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DESIGN & DEVELOPMENT OF POWER MANAGMENT IN INTELLIGENT BUILDINGS WITH SMART MONITORING & CONTROLLING SYSTEM

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Abstract: **The design and development of a smart monitoring and controlling system for household electrical appliances in real time has been reported in this paper. The system principally monitors electrical parameters of household appliances such as voltage and current and subsequently calculates the units of power consumed. The novelty of this system is the implementation of the controlling mechanism of appliances in different ways like by server or by user. The user can control the home appliances by sending message to GSM module or using server data. The developed system is a low cost and flexible in operation and thus can save electricity expense of the consumers. The prototype has been extensively tested in real-life situations and experimental results are very encouraging.**

Keywords: Energy management, home automation, intelligent control system, wireless sensor network, web server.

I. INTRODUCTION

It is foreseen that service and personal care wireless mechatronic systems will become more and more ubiquitous at home in the near future and will be very useful in assistive health care particularly for the elderly and disabled people. Wireless mechatronic systems consist of numerous spatially distributed sensors with limited data collection and processing capability to monitor the environmental situation. Wireless sensor networks (WSNs) have become increasingly important because of their ability to monitor and manage situational information for various intelligent services. Due to those advantages, WSNs has been applied in many fields, such as the military, industry, environmental monitoring, and healthcare. The WSNs are increasingly being used in the home for energy controlling services. Regular household appliances are monitored and controlled by WSNs installed in the home. New technologies include cutting-edge advancements in information technology, sensors, metering, transmission, distribution, and electricity storage technology, as well as providing new information and flexibility to both consumers and providers of electricity. The GSM and GPRS wireless communication platform is presently examining Japan's new smart home wireless system implication by having a new initiative with Japan's Government that will evaluate use of the forthcoming GSM, Internet Protocol (IP) specification, GSM and GPRS help Japan to create smart homes that improve energy management and efficiency [1].

It is expected that 65 million households will equip with smart meters by 2015 in the United States, and it is a realistic estimate of the size of the home energy management market [2]. There are several proposals to interconnect various domestic appliances by wireless networks to monitor and control such as provided in [3], [4]. But the prototypes are verified using test bed scenarios. Also, smart meter systems like [4]–[6] have been designed to specific usages particularly related to geo- graphical usages and are limited to specific places. Different information and communication technologies integrating with smart meter devices have been proposed and tested at different flats in a residential area for optimal power utilization [7], [8], but individual controlling of the devices are limited to specific houses. There has been design and developments of smart meters predicting the usage of power consumption [4] – [8]. How- ever, a low cost, flexible, and robust system to continuously monitor and control based on consumer requirements is at the early stages of development. In this study, we have designed and implemented a GSM and GPRS based intelligent home energy management and control service. We used the GSM and GPR S technology for networking and communication, because it has low power and low-cost characteristics, which enable it to be widely used in home and building environments. The paper focuses on human-friendly technical solutions for monitoring and easy control of household appliances. The in- habitant's comfort will be increased and better assistance can be provided. This paper emphasizes the realization of monitoring and controlling of electrical appliances in many ways.

The developed system has the following distinct features.

1) Using GSM and GPRS technology, the household appliances are controlled either remotely or automatically with the help of fabricated smart sensing unit.

2) Microprocessor/microcontroller is used to design of smart sensing unit which is used as a processing unit at the sensing end.

3) Flexibility in controlling the appliances: Depending on the user requirements, appliances can be monitored and controlled in different ways.

II. SYSTEM DESCRIPTION

The system has been designed for measurement of electrical parameters of household appliances. Important functions to the system are the ease of modeling, setup, and use. From the consumer point of view, electrical power consumption of

various appliances in a house along with supply voltage and current is the key parameter. Fig-1 shows the functional description of the developed system to monitor electrical parameters and control appliances based on the consumer requirements. The measurement of electrical parameters of home appliances is done by interfacing with fabricated sensing modules. The details of the design and development of the sensing modules are provided in the following sections. The output signals from the sensors are integrated and connected to energy meter module for transmitting electrical parameters data. In this project the controller automatically finds the temperature value. When the temperature value is exceeds the threshold value the fan will automatically ON. Voltage sensing circuit, current sensing circuit will show the voltage & current of BULB. Energy meter will show units consumption of the devices. Through GPRS server we can ON or OFF the loads at any time. And how much of electricity is consumed by the loads that information also posts in to server by using of GPRS module. Through GSM module we can on OFF the load by sending message. By analyzing the power from the system, energy consumption can be controlled. An electricity tariff plan has been set up to run various appliances at peak and off-peak tariff rates. The appliances are controlled either automatically or manually. The smart power metering circuit is connected to mains 240 V/50 Hz supply. Fig-2 shows different appliances connected to the developed smart sensing system. This regulated 12V is generated by stepping down the voltage from 230V to 18V now the step downed ac voltage is being rectified by the Bridge Rectifier using 1N4007 diodes. The rectified ac voltage is now filtered using a C' filter. Now the rectified, filtered D.C. voltage is fed to the Voltage Regulator. This voltage regulator provides/allows us to have a Regulated constant Voltage which is of +12V. The rectified; filtered and regulated voltage is again filtered for ripples using an electrolytic capacitor 100µF. Now the output from this section is fed to microcontroller board to supply operating voltage.

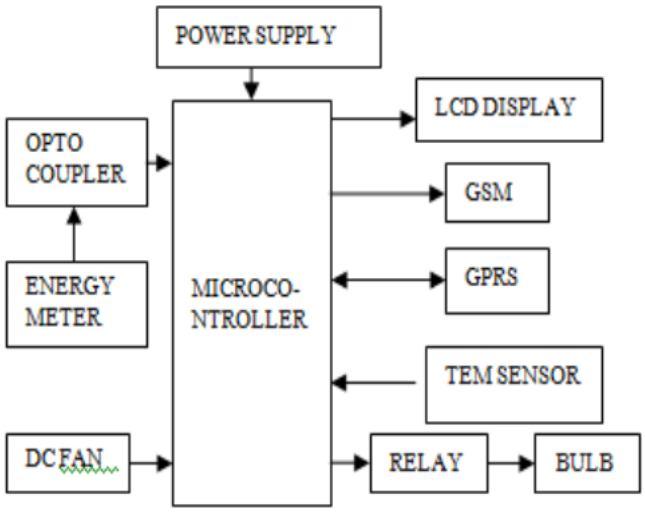

Fig-1: Functional block diagram

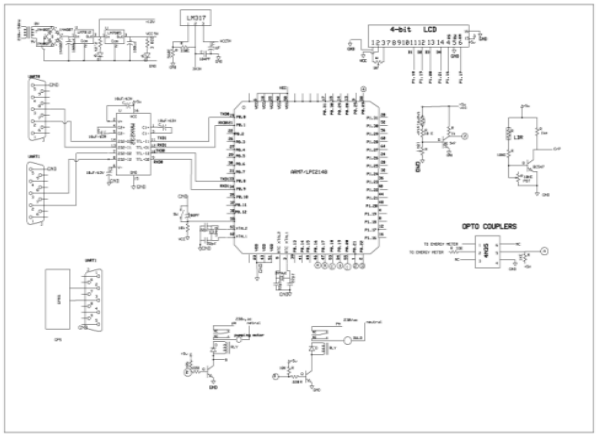

Fig-2: Schematic

By analyzing the power from the system, energy consumption can be controlled. An electricity tariff plan has been set up to run various appliances at peak and off-peak tariff rates. The appliances are controlled either automatically or manually (local/remotely). The smart power metering circuit is connected to mains 240 V/50 Hz supply. Fig-2 shows different appliances connected to the developed smart sensing system.

III. METHODOLOGY

Microcontroller: This section forms the control unit of the whole project. This section basically consists of a Microcontroller with its associated circuitry like Crystal with capacitors, Reset circuitry, Pull up resistors (if needed) and so on. The Microcontroller forms the heart of the project because it controls the devices being interfaced and communicates with the devices according to the program being written.

ARM7TDMI: ARM is the abbreviation of Advanced RISC Machines, it is the name of a class of processors, and is the name of a kind technology too. The RISC instruction set, and related decode mechanism are much simpler than those of Complex Instruction Set Computer (CISC) designs.

GSM: Global System for Mobile Communication (GSM) is a set of ETSI standards specifying the infrastructure for a digital cellular service. The network is structured into a number of discrete sections:

- Base Station Subsystem – the base stations and their controllers explained
- Network and Switching Subsystem – the part of the network most similar to a fixed network, sometimes just called the "core network"
- GPRS Core Network – the optional part which allows packet-based Internet connections
- Operations support system (OSS) – network maintenance

SM was intended to be a secure wireless system. It has considered the user authentication using a pre-shared key and challenge-response, and over-the-air encryption. However, GSM is vulnerable to different class of attacks, each of them aiming a different part of the network.

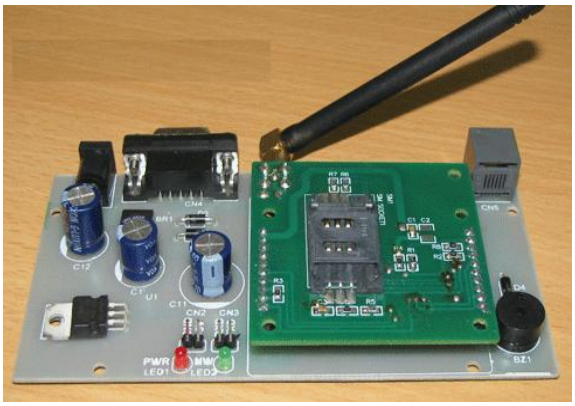

Fig 3: GSM Module

Current Sensors: A current sensor is a device that detects and converts current to an easily measured output voltage, which is proportional to the current through the measured path. When a current flows through a wire or in a circuit, voltage drop occurs. Also, a magnetic field is generated surrounding the current carrying conductor. Both of these phenomena are made use of in the design of current sensors. Thus, there are two types of current sensing: direct and indirect. Direct sensing is based on Ohm's law, while indirect sensing is based on Faraday's and Ampere's law. Direct Sensing involves measuring the voltage drop associated with the current passing through passive electrical components.

Voltage sensor: A voltage detector is a device that determines the presence/absence of an electrical charge in an object. It can be a simple, pen-shaped piece of testing hardware that indicates the presence of electricity or an advanced tool that detects precise voltage levels in electrical systems. A voltage detector measures the flux lines of the electric field formed between the earth's potential and a live component of the system. A displacement current is produced when the electric field is interfered by an operating head of the high-voltage detector. The current starts to flow via the test electrodes E1 and E2. A downstream electronic circuit identifies and measures this current. The high-voltage detector generates a visual and acoustic signal if the displacement current exceeds the threshold value thereby indicating the presence of a voltage.

IV. RESULTS

The project is having the facility of getting the voltage, current and power units reading at any time on the server. The Fig-3 shows the message which is send by the customer to GSM.

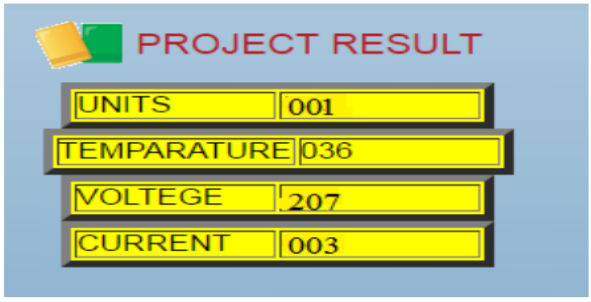

Fig-4: Data shown on server

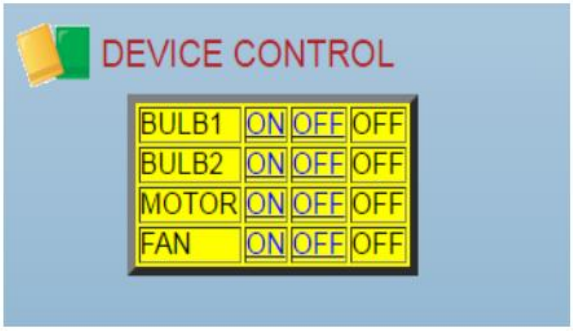

Fig-5: Home appliances can be control from server

V. CONCLUSION

A smart power monitoring and control system has been designed and developed toward the implementation of an intelligent building. The developed system effectively monitors and controls the electrical appliance usages at an elderly home. Thus, the real-time monitoring of the electrical appliances can be viewed through a website. The system can be extended for monitoring the whole intelligent building. We aim to determine the areas of daily peak hours of electricity usage levels and come with a solution by which we can lower the consumption and enhance better utilization of already limited resources during peak hours. The sensor networks are programmed with various user interfaces suitable for users of varying ability and for expert users such that the system can be maintained easily and interacted with very simply. This study also aims to assess consumer's response toward perceptions of smart grid technologies, their advantages and disadvantages, possible concerns, and overall perceived utility.

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