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Smart Power System

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***Abstract*: The main motive of the Smart Power System is to conserve energy in this modern world. Electricity plays a vital role in today's world, at the same time conservation of electricity is also very much important as it needed for future use. The Smart Power System helps to monitor the power consumed at each phase; the data is stored and updated meanwhile. It identifies the fault when overload occurs and controls it automatically. The data of both monitoring and identifying the fault is stored. By the application of Internet of Things, the stored data is notified to the public. This approach is to design an efficient and real time wireless networks to monitor the power consumption of any electrical devices or appliances. Sensor is set to sense the voltage and current. By utilizing the measured voltage and current, power can be computed. Control qualities are put away in cloud data base along with that the device sends the notification to the user about the status of the power consumed and the datasheet will be generated.**

***Keywords*: Power monitoring, Identifying fault, Controlling IoT, Notification, Datasheet.**

1. Introduction

Electricity is defined by flow of negatively charged particles known as electrons. In today's world electricity is the most important source and plays a vital role in human's life. Without electricity people cannot able to survive. From early morning till late night nothing is possible without electricity. As the importance of electricity is increasing day by day, hence conservation of electricity is the most needed one. People know the consumption of power on the whole, but many times they are disappointed with their electricity bill due to the unawareness of the power consumed by each appliance. If the power consumed is notified, it may help the user to use the electricity effectively. And also if the unused or unnecessary appliance with large consumption of power is automatically controlled will help them to conserve power. If the power consumed is monitored and updated, it will help the user to know about the consumption in a regular basis. This monitoring and controlling can be easily done by IoT.

Internet of Things (IoT) has a major role in this modern world, the significance and utilisation are increasing each passing day. IoT is a system of interrelated computing devices, mechanical and digital machines that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human to human or human to computer interaction. IoT is connecting the whole world without any connection between any of the appliances. It links billions of devices worldwide and is used to send and receive data all over the world. Internet of Things (IoT) makes everything easier and quicker. It has many uses and applications in many fields and domains. Internet of Things (IoT) interconnects various physical objects with embedded system, sensors, software etc. Because of IoT many things have become smarter.

A microcontroller is a small computer on a single integrated circuit. In modern terminology, it is a System on a chip or SoC. A microcontroller contains one or more CPUs along with memory and programmable input/output peripherals. Program memory in the form of Ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications consisting of various discrete chips. Instead of using separate microprocessor, storage devices, input or output devices, usage of microcontroller make it more economical to digitally control many devices. There are many microcontrollers like Altera, Fujitsu, Holtek, Infineon etc. Power bill makes the user very disappointing as it does not show the power consumed by each appliances. The proposed technology is used to make the user know about their power consumed by each devices and is updated in a regular basis. ATmega328p is used in this system to control and monitor the device. This makes the user to conserve energy effectively. In order to maintain continuous flow of energy load has to be considered. If the control of load is possible with small area or a single network does not give the efficiency. This system comprises of detecting units that identifies and controls electrical appliances utilised day by day. This decreases cost for the consumers.

2. Literature Survey

A. Power monitoring system and control

This project is about a case study of wireless sensor network (WSN) to support power management. This power management is done by using web services. The integration of WSNs with internet or web service communication to acknowledge the power management and provide information

using Internet of Things is the design of this proposed system. Various wireless devices operating with different communication standards is based on the idea of collecting energy information. It is used in the applications of regular household monitoring and controlling by WSNs, new technologies like advancements in information technology, sensors, meeting, transmission, distribution as well as energy storage are flexible to both consumers and suppliers of electricity.

B. Power consumption monitoring and home automation using IoT

There are many implementation is going for the smart home system for residential building to make it more efficient day by day. But now a day's mostly VB (visual basic) and PLCC is being used. Practically we can implement the smart home by many researchers to optimize the better result and to improve the technology for the less consumption of electricity. It is the monitoring of the energy consumption and the Controlling the environment in buildings, schools, offices and museums by using different types of sensors and actuators that control lights, temperature, and humidity. If the consumer is not aware with the threshold notification, then the meter will automatically get off. Then the consumer has to visit the webpage again and increment the threshold value.

C. Technique for estimation of power monitoring

In this project proposed a power consumption and monitoring system of the area that continuously monitor the consumption of consumer. If this consumption is beyond the limit of the meter in that case it cut off the power supply of the whole area. The whole process is based on the Ohm's law which states that," the electric power in watts associated with a complete electric circuit or a circuit component represents the rate at which energy is converted from the electrical energy of the moving charges to some other form, e.g., heat, mechanical energy, or energy stored in electric fields or magnetic fields". For a resistor in a D C Circuit the power is given by the product of applied voltage and the electric current". Here taking a voltage as a predefined data and on the calibration of current the power will be calculated. At this point of technological development, the problem of illegal usage of electricity can be solved electronically without any human control along with that meters are connected to the internet using IoT concept. IoT concepts are used so that the information regarding meter status will be send wirelessly from the place where the meter is placed to the server from there it sends the information to the main station or substation. This method eliminates the need of human power during disconnection and reconnection of the load.

3. Proposed System

The existing system has only monitoring the power consumed and also it cannot monitor the power consumed by each device. To overcome the drawbacks of various methods of power consumption problems, the implementation of power monitoring along with controlling fault using IoT is done. The relay circuit is used to identify the fault and when overload occurs controlling of the device is also implemented and is updated meanwhile. The user can able to analyse the power consumption and this helps in conservation of power.

4. Methodology

A 230V AC source is connected to voltage sensor and current sensor to phase and neutral respectively. The phase and neutral points are connected to the different loads for the measurement of power consumption. The analog signal from voltage and current sensors is given to microcontroller. The driver circuit is used to enhance the power from the output of microcontroller to the load. ESP module is used to send the notification to the user's device. The turning ON and OFF of a load is also sensed and the notification is send to the user. Fault is detected and the occurrence of the fault is notified. When a capacity is exceeded, the amount of power consumed is noted. The current and voltage measured using current and voltage sensor is converted into power by microcontroller and stores the data in SD card reader.

The detailed working of the project is given in the block diagram as shown in Fig. 1.

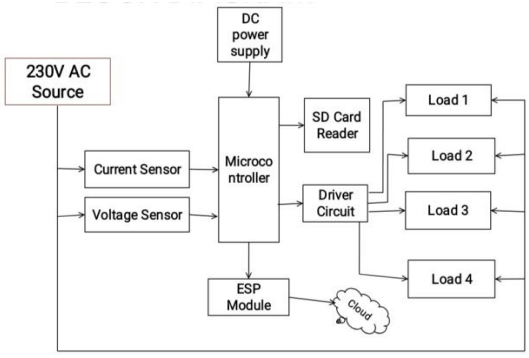

Fig. 1. Block diagram of Smart Power System

A. Hardware Architecture

1) Arduino MEGA 328p

Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header, a reset button and it is shown in Fig. 2. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power.

Fig. 2. Arduino MEGA 328p

2) Current sensor

In this project current sensor ACS712 is used to measure the current, voltage and it is shown in Fig.4.3. It gives accurate current measurement for both AC and DC signals. These are good sensors for metering and measuring overall power consumption of systems. This sensor produces an output voltage which is directly proportional to sensed current. It works on the principle of Hall Effect. 5V should be supplied to V_{cc} of ACS712 breakout board and the GND should be the negative of 0v of supply. Once it is powered, the V_{out} should produce output voltage which represent current going through the sensing pads. When the load is in OFF state then the sensor produces $V_{cc}/2$ voltage (no load voltage). ACS712 is able to measure current in two directions. Output voltage more than 2.5V ($V_{cc}/2$) indicates current in one direction and voltage less than 2.5V indicates current in another direction. 3.5-inch color screen, support 65K color display, display rich colors.320x480 HD resolution for clear display.

Fig. 3. Current sensor

3) Relay 5V

Relays are most commonly used switching device in electronics. The relay has 5V trigger voltage. The relay circuit is shown in Fig 4.4. Since the relay has 5V trigger voltage we have used a +5V DC supply to one end of the coil and the other end to ground through a switch. This switch can be anything from a small transistor to a microcontroller or a microprocessor which can perform switching operating. You can also notice a diode connected across the coil of the relay, this diode is called the Fly back Diode. The purpose of the diode is to protect the switch from high voltage spike that can produced by the relay coil. As shown one end of the load can be connected to the Common pin and the other end is either connected to NO or NC. If connected to NO the load remains disconnected before trigger and if connected to NC the load remains connected before trigger.

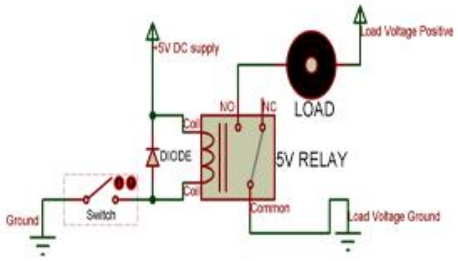

Fig. 4. Relay 5V

4) Voltage sensor

ZMPT101B voltage sensor module is a voltage sensor made from the ZMPT101B voltage transformer. It has high accuracy, good consistency for voltage and power measurement and it can measure up to 250V AC. It is simple to use and comes with a multi turn trim potentiometer for adjusting the ADC output. The specification of voltage sensor is the Output Signal is Analog from 0-5V as shown in Fig.4.5. It's operating voltage in DC 5V-30V. Measure within 250V AC and its rated input current is 2mASize: 49.5 mm x 19.4 mm. onboard micro-precision voltage transformer and analog output corresponding quantity can be adjusted to good consistency for voltage and power measurement.

Fig. 5. Voltage Sensor

5) GSM Module

A GSM module or a GPRS module is a chip or circuit that will be used to establish communication between a mobile device or a computing machine and a **GSM** or GPRS system. A GSM modem is a device which can be either a mobile phone or a modem device which can be used to make a computer or any other processor communicate over a network and is shown in Fig. 6. A GSM modem requires a SIM card to be operated and operates over a network range subscribed by the network operator.

Fig. 6. GSM Module

B. Power Supply 5V

1) Step down transformer

Selecting a suitable transformer is of great importance. The current rating and the secondary voltage of the transformer is a crucial factor. The current rating of the transformer depends upon the current required for the load to be driven. The input voltage to the 7805 IC should be at least 2V greater than the

required 2V output, therefore it requires an input voltage at least close to 7V. So, a 6-0-6 transformer with current rating 500mA is selected and is shown in Fig. 7. (Since 6*√2 = 8.4V).

Fig. 7. Step down Transformer

2) Optocoupler

The Optoisolators is enclosed in a single device, and has the appearance of an integrated circuit (IC) or a transistor with extra leads. Optocoupler can be used to isolate low-power circuits from higher power circuits and to remove electrical noise from signals. Optoisolators are most suited to digital signals but can also be used to transfer analog signals. The isolation of any data rate of more than 1 Mb/sec is considered high speed. The Fig.4.8 shows Optocoupler. The most common speed available for digital and analog Optoisolators is 1 Mb/sec, although 10 Mb/sec and 15 Mb/sec digital speeds are also available. Optoisolators are considered too slow for many modern digital uses, but researchers have created alternatives since the 1990s. In communications, high-speed Optoisolators are used in power supplies for servers and telecom applications -- Power over Ethernet (PoE) technology for wired Ethernet LANs, for example. Optoisolators components can also protect Ethernet and fibre optic cables from electrical surges. In VoIP phones, electrical signals can be isolated using a transistor output Optocoupler.

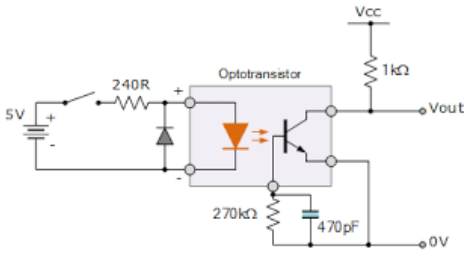

Fig. 8. Optocoupler

3) Rectifying circuit

The best is using a full wave rectifier and its advantage is DC saturation is less as in both cycle diodes conduct. The Fig. 9 shows rectifying circuit. Higher Transformer Utilization Factor (TUF). 1N4007 diodes are used as it is capable of withstanding a higher reverse voltage of 1000v whereas 1N4001 is 50V.

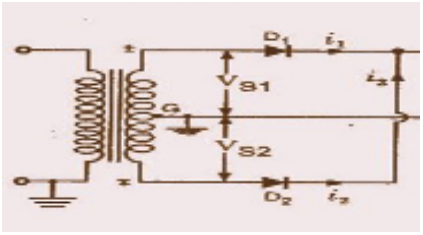

Fig. 9. Rectifying circuit

5. Conclusion

Smart Power System using IoT for monitoring the power consumption and controlling the fault has been successfully implemented. A smart power monitoring and control system has been designed and developed towards the implementation of an intelligent building. This system monitors and controls the power consumption of appliances remotely by using wireless network. And also protect the load from High voltages. The entire system is designed on an embedded platform which is easy to design and consume less power, and provides at low cost with portable size. Thus, the continuous monitoring of the electrical appliances can be observed through a website as well as android app. Further, this work can be extended for power consumption of whole building and electricity bill can be determined.

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