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Peak Hour Load Control & Overcurrent Monitoring System

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Abstract - *Different methods can be proposed to reduce the power demand and thereby increase the energy efficiency. One of the innovative technique is demand shifting. This project will focus on optimal utilization of available electricity during peak hours. With reduction in consumer load during peak hours, there is an opportunity to improve the load curve and load factor along with saving in energy bill due to the lowering Maximum Demand charges (penalties) during peak hours. This project also addresses the problem of developing a wireless diagnostic system for over current monitoring in household appliances. Wherein the high power rated apparatus are linked to the consumers PC to get alerts whenever the appliances are found faulty. This in turn reduces the unwanted increase in electricity bill. Motivated by real examples, we develop new schemes to detect not only fail-stop failure, but obstructed view and moved-location failures that are not the traditional fault detection foci. This paper addresses various communications and optimization based residential energy management schemes and different communication and networking technologies involved in these schemes.*

Key Words: Maximum Demand, Demand shifting, Load Management, Arcing fault, Trip circuit.

1.INTRODUCTION

The purpose of this project is to explore the conceptual requirements and opportunities to develop load control schemes that are competitive with conventional generation based approaches to providing power system control services. The primary characteristic of load control that distinguishes it from conventional generation-based approaches is that it must deliver a reliable resource to the power system while simultaneously maintaining a level of service commensurate with customer expectations. These two objectives are often in competition, and one of the greatest technical challenges to the competitiveness of engaging loads in power system services is to develop approaches that balance these objectives. A well-known characteristic of the current electricity market is the low elasticity of its short run prices. This is mainly due to the fact that end consumers hardly react against peaks of demand, in spite of the fact that their consumption habits are largely causing imbalance. Most electricity markets do not consider consumers as active elements capable of adopting optimized strategies and decisions but simply as loads to be continuously supplied. Electricity peak demand occurs on hot summer days and cold winter nights when high energy appliances such as air conditioners and heaters are cranked up and added to our usual energy needs. On these occasions, when demand exceeds supply, energy distributors are forced to shed loads or sometimes turn off power to the entire suburbs.

Load management allows utilities to reduce demand for electricity during peak usage times, which can, in turn, reduce costs by eliminating the need for peaking power plants. Load management can also help reduce harmful emissions, since peaking plants or backup generators are often dirtier and less efficient than base load power plants. New load-management technologies are constantly under development both by private industry and public entities. Overcurrent protection is the protection against short circuits. It generally operates instantly. The simplest overcurrent relay is a magnetic coil that trips when current is higher than the trip value. Some believe that high-level bolted faults are common occurrences, but the fact is that the majority of over currents are overloads and low-level arcing faults.

2.DESCRIPTION

Today most control systems are constructed with Programmable Logic Controllers (PLCs), Microcontrollers and Interconnected relays. It is a set of device that manages, commands, directs or regulates the behaviour of other devices or system. Control systems are quite easy to design, and can handle very complex operations. Since modern microcontrollers are so cheap, it is very common to

implement control systems, with microcontrollers common in an embedded system. In this project, Atmega32 microcontroller is used for relay control and load control.

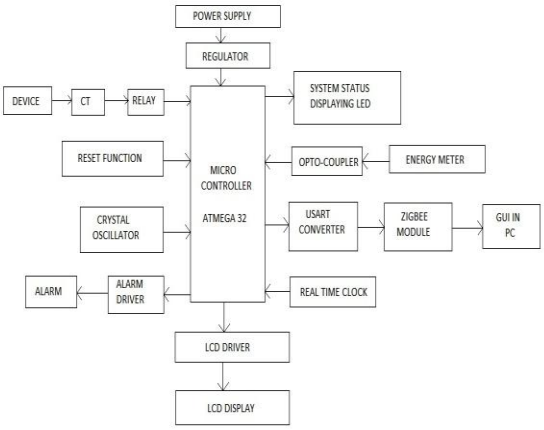
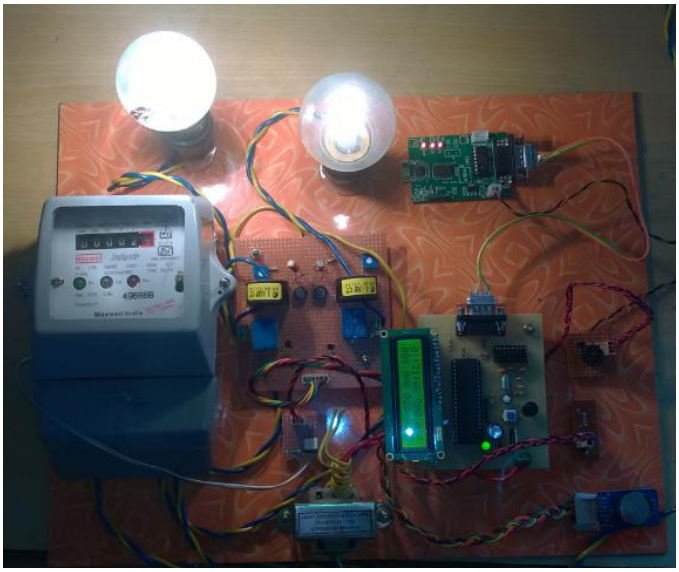


Figure -1: Block Diagram

Today most control systems are constructed with Programmable Logic Controllers (PLCs), Microcontrollers and Interconnected relays. It is a set of device that manages, commands, directs or regulates the behaviour of other devices or system. Control systems are quite easy to design, and can handle very complex operations. Since modern microcontrollers are so cheap, it is very common to implement control systems, with microcontrollers common in an embedded system. In this project, Atmega32 microcontroller is used for relay control and load control. The microcontroller ATMEGA32 is the main backbone of the system. It links each individual component, i.e. the wattmeter, LCD display, current transformer, alarm, zigbee module, optocoupler, RTC etc. It takes input from optocoupler, RTC and current transformer and produces control signals for zigbee, LCD and alarm. The MAX232 is an integrated circuit that converts signals from a RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. The MAX232 is a dual driver/receiver and typically converts the RX, TX, CTS and RTS signals. MAX232 is connected to PORT D. A current transformer is provided for each appliance. This reads the current through the device, compares this with the components' designed value. After this comparison, the microcontroller obtains the status of the device. This status signal from microcontroller is transmitted through PORT D to MAX232. This is given to a zigbee module through a DB9 connector. The zigbee module transmits these signal to PC through a graphical user interface called Terminal. The signal obtained at the microcontroller from wattmeter are optical pulses. Optocoupler is connected to port A. Microcontroller then uses these signals to display the energy unit and amount on LCD. Here 8 bit data transfer is enabled.

3.SYSTEM OPERATION

Peak load control is enabled in project by alerting the consumer about the load consumption. More than giving awareness on load consumption and electricity tariff, this method proved to be a useful strategy. Here a design is enabled by which, the microcontroller sets up a new counter during the peak hour. Once when the device enter the peak hour, the load consumed is calculated seperately. Optocoupler converts the light pulses of wattmeter to electrical signals. This is being sent to microcontroller. Once when the electricity consumption reaches 2 units, it gives a signal to the microcontroller indicating that the consumption is about to reach the maximum limit. Microcontroller thereby enables the port PA.7 where a buzzer is connected. When consumption reaches 3 units, which is the designed maximum limit, it again gives an alarm and thereby the rate per unit of the peak hour doubles. When the consumption reaches above 4 units, all the power plugs in the home gets disabled using a relay mechanism. An external switch is provided which can be used to enable these power plugs, if required.



The rated current readings of all the appliances are stored in the microcontroller. Each device is provided with a current transformer. The current transformer continuously monitors the current reading and gives it to the microcontroller. The microcontroller compares the current reading with the rated reading. This is linked to a terminal in the consumer's PC through zigbee module. During normal condition, the terminal displays which all devices are on. During overcurrent condition, the terminal displays which device is faulty. Thus the consumer gets an awareness on the efficient working of all the home appliances, especially the faulty devices.

3.1 Atmega 32

The Atmel AVR Atmega32 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. It has 8 ADC pins that is why it is used for load contol. The Atmel AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle.

3.2 LCD

The LCD display is used to display various voltages and instructions to users. A liquid crystal is a material (normally organic for LCDs) that will own like a liquid but whose molecular structure has some properties normally associated with solids. A 16*2 LCD means it can display 16 characters per line and there are 2 such lines. LCD each character is displayed 5*7 pixel matrix. This LCD has two registers, namely Command and Data. The Command register store the command instructions given to the LCD. The Data register stores the data to be displayed on the LCD.

3.3 MAX232

The MAX232 is an integrated circuit that converts signals from a RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. The MAX232 is a dual driver/receiver and typically converts the RX, TX, CTS and RTS signals. Max232 is designed by Maxim Integrated Products. This IC is widely used in RS232 Communication systems in which the conversion of voltage level is required to make TTL devices to be compatible with PC serial port and vice versa. This chip contains charge pumps which pumps the voltage to the Desired Level. It can be powered by a single +5 volt power supply and its output can reach +7.5 to -7.5 volts. MAX232 comes in 16 Pin Dip and many other packages and it contains Dual Drivers. It can be used as a hardware layer convertor for 2 systems to communicate simultaneously. Max232 is one of the versatile IC to use in most of the signal voltage level conversion problems.

3.4 Zigbee Module

A Zigbee is used to create personal area networks with small, low power digital radios. The technology defined by zigbee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as bluetooth or Wi-Fi. Its applications include wireless light switches, electrical meters with in-home-displays, traffic management systems, and other consumer and industrial equipment that requires short-range low-rate wireless data transfer.

3.5 Current Transformer

A current transformer (CT) is an electric device that produces an alternating current (AC) in its secondary which is proportional to the AC in its primary. When a current is too high to measure directly or the voltage of the circuit is too high, a CT can be used to provide an isolated lower current in its secondary which is proportional to the current in the primary circuit. The induced secondary current is then suitable for measuring instruments or processing in electronic equipment.

3.6 Opto coupler

Optocouplers are made up of a light emitting device and a light sensitive device, all wrapped up in one package, but with no electrical connection between the two. The light emitter is nearly always an LED. The light sensitive device may be a photodiode, phototransistor, or more esoteric devices such as thyristors, TRIACs etc.

4.CONCLUSION

Demand-side management is challenging, since it often requires active, and often burdensome, consumer involvement. Forcing people to think about how they use

power is simply not effective in encouraging broader adoption of demand-side management. The approach will flatten the house-hold demand over each day and reduces the load on generating station during peak demand hours. On a conclusion note, this project has revisited the need for domestic energy management for efficient consumption of electricity. Consuming electrical energy efficiently results in reducing peak load, lowering electricity bills and minimizing the emission of green house gases. This project has discussed several home energy management schemes where different pricing schemes have been applied to get economical and social advantages. The proposed method shows an alternate approach for load shedding. The residual windings deformations of power transformers during short circuits will be appear practically instantly, without leaving time on the analysis the results of the diagnostic measurements, and requiring as it is possible rapid switch off with the purpose averting or reduction in the scales future repairing of electrical equipment. With the increase in incentives from the government for renewable based homer power automation, the solution shows great promise in current market. Hope that this work will channelize the efforts towards a more efficient, user friendly home energy management system.

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