

Smart and Efficient Load Control System using Dynamic tariff

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Abstract - Now a day we know that Dynamic pricing is only one of the best tools to achieve demand side management in Electricity Industries for. The selection then the implementation of the appropriate dynamic pricing scheme is required for proper enhancement of the consumers electrical load profile as required by demand side management systems. This paper highlights how can we design and implement of IoT based energy efficient system using dynamic tariff schemes. This design can be innovate the pattern of energy consumption by the different categories of the consumers as per the rate of tariff vary according to the variation in load on the system. The consumers of electricity can be plan for their consumption according to essential use of electricity and non- essential use of electricity as per the dynamic tariff. Indirectly consumer of electricity can be scheduled their consumption to get benefits by optimum utilization of electricity as per tariff changes or vary. This proposed system can be contribute to increase the load factor of the power system during off peak period by encouraging the consumers of electricity with the help of providing variation of rate charged to the consumers, this will results in the production cost of electricity per unit will be reduced. It will beneficial to both side's consumers as well as suppliers. This system provides monitoring facility to consumers to acquire knowledge of their consumption which will be helpful to plan their utilization of home appliance or domestic load.

Key Words: IoT (Internet of Things), Microcontroller, LCD display, embedded programming, temperature sensor, HTML, PHP web server, Ethernet Library stack, and Xamp software for local web server.

1. INTRODUCTION

Electricity is the resource that drives the modern economy. Electricity market and Utilities are used to offer and

introduces a uniform Electricity price Structure to Consumers like household or industrial. These prices can't reflect neither the total cost of electricity generation nor distribution. To face the peak load criteria, it is required and essential to add an additional electricity sources. These sources will be used if and only if there are a peak periods otherwise, these sources will be idle. To reduce the added power capacity, power suppliers will run to use dynamic pricing schemes which have the ability to enhance the load profiles and reduce the power consumption and consequently will increase the efficiency of generation and distribution power plants [1]. Dynamic pricing has lots of benefits to the consumers' side, because it gives opportunity to the consumers to decrease the electrical bill by using preferable pricing scheme technique or by demand side management technique. Dynamic pricing is one of the main aspects of smart grid. The main objectives of smart grid are to increase power system efficiency, reduce peak-to-average load ratio, minimize the cost of production and incorporate Renewable Energy Sources (RES) [2]. For example; real time pricing is one of the smart grid objectives as the production cost of electricity depends on usage time; it is higher during peak hours and lower during off peak hours [3].

Electricity is used to illuminate and condition our homes, to power our businesses and factories, and to operate the appliances and devices that enhance our quality of life. Retail electricity markets generally offer flat pricing or block pricing. Prices remain unchanged irrespective of demand in the first case, while in the second, the per unit rate of electricity either increases or decreases with increasing slabs of electricity consumption [4].

Dynamic pricing experiments are intended to reveal how consumers respond to electricity prices and identify the most promising mechanisms suitable for wide-scale deployment. Traditional electricity rate structures do not reflect the cost difference of supplying electricity in peak versus off-peak hours. Therefore, the customer has no

market incentive to adjust their pattern of electricity consumption. Dynamic pricing options such as time of use (TOU), critical peak pricing (CPP), critical peak rebate (CPR), real time pricing (RTP), and variable peak pricing (VPP), that reflect time-varying cost of electricity supply, have been in use worldwide to encourage peak load management and demand reduction.

1.1 Dynamic Pricing

Dynamic pricing is also known as surge pricing, demand pricing or time based pricing in which the business like electricity industries decide or set the flexible prices for their products or their services.

The classification of Dynamic pricing schemes will be as below.

1. Real time Pricing: It is the purest form of dynamic pricing scheme with maximum uncertainty for the consumer. Here the prices changes with regular interval of one hour or less or more and the consumers are made aware of the prices beforehand as per the design of the scheme. Usually, RTP schemes were offered to utilities or largest companies but, because of the rapid decrease in the cost of advanced infrastructure metering systems,

2. Critical peak pricing: In this type of pricing schemes consumers are charged at higher fix rate during a few peak hours on a day and discounted rate during rest of the day. Prices are changing depending on the system costs or operating conditions with the electric utility or the local distribution company.

3. Time of use Pricing (TOU): These are called pre declared tariff varying different time of day during high during peak hours and low during peak hours. This type of scheme can be stay effective for short or long term so that's why it is also called time of day tariff.

1.2 Problem Definition:

Smart meters present these challenges and costs to the electric company...

- Transitioning to new technology and processes
- Managing public reaction and customer acceptance of the new meters
- Making a long-term financial commitment to the new metering technology and related software

- Managing and storing vast quantities of metering data
- Ensuring the security of metering data

Smart meters pose these challenges to consumers...

- Verifying that the new meter is accurate
- Protecting the privacy of their personal data
- Paying additional fees for the new meter

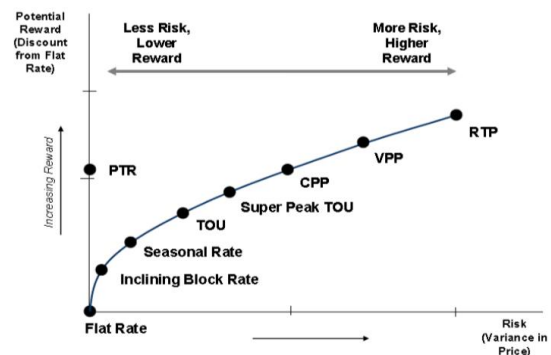


Chart -1: Graph of Risk and Potential of dynamic pricing

2. System Design

The system design consist of software for web browser, hardware with microcontroller, Router, Ethernet cable etc.

1. Software requirement for system

In this System we would be used Xampp software to create a virtual web server for testing and develop purpose of the system. And also for PCB designing purpose we used Altius software.

2. Hardware Requirement for system

We will be used Microcontroller ATMEGA 328P because it gives high performance at lower power in any system design. We also used router for create a Network connection and used as an IOT gateway of the system.

The controller ATMEGA 328P is 8-Bit Microcontroller from Atmel and advanced RISC architecture. Controller have 32KB of programmable FLASH, 1KB of EEPROM, 2KB SRAM 10,000 Write and Erase Cycles for Flash.

2.1 System Circuit

System circuit describes the block diagram of the system in which how the model was developed and how will it work. And also the components used for conditioning the signal and their output.

1. Block diagram

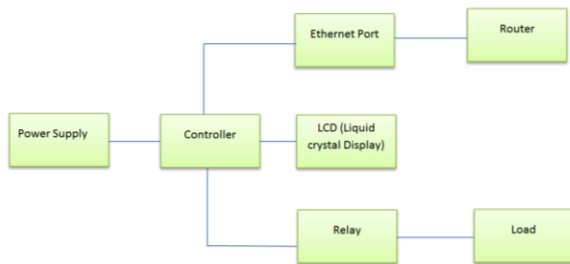


Fig -1: Block diagram of proposed system

The block diagram of the proposed model is as shown in fig. As per the title given the system will be smart in the case because the system will be work if the rate would be change and also the time duration will be change. In this model the developed system will be connect with the smart meter and control the house and industrial load automatically as per the change the rate and also as per the time duration will be change like in off peak hour some instrument are automatically off.

The consumption of energy will deduce in the electricity bill and we consume the price money. In this system we given input of rate or time duration from the virtual web server this data are then available in virtual IOT cloud network and then this system connected with meter fetch the data from the cloud network and control the load connect in the circuit like LCD,LED,Bulb Etc.

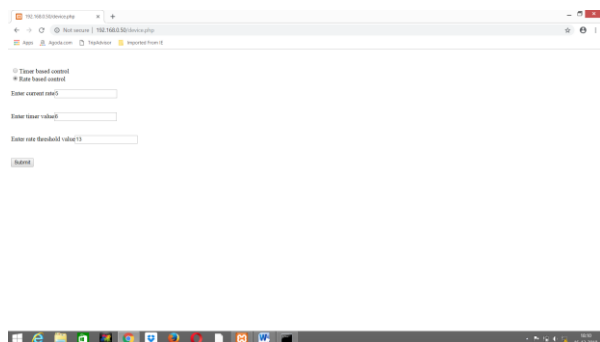


Fig -2: output of the virtual web server

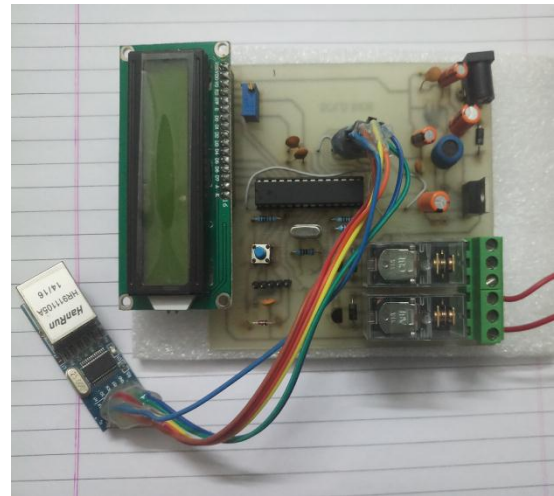


Fig -3: Hardware of Proposed System

2.2 Components Used

1. Regulated DC Supply:

A 5v regulated DC supply is providing to microcontroller and LCD. We will use LM7805 for power supply.

2. Liquid crystal display (LCD):

A 16X2 LCD is used for displaying the voltage and current along with load power. It displays the load will be on or not and the mode like rate based or the time based.



Fig -4: LCD Display

3. Other basic components like resistor, capacitor, relay, Ethernet cable, router etc. will also use.

4. ENC28J60 Ethernet Module:

ENC28J60 Ethernet Module utilizes the new Microchip ENC28J60 Stand-Alone Ethernet Controller IC featuring a host of features to handle most of the network protocol requirements. This Ethernet LAN module connects directly to most microcontrollers.



Fig -5: Ethernet Module

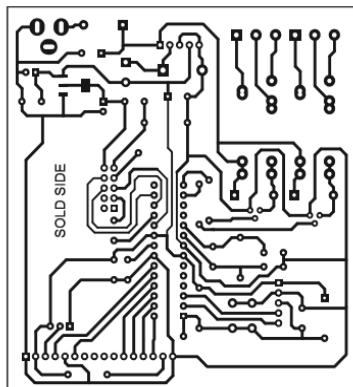


Fig -6: Layout of Proposed Model

2.3 System PROS. AND CONS.

System Pros or Advantages:

- Customer can purchase energy from any provider.
- It helps to control critical load from remotely.
- It helps to save energy using electrical appliances in an efficient way.
- It helps in developing smart grid.

System Cons or Disadvantages:

- Consumers have to be actual cost as they occur retiring existing electricity meter or similar.
- Potential for higher bill for low use and low income customer.
- New technologies bears risk of wrong choice.
- Smart meter proposal may be a down payment to unknown future smart grid investment.
- Benefits are estimated over 15-20 year period and degree of accuracy is never calculated.
- These new concept may give rise to a half of degraded service of advance payment system.

- New privacy concern will become evident with the access of individual house hold usage information.
- Loss of internet connection may degrade the efficiency of the system.

3. CONCLUSIONS

From this we conclude that the dynamic pricing scheme for demand response will be good flexible and simple way to save money by electricity consumption. The concept is very flexible with the home appliances as well as industrial small appliances. Energy can saved efficiently used by shifting heavy electricity uses at lowered price hour. This gives option of not only how much of electricity used but also when to use it and spread awareness. As the utility keeps on changing the price for electricity market price is daily updated. In summer price will be cheaper during early morning, night and weekend hours. Higher prices when there is increase in demand for electricity like hot summer afternoon.

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