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IOT BASED ELECTRICITY ENERGY METER READING THROUGH INTERNET

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Abstract - The main objective of the project is to develop an iot based electricity meter reading displayed for units consumed and cost there upon over the internet. A digital meter whose blinking LED signal is interfaced to microcontroller through LDR the blinking LED flashes 3200 times for 1 unit the LDR sensor gives an interrupt each time the meter LED flashes to the programmed microcontroller,micro controller takes this reading and displays the it on an LCD duly interfaced to the microcontroller.the reading of the energy meter is also sent to Ethernet shield module being fed from the micro controller via level shifter ic and RS 232 link which transmit data directly to a dedicated web page for display any where in the world. The power supply consists of a step down transformer 230/12V which steps down the voltage to 12V AC. This is converted to DC using a bridge rectifier and it is then regulated to 5V using a voltage regulator 7805 which is required for the operation of the microcontroller and other components.

1. INTRODUCTION

Monitoring and keeping tracking of your electricity consumption for verification is a tedious task today since you need to go to meter reading room and take down readings. Well it is important to know if you are charged accordingly so the need is quite certain.Well we automate the system by allowing users to monitor energy meter readings over the internet. Our proposed system uses energy meter with microcontroller system to monitor energy usage using a meter.The meter is used to monitor units consumed and transmit the units as well as cost charged over the internet using Net connection.This allows user to easily check the energy usage along with the cost charged online using a simple web application. Thus the energy meter monitoring system allows user to effectively monitor electricity meter readings and check the billing online with ease. Android is a software stack for mobile devices that includes an operating system, middleware and key applications. Android phone has good connectivity options, including Wi-Fi, Bluetooth, and wireless data over a cellular connection (for example, GPRS, EDGE (Enhanced Data rates for GSM Evolution), and 3G). Android provides access to a wide range of useful libraries and tools that can be used to build rich applications. In addition, Android includes a full set of tools that have been built from the ground up alongside the platform providing developers with high productivity and deep insight into their applications.The main brain for this project is Arduino UNO Board along with Arduino Ethernet Shield to give it a wireless connectivity. Arduino runs a code to control a Relay board according to the input and also serves a web page through which respective output to the relay board can be controlled.

2. LITERATURE SURVEY

The first meter was Samuel gardinars (USA) lamphour meter patented in 1872. It measured the time during which energy was supplied to the load, as all the lamps connected to this meter were controlled by one switch. In the year 1888 oliver B. shallen berger invents the A.C watt – hour meter. After that many improvements were happened reduction of size, weight and dimensions. Induction meters are still manufactured which are called work horses of metering their price is low and reliability is excellent. As the electricity consumption increases the concept of multi tarrif meter with local (or) remotely controlled swithes the maximum demand meter were born in the century. The first ripple controlsystem invented in 1899 by the French cesr, rene loubery. In 1934 landis & gyr developed the trivector meter, measuring active and reactive energy and apparent demand. Electronic meters came into use in 1970s. hybrid meters consisting of induction meters and electronic tarrif units were constructed in the 1980s. Remote metring was born in the 1960s. today meters with complex functionality are based on the latest electronic technology, using digital signal processing with functions being in the firmware. Now another development in metering in the form of IOT.

3. INTERNET OF THINGS

As we all know technology advancing day by day consequently many inventions and innovations are taking place one of those is IOT (Internet of things). It is a communication system that connects all the electrical and electronic devices together with the main aim of exchanging data over the internet. Why should we exchange data means earlier when we had no IOT its not possible to monitor electrical appliances in our homes, office from more distance not only electrical

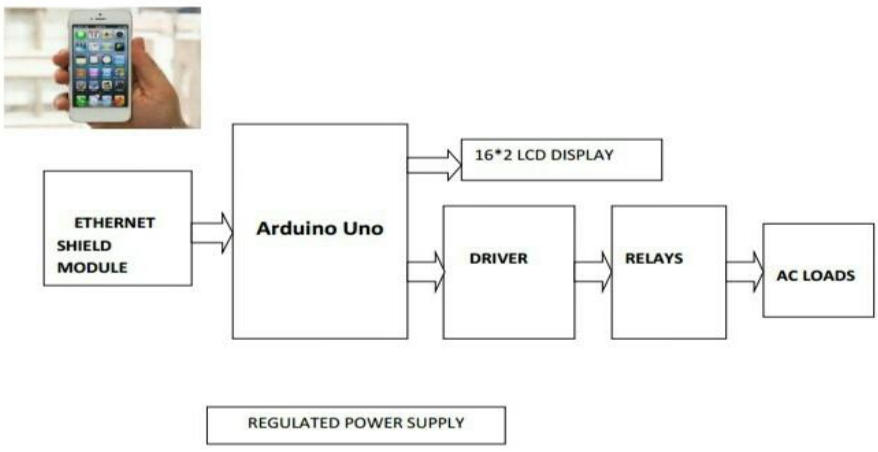
appliances but also in many fields it makes possible to exchange and monitor data over the internet. No doubt IOT is going to make drastic changes in the technology in future. Imagine once how helpful it would be if doctor analyses the patient on the way to the hospital. Even small things can be monitored by applying the internet of things (IOT). Here one thing we have to observe that is everything is possible only with the of other things. Generally we use internet for browsing, social networking and exchanging the data in other forms. It is also one step advancement in exchanging the data in fact very crucial advancement, it offers many benefits in terms of safety, economy and time consumption and makes the work easier, faster, safer and eliminate unnecessary wastage of cost and natural resources. Example in this project I have designed electricity energy meter for exchanging the data from the meter over the internet. It facilitates us to monitor to monitor the electrical load from anywhere in the world through internet. Benefits of combining IOT system with meter is 1. reduction of electricity consumption. 2. Conservation of natural resources like coal from which eclectricity is produced through turbines 3.Cost of electricity will be reduced. Only drawback is cost of installing installing iot based meter is somewhat higher than general digital meter however that can be recovered in the form of low consumption of electricity.

4. EMBEDDED SYSTEMS

An embedded system is a computer system designed to perform one or a few dedicated functions often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. By contrast, a general-purpose computer, such as a personal computer (PC), is designed to be flexible and to meet a wide range of end-user needs. Embedded systems control many devices in common use today. Embedded systems are controlled by one or more main processing cores that are typically either microcontrollers or digital signal processors (DSP). The key characteristic, however, is being dedicated to handle a particular task, which may require very powerful processors. For example, air traffic control systems may usefully be viewed as embedded, even though they involve mainframe computers and dedicated regional and national networks between airports and radar sites. (Each radar probably includes one or more embedded systems of its own.) Since the embedded system is dedicated to specific tasks, design engineers can optimize it to reduce the size and cost of the product and increase the reliability and performance. Some embedded systems are mass-produced, benefiting from economies of scale. Physically embedded systems range from portable devices such as digital watches and MP3 players, to large stationary installations like traffic lights, factory controllers, or the systems controlling nuclear power plants. Complexity varies from low, with a single microcontroller chip, to very high with multiple units, peripherals and networks mounted inside a large chassis or enclose. In general, "embedded system" is not a strictly definable term, as most systems have some element of extensibility or programmability. For example, handheld computers share some elements with embedded systems such as the operating systems and microprocessors which power them, but they allow different applications to be loaded and peripherals to be connected. Moreover, even systems which don't expose programmability as a primary feature generally need to support software updates. On a continuum from "general purpose" to "embedded", large application systems will have subcomponents at most points even if the system as a whole is "designed to perform one or a few dedicated functions", and is thus appropriate to call "embedded". Arduino Uno

5. HARDWARE DESCRIPTION

Block diagram :



- Micro controller (Arduino Uno)
- . Reset button

- Crystal oscillator
- Regulated power supply (RPS)
- LED indicator
- Ethernet module
- Relay

Micro controller (Arduino Uno) :

The Arduino is a family of microcontroller boards to simplify electronic design, prototyping and experimenting for artists, hackers, hobbyists, but also many professionals. People use it as brains for their robots, to build new digital music instruments, or to build a system that lets your house plants tweet you when they're dry. Arduinos (we use the standard Arduino Uno) are built around an AT mega microcontroller — essentially a complete computer with CPU, RAM, Flash memory, and input/output pins, all on a single chip. Unlike, say, a Raspberry Pi, it's designed to attach all kinds of sensors, LEDs, small motors and speakers, servos, etc. directly to these pins, which can read in or output digital or analog voltages between 0 and 5 volts. The Arduino connects to your computer via USB, where you program it in a simple language (C/C++, similar to Java) from inside the free Arduino IDE by uploading your compiled code to the board. Once programmed, the Arduino can run with the USB link back to your computer, or stand-alone without it — no keyboard or screen needed, just power.

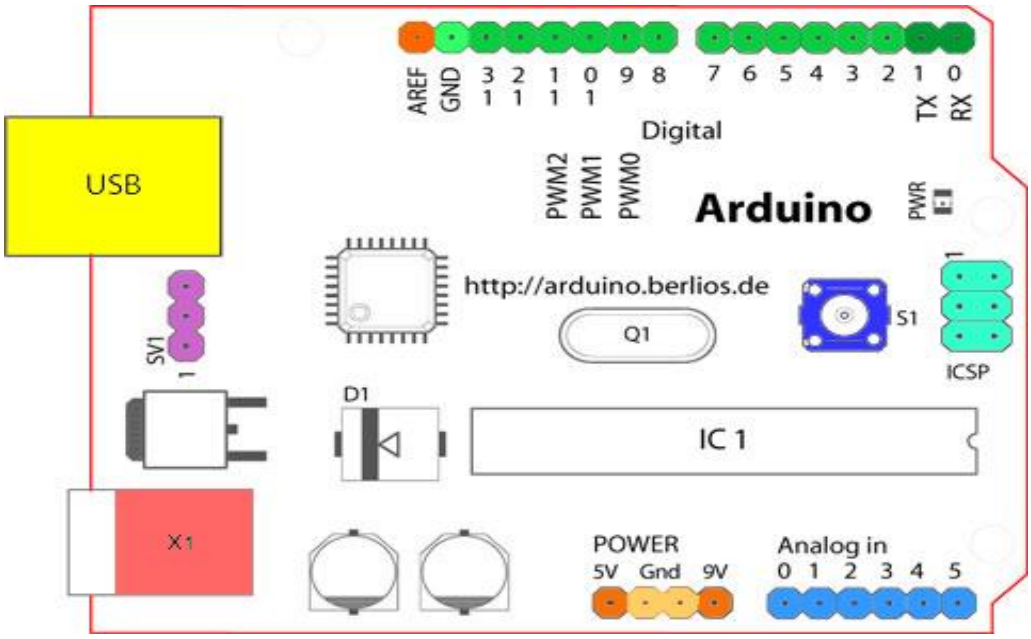


Fig . 1.

Regulated power supply:

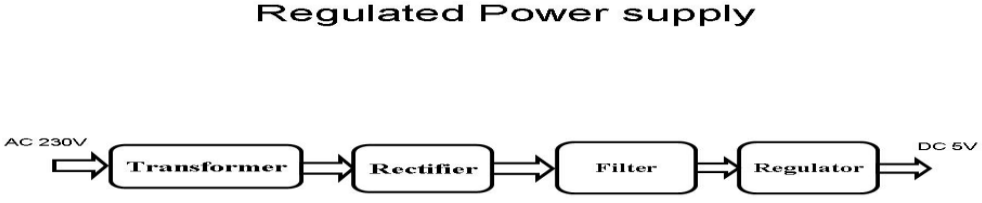


Fig. 2.

Transformer:

A transformer is a device that transfers electrical energy from one circuit to another through inductively coupled conductors without changing its frequency. A varying current in the first or primary winding creates a varying magnetic flux in the transformer's core, and thus a varying magnetic field through the secondary winding. This varying magnetic field induces a varying electromotive force (EMF) or "voltage" in the secondary winding. This effect is called mutual induction. If a load is connected to the secondary, an electric current will flow in the secondary winding and electrical energy will be transferred from the primary circuit through the transformer to the load. This field is made up from lines of force and has the same shape as a bar magnet. If the current is increased, the lines of force move outwards from the coil. If the current is reduced, the lines of force move inwards. If another coil is placed adjacent to the first coil then, as the field moves out or in, the moving lines of force will "cut" the turns of the second coil. As it does this, a voltage is induced in the second coil. With the 50 Hz AC mains supply, this will happen 50 times a second. This is called MUTUAL INDUCTION and forms the basis of the transformer.

Rectifier:

A rectifier is an electrical device that converts alternating current (AC) to direct current (DC), a process known as rectification. Rectifiers have many uses including as components of power supplies and as detectors of radio signals. Rectifiers may be made of solid-state diodes, vacuum tube diodes, mercury arc valves, and other components. A device that it can perform the opposite function (converting DC to AC) is known as an inverter. When only one diode is used to rectify AC (by blocking the negative or positive portion of the waveform), the difference between the term diode and the term rectifier is merely one of usage, i.e., the term rectifier describes a diode that is being used to convert AC to DC. Almost all rectifiers comprise a number of diodes in a specific arrangement for more efficiently converting AC to DC than is possible with only one diode. Before the development of silicon semiconductor rectifiers, vacuum tube diodes and copper (I) oxide or selenium rectifier stacks were used.

Filter:

The process of converting a pulsating direct current to a pure direct current using filters is called as filtration . Electronic filters are electronic circuits, which perform signal-processing functions, specifically to remove unwanted frequency components from the signal, to enhance wanted ones.

Regulator:

A voltage regulator (also called a ‘regulator’) with only three terminals appears to be a simple device, but it is in fact a very complex integrated circuit. It converts a varying input voltage into a constant ‘regulated’ output voltage. Voltage Regulators are available in a variety of outputs like 5V, 6V, 9V, 12V and 15V. The LM78XX series of voltage regulators are designed for positive input. For applications requiring negative input, the LM79XX series is used. Using a pair of ‘voltage-divider’ resistors can increase the output voltage of a regulator circuit. It is not possible to obtain a voltage lower than the stated rating. You cannot use a 12V regulator to make a 5V power supply. Voltage regulators are very robust. These can withstand over-current draw due to short circuits and also over-heating. In both cases, the regulator will cut off before any damage occurs. The only way to destroy a regulator is to apply reverse voltage to its input. Reverse polarity destroys the regulator almost instantly. Fig: 3u shows voltage regulator.

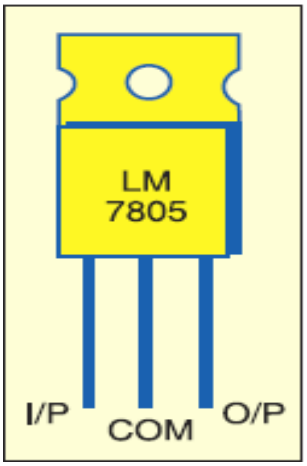


Fig. 3.

Relay :

A **relay** is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism, but other operating principles are also used. Relays find applications where it is necessary to control a circuit by a low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits, repeating the signal coming in from one circuit and re-transmitting it to another. Relays found extensive use in telephone exchanges and early computers to perform logical operations. A type of relay that can handle the high power required to directly drive an electric motor is called a contractor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device triggered by light to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protection relays".

Relay driver :

The current needed to operate the relay coil is more than can be supplied by most chips (op. amps etc), so a transistor is usually needed, as shown in the diagram below. Use BC109C or similar. A resistor of about 4k7 will probably be alright. The diode is needed to short circuit the high voltage "back emf" induced when current flowing through the coil is suddenly switched off.

Ethernet:

Ethernet is a family of computer networking technologies for local area networks (LANs). Ethernet was commercially introduced in 1980 and standardized in 1985 as IEEE 802.3. Ethernet has largely replaced competing wired LAN technologies. The Ethernet standards comprise several wiring and signaling variants of the OSI physical layer in use with Ethernet. The original 10BASE5 Ethernet used coaxial cable as a shared medium. Later the coaxial cables were replaced by twisted pair and fiber optic links in conjunction with hubs orswitches. Data rates were periodically increased from the original 10 megabits per second to 100 gigabits per second.Systems communicating over Ethernet divide a stream of data into shorter pieces called frames. Each frame contains source and destination addresses and error-checking data so that damaged data can be detected and re-transmitted. As per the OSI model Ethernet provides services up to and including the layer. Since its commercial release, Ethernet has retained a good degree of compatibility. Features such as the 48-bit MAC address and frame format have influenced other networking protocols.

Android:

Android is a software platform and operating system for mobile devices, based on the Linux kernel, and developed by Google and later the Open Handset Alliance. It allows developers to write managed code in the Java language, controlling the device via Google-developed Java libraries. The unveiling of the Android platform on 5 November 2007 was announced with the founding of the Open Handset Alliance, an association of 48 hardware, software, and telecom companies devoted to advancing open standards for mobile devices. Google released most of the Android code under the Apache license, a free-software and open source license.

DESCRIPTION6. SOFTWARE

This project is implemented using following software's:

-
- Express PCB – for designing circuit
- Arduino compiler - for compilation part
- Proteus 7 (Embedded C) – for simulation part

Express PCB **:**

Breadboards are great for prototyping equipment as it allows great flexibility to modify a design when needed; however the final product of a project, ideally should have a neat PCB, few cables, and survive a shake test. Not only is a proper PCB neater but it is also more durable as there are no cables which can yank loose. Express PCB is a software tool to design PCBs specifically for manufacture by the company Express PCB (no other PCB maker accepts Express PCB files). It is very easy to use, but it does have several limitations.

It can be likened to more of a toy then a professional CAD program.

It has a poor part library (which we can work around)

It cannot import or export files in different formats

It cannot be used to make prepare boards for DIY production

Express PCB has been used to design many PCBs (some layered and with surface-mount parts. Print out PCB patterns and use the toner transfer method with an Etch Resistant Pen to make boards. However, Express PCB does not have a nice print layout. Here is the procedure to design in Express PCB and clean up the patterns so they print nicely.

Preparing Express PCB for First Use:

Express PCB comes with a less then exciting list of parts. So before any project is started head over to Audio logical and grab the additional parts by morsel, ppl, and tangent, and extract them into your Express PCB directory. At this point start the program and get ready to setup the workspace to suit your style.Click View -> Options. In this menu, setup the units for "mm" or "in" depending on how you think, and click "see through the top copper layer" at the bottom. The standard color scheme of red and green is generally used but it is not as pleasing as red and blue.

The Interface:

When a project is first started you will be greeted with a yellow outline. This yellow outline is the dimension of the PCB. Typically after positioning of parts and traces, move them to their final position and then crop the PCB to the correct size. However, in designing a board with a certain size constraint, crop the PCB to the correct size before starting. The select tool: It is fairly obvious what this does. It allows you to move and manipulate parts. When this tool is selected the top toolbar will show buttons to move traces to the top / bottom copper layer, and rotate buttons.

- The zoom to selection tool: does just that.
- The place pad: button allows you to place small soldier pads which are useful for board connections or if a part is not in the part library but the part dimensions are available. When this tool is selected the top toolbar will give you a large selection of round holes, square holes and surface mount pads.
- The place component: tool allows you to select a component from the top toolbar and then by clicking in the workspace places that component in the orientation chosen using the buttons next to the component list. The components can always be rotated afterwards with the select tool if the orientation is wrong.
- The place trace: tool allows you to place a solid trace on the board of varying thicknesses. The top toolbar allows you to select the top or bottom layer to place the trace on.
- The Insert Corner in trace: button does exactly what it says. When this tool is selected, clicking on a trace will insert a corner which can be moved to route around components and other traces.
- The remove a trace button is not very important since the delete key will achieve the same result.

7. WORKING

When the power is supplied to the load its consumption and cost is displayed in digital meter and over internet through Ethernet shield module. Power supply consist of transformer which steps down 240V to 20V which is again reduced to 5V by using voltage regulator, rectifier is used to convert AC to DC filter cleans unnecessary frequencies of DC power. 5V is the operating voltage of microcontroller, LCD screen and all other parts of the system. Ethernet shield module is interfaced to the micro controller reading displayed in LCD is also sent to the mobile having arduino software. Relay is used to makes and breaks the circuit by installing this system we can moniter the electrical loads from anywhere in the world which in turns reduces the electricity consumption and cost.

8. ADVANTAGES AND DISADVANTAGES

Advantages:

1. Ethernet based user-friendly interfacing.
2. Low power consumption.
3. Controls high and low voltage devices.
4. Long life.

5. Ethernet wireless transmission.
6. Fast response.
7. Efficient and low cost design.
8. Low power consumption.

Disadvantages:

1. Status and feed back of devices is not obtained.
2. Limited distance.

Applications:

1. It can be used in places where humans cannot work.
2. Mainly in military applications, robots play a vital role for detection of explosives.
3. Can be used to control devices.

9. RESULT

The project IOT based electricity energy meter was designed an advanced home automation system using Ethernet technology. The devices can be switched ON/OFF using Ethernet in pc, android phone .

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