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Industrial Automation and Tariff Control using Arduino

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Abstract: The day by day increase within the demand for supply of electricity during last recent years could be a dramatic growth within the national's annual residential development and played a significant role in increasing the demand for power. to fulfill the projected demand for power to deal with, the event plans, increases within the population and also the rising within the living standards, government will must accomplish new power generating units. Electricity tariff control and setting could also be a primary instrument of economic regulation. Through this paper we aim to debate the potential for alternative routes of charging for electricity and providing concessions to spice up the ways of essential electricity use, facilitate the equitable, efficient and full recovery of the worth of supplying electricity and provide clear information to consumers regarding the impact of their electricity use. Many of the prevailing tariff elements are formulated over the years as a result of the obtainable technology. As seen in the electricity tariff structures its therefore the important to contemplate style of the developments in technology with relevance metering which may facilitate a greater variety in tariff structures now or in the future.

Keywords: tariff, ABT tariff, step rate tariff, unscheduled interchange tariff, TOU tariff, CPP tariff, real-time pricing tariff (RTP), FIT, dynamic pricing.

I. INTRODUCTION

Electricity is characterized by the very fact that its production and consumption act nearly at the identical time. Furthermore electricity cant be stored in more quantities. This suggest that power generation must match demand alteration, whereas demand is plagued by climate, economic process and customers consumption patterns. These factors make the demand to fluctuate at different time. Utility must invest within the generation plant and equipment to stay enough net peaking capability in line with the system maximum demand. If the utilities dont impose any system measures, there will be a heavy imbalance in power supply and demand. The insufficient investment or the more complexity will lead to idle asset or create power shortage problems which is create problem to both suppliers and customers. The system is mentioned to the "Demand Side Management". It relates to all or any kind of energy; electricity, gas, solar, diesel, petrol etc. The researcher will concentrate only on power. Demand side management could be a method of containing and reducing the general cost of energy. By establishing a requirement side management program, an utility should aim to conserve all kind of energy by eliminating waste and inspiring the efficient use of energy. The financial benefits of a successful demand side management will be quite large. Energy is one in every of the factors of production over which a utility has some control and soundly based demand side management program could be a means of reducing operating costs, increasing profits and remaining competitive. In nonprofit organization like government utilities, hospital and university, demand side management would be some way to stretch a really limited budget.

II. SYSTEM ARCHITECTURE ANDDESIGN

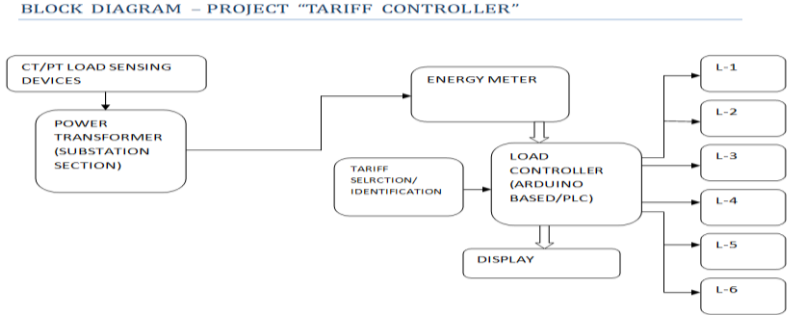

Fig1: Industrial Automation and Tariff Control Using Arduino

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Time-of-Use (TOU) tariff rates are often structured during a variety kind of ways, counting on the utilities costs and thus the type of consumers. While small customers (e.g. households) prefer a simpler rate structure, large industrial customers often have an energy manager and, therefore, prefer a more complex tariff structure if the electricity bill are often reduced. TOU rates have predetermined pricing periods and rates and thus, do not always reflect the marginal costs of generation, but they are a right step in the direction of differential cost-based pricing. The choice of the load shape objective is decided by the quantity of the provision side constraints. Some of these constraints may be whether the system is energy constrained, reliability of the system, the need for schedule maintenance and the state of distribution and transmission system. The basic type of load shape changes are of three types. Load management does not aim to decrease the general electricity consumption, rather approaches (or replies to) the consumption pattern. It may be applied both on energy demand and on supply sides

2.1 Arduino: The high-speed Microchip pico Power of 1-byte AVR RISC hardware used-controller combines 32KB ISP non volatile storage with read-while-write capabilities, 1KB EEPROM, 2048B S-RAM, 23 general purpose Input an output lines, 32 resistors (GPR), three timer/counter having compare modes, this controller has many interrupts (internal/external), SPI serial interface, A/D converter (8-channels in TQFP and QFN/MLF packages), USART serial programmable, watchdog timer having internal oscillator, software selectable power saving modes. The device operates between 1.8-5.5 volts. In a single clock cycle the microcontroller will execute a powerfull instructions and device get the throught performance of one MIPS per MHz

Fig: Arduino Atmega 328P

2.2 Relay Module: The relay module used in this project is an 8 channel high quality board which is works on 5-6Volt. This relay module is used to control the power appliances from microcontroller and from low voltage circuits. it used for switching of 240V appliances for example, lights, fans, etc. Prime quality relays are used, which can handle a current and voltage ratings of 7A/240 V AC or 7A/24V DC. A single relay in a 8 relay module has three three connections namely - Common, Normally Open and the Normally Closed brought out. This 3 pins are screw to 3 pin terminals which made easy to connect and remove connections. Each relay has its saperate LED to indicate its status, this will help during the operation. The board can accept inputs withing a wide range of voltages.

Fig: 8 Channel Relay Module

2.3 Transformer: A stepdown transformer is use to convert the high voltage which is fed to its primary winding into a low voltage which appears across a secondary winding. 2:1 is the voltage turn ratio of the step-down transformer.

Fig2.3: Transformer (Stepdown 230v/12v)

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The primary winding has more turns with respect to the secondary winding. The fig shows a stepdown transformer which is used to step down the voltage level. The voltage turn ratio of the given transformer determines the magnitude of voltage transforms from primary to secondary windings of transformer.

2.4 Bridge Rectifier: The fig shows constructional diagram of a bridge rectifier which uses a 4 diodes rectification element. The bridge rectifier is consist of four diodes namely D1, D2, D3, D4 and load resistor RL. These four diodes are connected in a bridge configuration to convert the Alternating Current into Direct Current. The most advantage of this bridge circuit configuration is that we do not require an expensive center tapped transformer, thereby reducing its cost and size.

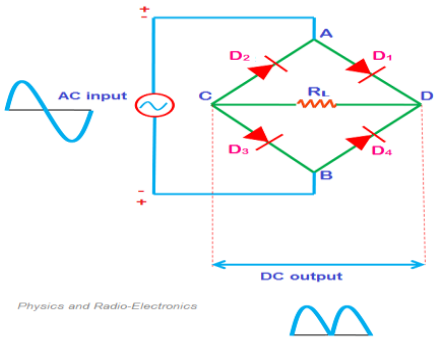

Fig: Bridge Rectifier

2.5 Bluetooth Module (HC-05): The bluetooth module is used for wireless data transmission, it is a serial port protocol module designed for transparent wireless serial connection setup. This port Bluetooth module is fully qualified Bluetooth V2. 0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband The Bluetooth module HC-05 may be a MASTER/SLAVE module. By default the factory setting is SLAVE. The Role of the module (Master or Slave) are often configured only by AT COMMANDS. The slave modules is not create a connection to different Bluetooth device, but can accept connections. Master module can create a connection to another devices. The user can use it simply for a interface replacement to ascertain connection between MCU and GPS, PC to your embedded project.

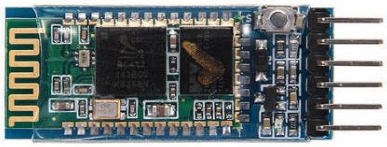

Fig2.5: Bluetooth Module

2.6 Current Transformer: The current transformer is works on the principle of emf production. An alternating current is produces in primary which produces a magnetic field in the core, then it induces an alternating current in the secondary due to magnetic field. The current transformers need to have a accurate coupling between the primary winding and secondary winding to ensure that the current in secondary is proportional to the primary current. The primary circuit is mostly do not affected by the insertion of the CT. The primary current is the current in the secondary but in the given ratio as divided by the number of turns of the secondary. In the given fig on the right side, 'I' is the current in the primary, and 'B' is the magnetic field, and 'N' is the number of turns on the secondary, and 'A' is an AC ammeter.

Figure 2.6: Current Transformer

2.7 Potential Transformer: The potential transformer is voltage transformer which act as a stepdown transformer. It reduces the voltage at desired measuring level in given ratio of circuit. The PT is connected in parallel with the circuit which voltage is to be measured. It is similar to the power transformer.in common the potential transformer is abbrevated as PT.

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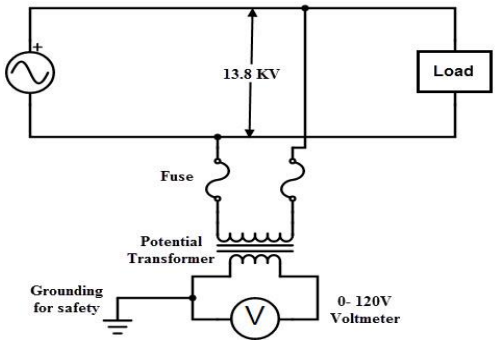

Figure 2.7: Potential Transformer

2.8 Inductor Coil: The inductor is basically a coil which in form of turns.it is also called as a coil, choke, or reactor. it is a passive two-terminal electrical component which stores the energy in form of magnetic field when electric current flows through it.it is typically consists of wire which is insulated and wound around a core. When the current is applied to it an inductor changes, the magnetic field induces an electromotive force (e.m.f.) or (voltage) in the conductor, it is called as a faradays law of induction. The induced voltage is a polarity or direction which oppose the change in current that created it. Due to this, inductors oposes changes in flow of current through it. An inductor is abbrivated by its inductance, it is the rate of change of flow in current. In the International SI unit of the inductance is Henry (H), invented in the 19th century American scientist Joseph Henry. In the measurement of magnetic circuits, it is equivalent to weber/ampere.

Fig2.8: Inductor coil

2.9 Capacitor: The construction of capacitor is placing two equal parallel plate having dielectric medium between them. it is an energy storing element which stores the energy in electric field. It is a passive electronic device having two terminals. The capacitor is characterized by capacitance. Some capacitance is exists between any two electrical conductors having distance between them is less in proximity in a circuit, a capacitor is a device designed for add capacitance in a circuit. The capacitor was originally known as a condenser. The formation of capacitor physically and practically are in the large variety and in many type of capacitor is used. Capacitors are contain two parallel electrical conductors having dielectric medium in them. A conductor may be a thin sheet, foil, sintered bead of metal, or an electrolyte. The medium which is nonconducting or dielectric acts to increase the capacitor's charge capacity. the medium which is generally used as dielectrics are include glass, ceramic, plastic film, paper, mica, air, and oxide layers. Capacitors is widely used in electrical circuits or in electrical networks. Unlike a resistor, an ideal capacitor does.

III. SYSTEM IMPLEMENTATION

Time of use tariff and maximum demand tariff rates can be set in a many ways, which is depend on the utility cost and the type of consumers. While small customers prefer a less complicated rate structure and large industrial customer uses an energy manager and prefer a more complex tariff structure in order to reduce electricity bill. In our project we can control industrial tariff through controlling on and off time of industrial load. We can control the on and off time of the business load during this project we use various load like resistive, inductive, and induction motor, and connect this load to the controller through relay module. The main objective is to develop a tariff controller that controls the consumers energy consumption in automatic way by use the Arduino microcontroller as small plc controller to control the various industrial operation. At installation time all the working time of machines or industrial load is programmed in the controller. In industry at starting time all the heavy loads are off only mandatory machines or critical operation machine are working and other load are off and according to its operation they will on and off by the controller. The schedule of all machines or loads are fitted in a program according to this scheduled all machines are operating. Consists of a stepdown transformer230/12V, 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.

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Figure (10): Prototype of the proposed system

IV. CONCLUSION

This study investigates the effectiveness of load management techniques & methods in electric power system. It aims to focus on the fact that electrical companies in worldwide can provide reliable and efficient electrical service to their consumers in most efficient and economical manner by getting various kind of load management techniques. Different electricity manufacturing companies around the world are adopt different load management techniques to improve the load profile of their power system.

The implementation of these techniques are adopted by the different utility sectors in co-operation with their customers. In today's modern world energy management is an important issue. The successful management of load yields various benefits. The management for load utilization is important in power system it is beneficial for the customer as well as the utility sector and also saves environment from unnecessary pollution

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