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RESEARCH ARTICLE

MANAGEMENT OF MAXIMUM POWER DEMAND WITH GENERATOR CONTROL MECHANISM USING I2C PROTOCOL

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Abstract : *Maximum Demand Control is an embedded based project which can be implemented in industries where three phase of parameters have to be monitored and controlled. At present industries are using an individual controller for controlling these individual parameters. The aim of this project is to use a single controller for controlling more than one parameter in a fully automatic mode. This project is useful for power management in industries, colleges and big consumers. In our state, there is a scarcity of electrical energy. Due to this, the Electricity Board provides only limited amount of energy to the industries, educational institutions and other big consumers. If they exceed the limited amount, they have to pay penalty. At present TNEB has formulated few rules that allow only 80% of the permissible energy to be consumed. When an industry uses the maximum amount of energy, the microcontroller will provide a sound by using a buzzer. The main objective of our project is to maintain the present value of each phase. When the value is exceeded, the phase will automatically share the load where the demand is required. Here the buzzer is used to give the alert of overload or maximum demand to user. If it exceeds the present value, it will automatically start a generator and then the parameters will be monitored by using Inter-Integrated Protocol.*

Keywords - *Automatic, Demand Control, Inter integrated protocol, Load, Penalty*

I. INTRODUCTION

HT consumers have to pay a maximum demand charge in addition to the usual charge for the number of units consumed. It is necessary to monitor power use and to turn off or reduce non-essential loads. Maximum demand controller is a device designed to meet the need of industries conscious of the value of load management. Maximum demand controller is a device designed to meet the need of industries conscious of the value of load management. Alarm is sounded when demand approaches a preset value. If corrective action is not taken, the controller switches off non-essential loads in a logical sequence. This sequence is predetermined by the user and is programmed jointly by the user and the supplier of the device. The plant equipments selected for the load management are stopped and restarted as per the desired load profile. Demand control scheme is implemented by using suitable control contactors. Audio and visual annunciations could also be used. This project can be used for load management in industries and also to avoid the penalties and production losses.

The earlier method of managing maximum power demand was by Automatic power factor control (APFC) unit. Power factor is defined as the ratio of real power to the apparent power. This definition is often mathematically represented as KW/KVA, where the numerator is the active (real) power and the denominator is the (active + reactive) or apparent power. Reactive power is the non working power generated by the magnetic and inductive loads, to generate magnetic flux. When there is an increase in reactive power, the apparent power also increases with that, so the power factor decreases gradually. Power factor is inversely proportional to the apparent power. Due to low power factor, the industry pays more to meet its demand, and so the efficiency of the system also decreases. So Power factor correction was used for minimizing the penalty for the industrial units. This project aims at developing an alternative method for maximum power demand management with generator control mechanism.

II. BACK GROUND

The main objective of this project is to reduce the penalty for industries using I2c protocol. The earlier method of managing maximum power demand was by automatic power factor control (APFC).Reactive power is the non working power generated by the magnetic and inductive loads to generate magnetic flux. Power factor is inversely proportional to the reactive power. If the reactive power is high, the power factor will become low. Low power factor is an indicator that system is not efficient and there will be electricity loss. Advantage of good correction power factor is also discussed through the process of power factor improvement, demand for apparent power (S) and reactive power (Q) could be reduced to both generator and consumers. Lost electricity also could be reduced and system voltage can be increased. Power factor correction methods include synchronous motor, static capacitor bank and automatic capacitor bank. Capacitor bank, either static or automatic use by widespread base low material cost and easy maintenance. It also discusses effect and location of capacitor bank, size, and voltage increase.

Due to low pf, the industries have to pay more to meet its demand and so the efficiency also decreases. So power factor correction is essential for minimizing the penalty. This project aims at developing the alternative for demand management with generator control mechanism. When connecting multiple devices to a microcontroller, the address and data lines of each device are conventionally connected individually. This results in a lot of traces on the PCB, and requires more components to connect everything together. This made these systems expensive to produce and susceptible to interference and noise. To solve this problem, Inter-IC bus or I2C was developed .I2C is a low-bandwidth, short distance protocol for on board communications. All devices are connected through two wires: serial data (SDA) and serial clock (SCL). I2C has many important features worth mentioning. It supports multiple data speeds: standard (100 kbps), fast (400 kbps) and high speed (3.4 Mbps) communications. Other features are built in collision detection, 10-bit Addressing, Multi-master Support and Data broadcast.

III. PROBLEM FORMULATION

This project improves a system's power factor by using a set of capacitors that are connected in parallel with the inductive load. In this system, a temporary lagging load is created with the use of inductor choke, which is used in many tube lights to build high voltage. In all four capacitors, the insertion to load depends on the value of the power factor. Imagine if the power factor is below 0.5, then there will be a chance to join all the capacitor to the load. This system is implemented by the concepts of Zero Voltage Switching (ZVS) and Zero Current Switching (ZCS). The voltage's and current's zero positions are detected by this circuit, which calculates the time difference between these two, and correspondingly calculates the power factor. Therefore, depending on this value of the power factor, the capacitors are switched.

A microcontroller is used in this project as a central processing unit to calculate the power factor and to switch the capacitors. The working of this project is explained with the help of the below block diagram, which consists of a power supply block to power the entire circuit, a voltage and a current zero crossing detection block, in addition to the load arrangement with the capacitors that are switched on by using relays. It uses a potential transformer to supply the voltage to the Zero Voltage Crossing circuit, which detects the zero crossing of the voltage wave form, for every 10 ms – by comparing the voltage pulses applied to the operational amplifier. These voltage pulses from the operational amplifier are applied to the microcontroller as interrupt signals.

Similarly, a current transformer is used here to give the current wave to the ZCS circuit wherein the operational amplifier output is enabled for every 10 ms by comparing the zero position of the current with the predefined setting. This signal is also applied to the microcontroller as an interrupt signal. The microcontroller finds time elapse between these two interrupts and substitutes it in a certain equation for calculating the power factor. If this power factor value is in between 0.95 to 1, then the microcontroller doesn't send any command signals to the relay driver to switch the capacitors on. But, if it is less than 0.95, then the microcontroller sends command signals to the relay driver so that the capacitor comes in parallel with the load. Therefore, these capacitors reduce the lagging nature of the load by giving leading currents to it. The number of capacitors' switching depends on the value of the power factor – very low power factor needs all the capacitor, whereas high power factor needs none of those. In this way, one can improve the lagging power factor so that the losses will be minimized and therefore, the penalty imposed by the power supply companies will be minimized. In this proposed system we include a generator control to a maximum demand controller and parameters are monitored by using an I2c protocol. It is also used for effective demand management in modern industries and to avoid penalties and production losses.

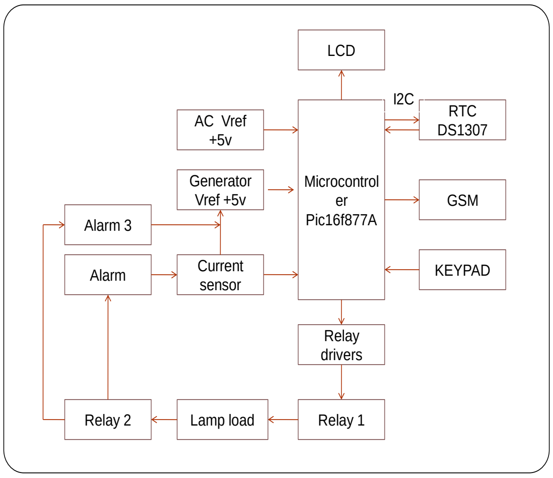

Fig1.functional block diagram of maximum demand control

IV. I2C PROTOCOL

Inter-Integrated Circuit is a multi-master, multi-slave, single-ended, serial computer bus used for attaching low-speed peripherals to Computer motherboards and embedded systems. I²C is appropriate for peripherals where simplicity and low manufacturing cost are more important than speed. Common applications of the I²C bus are Reading configuration data, Supporting systems management, cards, Accessing chips, Accessing low speed DAC and ADC, Changing contrast, hue, and colour balance settings in monitors changing sound volume in intelligent speakers. Controlling displays Reading hardware monitors and diagnostic sensors, Reading RTC. Turning on and turning off the power supply of system components.

V. SIMULATION CIRCUIT

By using proteus simulation software to design our project simulink diagram with the configuration of PIC16F877A can operate 4MHz frequency and i2c communication using Embedded C programming language.

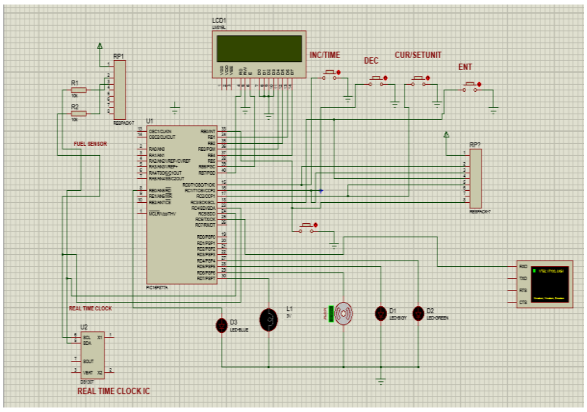

Fig 2. Software simulation circuit using proteus

VI. STEPS FOR SIMULATION

Start the simulation by clicking the play button. Set the Current Sensor unit to set mode. Increments the set mode value up to 10 watts. Enter the value. Note down the value of consumed units. If the power limit reaches 70%, a buzzer is activated and alarm sound is produced. An alert message is sent to the server. After reaching 85%, the non-critical loads are automatically switched off. After reaching 95%, the critical loads are connected to the generator and the power supply will be provided to the loads. The process is repeated for every month. A period of 30 days is taken into account. The entire set up is reset at the end of 30th day. The period of calculation for every new day starts from 12 am to 12 p.m.

VII. SIMULATION RESULT

An alert message has been sent after crossing 70% of the power limit. Both the critical loads and non-critical are in operation (Fig 3.1). All the non-critical loads have been switched off (fig 3.2). Maximum limit has been reached and the critical loads start operating after getting connected to the generator (fig 3.3).There is a clear depiction that the loads are operated through generator and the parameters are monitored and preset.

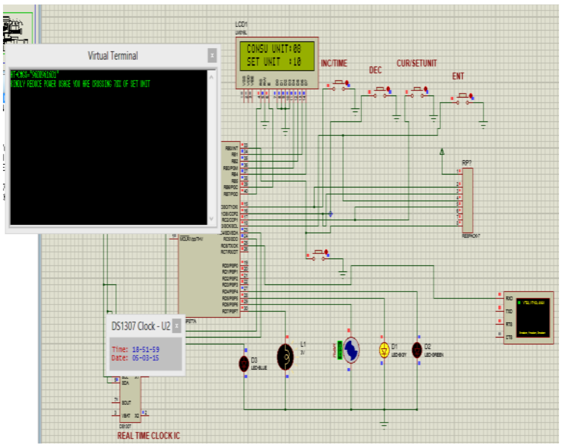

Fig 3.1

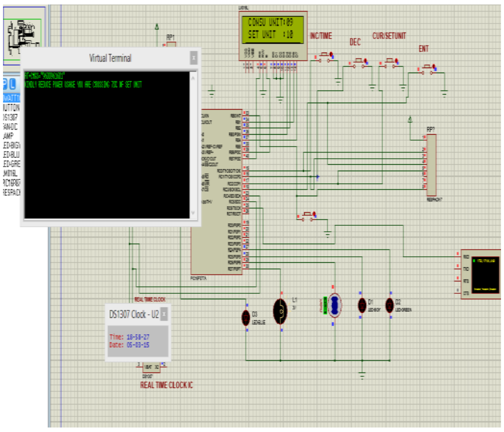

Fig 3.2

There is a clear depiction that the loads are operated through generator and the parameters are monitored and preset.

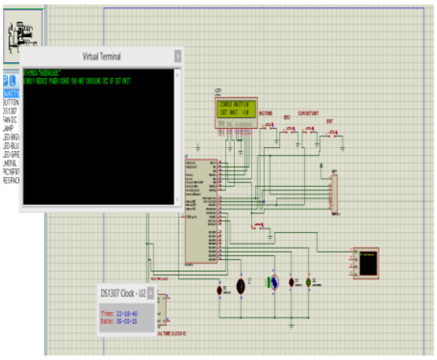

Fig 3.3

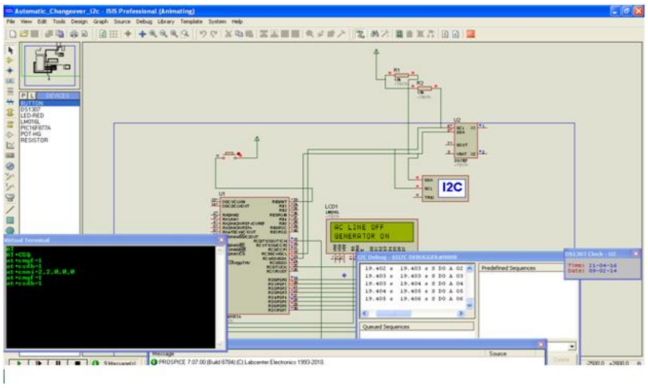

Fig 3.4

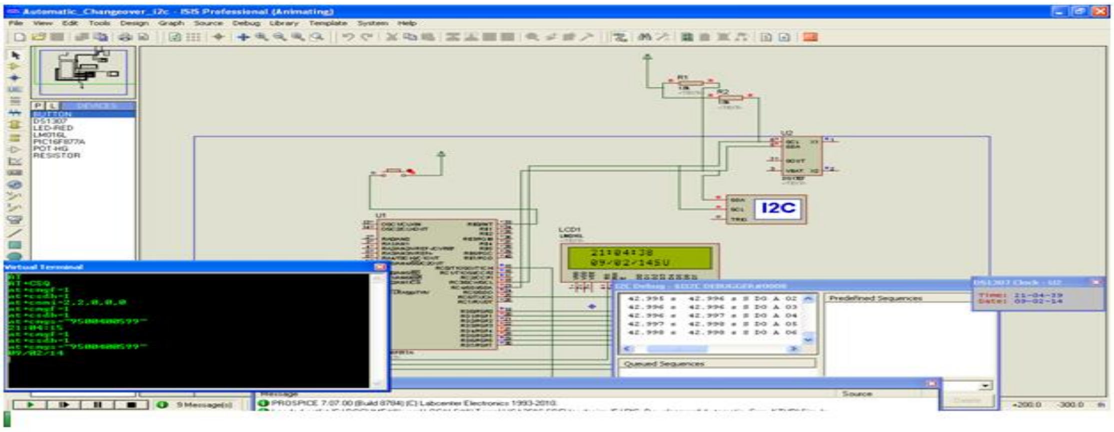

Fig 3.5

The process of multiple tasks can be controlled by PIC16F877A microcontroller and monitored by LCD unit. The initial stage of circuit is ideal but when the maximum value is exceeded the operation will be started by drivers of relay units. When the 70 % of Restriction and Control Measure value is reached the relay is operated and the circuit is closed .At 75% second relay is operated and at 85% non critical loads are switched off .At 95% the relay trips the AC line and generator is switched ON automatically. This process is displayed in the LCD Unit. When generator is started the parameters like current ,voltage , frequency and fuel level will be monitored by i2c protocol for DS1307 RTC and these actions can be displayed in desktop and also send a text message to user or an control engineer by GSM unit for a securable and Acknowledgment of power house unit of Industries.

VIII. FUTURE SCOPE

By proper implementation it can be useful in economic growth as well as it can reduce the deficiency of power in TamilNadu. It gives awareness about maximum demand power restrictions by maintaining 0.8 power factor and more favourable for LT companies.

IX. CONCLUSION

This paper is mainly emphazing the minimization of production losses with continuous operation, avoiding power demand and increasing the effective output products by reducing the maximum power .Effective demand management project is used to curtail electricity charges, positive limits within contracted demand so as to avoid the penalty and power charges which affect the production process. It is useful in load shedding that helps to use the minimum implant generation and optimum utilization of both EB power and implant generation leading to low pay back period and high savings of power and money . The practicality and effectiveness of the proposed concepts are verified by the simulation and experimental results.

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