current in any one coil of the transformer produces a varying magnetic flux in the transformer's core, which induces a varying electromotive force across any other coils wound around the same core. Electrical energy can be transferred between separate coils without a metallic (conductive) connection between the two circuits. Faraday's law of induction, discovered in 1831, describes the induced voltage effect in any coil due to a changing magnetic flux encircled by the coil.

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The process is known as rectification, since it "straightens" the direction of current. Physically, rectifiers take a number of forms, including vacuum tube diodes, wet chemical cells, mercury-arc valves, stacks of copper and selenium oxide plates, semiconductor diodes, silicon-controlled rectifiers and the

silicon-based semiconductor switches. Historically, even synchronous electromechanical switches and motors have been used. Early radio receivers, called crystal radios, used a "cat's whisker" of fine wire pressing on a crystal of galena (lead sulfide) to serve as a point-contact rectifier or "crystal detector".

A simple **voltage regulator** can be made from a resistor in series with a diode (or series of diodes). Due to the logarithmic shape of diode V-I curves, the voltage across the diode changes only slightly due to changes in current drawn or changes in the input. When precise voltage control and efficiency are not important, this design may be fine. Since the forward voltage of a diode is small, this kind of voltage regulator is only suitable for low voltage regulated output. When higher voltage output is needed, a zener diode or series of zener diodes may be employed. Zener diode regulators make use of the zener diode's fixed reverse voltage, which can be quite large.

5. SOFTWARE REQUIREMENTS

- **Arduino IDE**

6. CONCLUSION

The design of a low-cost ENERGY CONSUMPTION METER USING ARDUINO AND PZEM-004T is presented. This proposed system is suitable for energy consumption. This is based on low cost energy consumption, PZEM-004T, ARDUINO UNO, LCD display, RECTIFIER, RELAY, REGULATOR, POWER SUPPLY. The experimental results showed that the developed energy consumption system can successfully monitor voltage, current, frequency, powerfactor. In future work, this system could be further developed to get more insight on energy usage profile and learn to automatically detect which appliance is in use.

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