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Digitalization of Net Metering

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Abstract: *Net metering is one of the newest concept that makes a revolution in the current world. This concept has been a tremendous success in many countries like United States, Germany. The idea behind the net metering enables a significant positive response from the people. The consumer, supplied from the utilities for their power needs generates a part of the power from any renewable sources such as sun, wind etc...That part of power produced by the consumer can be used for powering their households. The excess power generated by the consumer can be given to the utilities for which the former are rewarded with reduced electricity bills or it can be credited for subsequent billing cycle. When the power which is generated by the consumer is not sufficient to satisfy their power needs, then the utility power can be consumed. This paper proposes a digitized net metering system that uses a AVR microcontroller Atmega 328p which computes the net difference between the utility power and consumer generated power. The system uses ACS 712 current sensor and a Relay for sensing the current value and switching operations. A Wifi module is interfaced to the microcontroller so as to communicate with the user. The consumed energy is available for the consumer using Webview.*

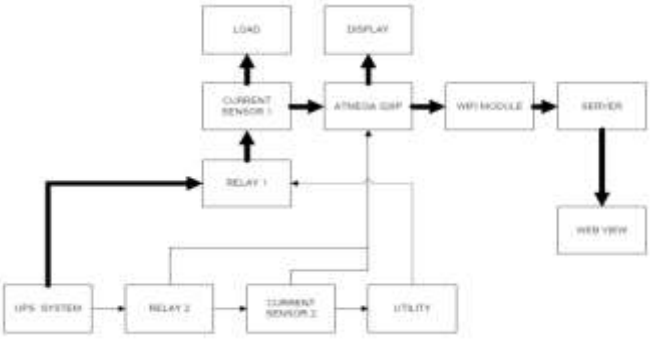
I. Introduction

Electrical energy became an important factor in the progress of every country. The difference between the demand and generation has to be balanced by making use of renewable sources. Renewable energy generation has to go in hand with the conventional power generation [1]. Comparing to the conventional power system there are many advantages such as lower pollution, zero fuel cost, less maintenance. So a balanced use of both the power is necessary.Net metering system has been developed to make sure that the consumerhave always a source of energy which is reliable even when their own generation system is not able to produce the power. The net metering program is running successfully in many developed countries like United States, Canada, Italy etc....Net Metering policy was first introduced in Thailand. This concept encourages the customers to utilize more of the renewable energy than the utility energy so that the power demand and utility generation can be reduced. In India the policy of net metering is in the childhood stage. So it is important to have a better idea of various net metering systems [2].

Renewable generation cannot be a substitute for the distribution utility generation and meanwhile it can be a supplementary generation process. The power which is generated by the consumer can be used for powering his own loads whereas the excess power generated can be feed to the distribution utilities for which the former is rewarded with reduced electricity bills or it can be credited for subsequent billing cycle. This can lead to the balancing of energy demand. When the power which is generated by the consumer is not sufficient to satisfy their power needs, then the distribution utility power can be used to feed the consumer loads. This process can lead to the balancing of energydemands and it plays an important role in the reduction of power generation by the distribution utilities which in turn can reduce the cost of unit of electricity since the generation is reduced. By the implementation of net metering using renewable generation the consumer also become a 'prosumer' [4].The use of netmetering system enables the elimination of battery for the storage of power since consumer generated power is made as the supplementary to distribution utility power and not as a substitute. Now, the world makes a transition from centralized generating facility to distributed generating facility, the concept of net metering plays an important role in keeping this transition smooth.

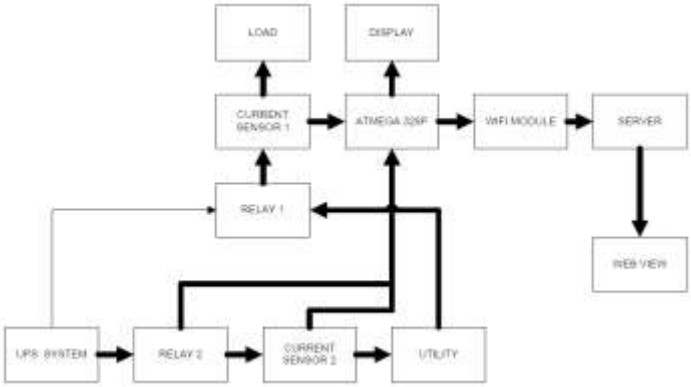
II. Block diagram description

CASE 1



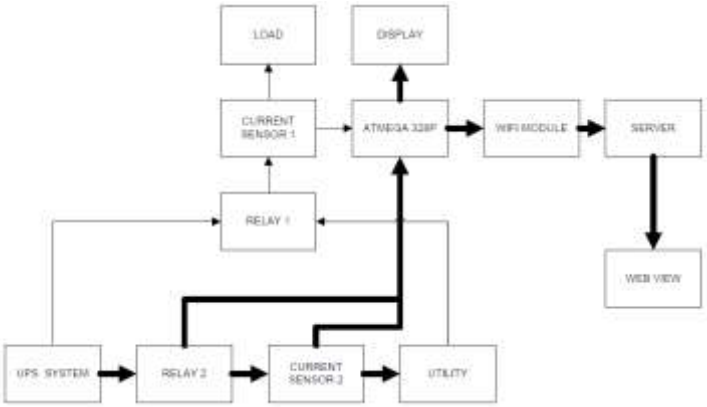
In this case the load is below 70W, at this instant the UPS power the load. Such that the connection from the utility is switched off by relay 1. Here LCD display shows the power drawn by the load. Here the generated power is completely utilized by the load. The current sensor senses the current and the power is calculated .The controller keeps on checking the output of current sensor.

CASE 2



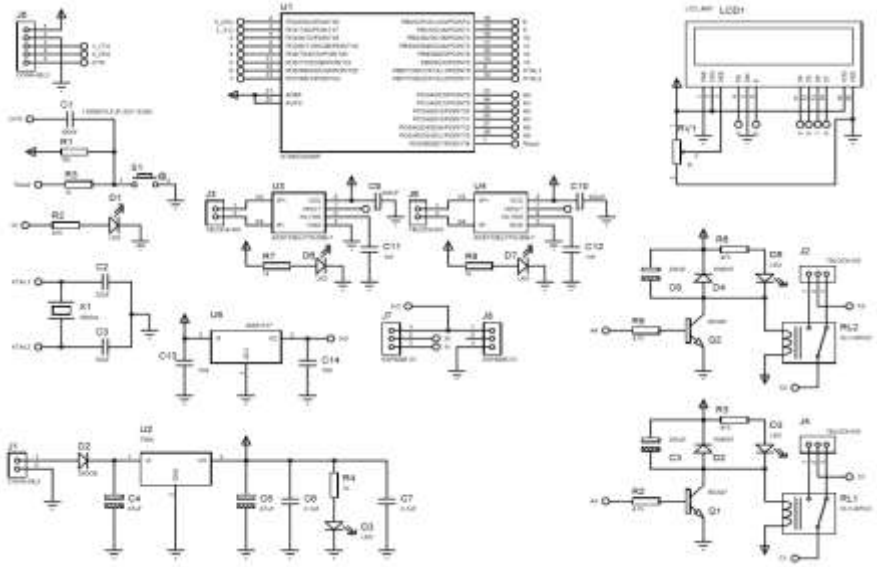
At this instant the load is greater than 70W. Here the relay 1 operates and the utility powers the load. The current sensor reads the current and the power is calculated. Here the display shows the power drawn from the utility. At the same time the relay2 operates to give power to the utility. Here the energy produced by the UPS system at the instant is transferred to the utility system. Thus a transfer of energy from the UPS to the utility occurs.

CASE 3



In this case the load is zero. Here the relay 2 operates and gives the power to the utility. To maximize the efficiency of the system, energy produced by the UPS system at the instant is transferred to the utility system. The current sensor senses the current and display shows the power given to the utility.

III. Proposed System and Methodology



1) ACS 712 Current Sensor

The current sensor that is used in this system consists of a full scale value of 5A.The device consists of 8 pins. The sensor works on the principle of Hall effect. The sensor measures the current carrying by a load which is used to measure the power consumed. The input pins 1 and 2, 3 and 4 connects to the load where the two pair of pins are internally. The output is connected to the pin 13 of microcontroller.

2) 7805 Voltage Regulator

This unit provides a constant 5V power supply to the microcontroller. The current sensor is also provided with 5V supply through the voltage regulator.

3) Atmega 328p Processing unit

The proposed system uses Atmega 328p arduino as the processing unit. This unit controls the entire working of the system through the use of both hardware and software. The input to the unit is given through the current sensor output. This data is being processed by it and calculates the net energy by using the appropriate software instructions. The output is displayed through the LCD display.

4) Wifi Module

It is a type of microcontroller which facilitates wireless transmission of information received from the output of control unit. It can be programmed just like any other MCU.

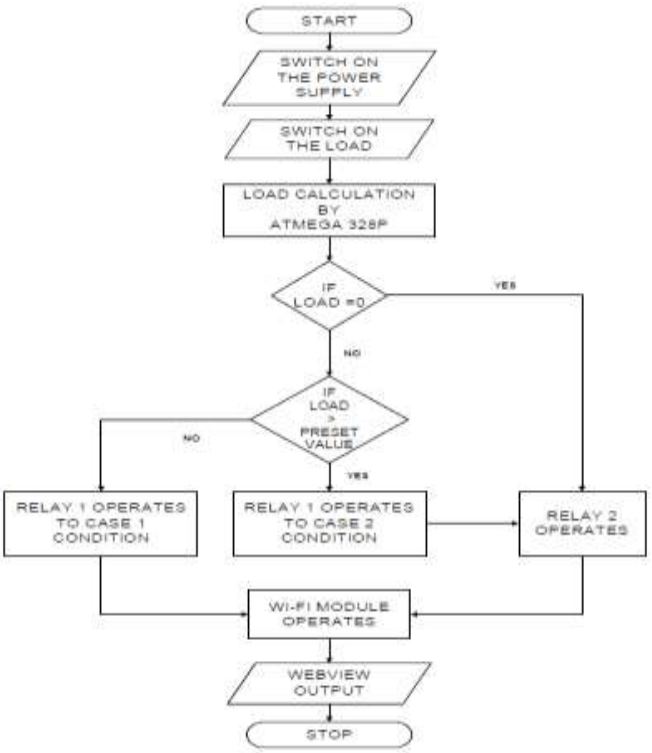
5) Webview

Webview is a view that is used to display the web pages.It is used to display the web contents by using the server addresses.

IV. Hardware Implementation

In the proposed system, three 60 W lighting loads are considered. When one of the 60 W lamp is switched on, the current sensor measures the current through the load. The instantaneous power is calculated by using the equation P=VI, where I is the current measured by the current sensor and V is kept constant as 220V. The microcontroller Atmega 328p does the further calculations, it keeps track of present power utilization and switching of relays at preset load value. The LCD keeps us notified about the present power utilization and the total units consumed in Watt hour. A wifi module is used for delivering the current status of metering system to the user/consumer from time to time, which makes him able to keep track of his power usage. Data is transferred to server via the wifi module. A web view is designed to access the user about the usage and net metering.

Due to technical difficulties in the system, a UPS is used instead of a PV module. The value of load determines whether the load is to be fed by the UPS or utility supply. There is a preset value of 70 W in this case .When the load is below 70 W, the UPS feeds the load. When the load reads above 70 W, the utility feeds the load. The power produced by the UPS at this instant is fed back to the utility which shown by 60 W incandescent lamp due to technical difficulties. When there is no load, the power produced by the UPS is fed to 60 W load in the utility side (this 60 W bulb symbolises the return feed- back of power).



V. Conclusion

In this paper, the proposed netmeter system enables the consumer to get a detailed view on their power usage. The proposed hardware facilitates accurate data about total usage, net usage and amount. It provides an efficient way of power management in the consumer side.

References

[1] K. Maharaja, P. Pradeep Balaji, S. Sangeetha, M. Elakkiya, "Development of Bidirectional Net Meter in Grid Connected Solar PV System for Domestic Consumers,"

[2] Jagruti Thakur, Basab Chakraborty School of Engineering Entrepreneurship, "Smart net metering models for smart grid in India",4th International Conference on Renewable Energy Research and Applications,Palermo,Italy

[3] Vinayaka R Deskar, Vinod Kumar M P, Pradeep Kumar, Swami Gururaj M, "Design of Net Meter Using FPGA," IEEE International Conference On Recent Trends In Electronics Information Communication Technology, May 20-21, 2016, India

[4] Tania Tony, Sivraj P. and Sasi K.K.,"Net Energy Meter with Appliance Control and Bidirectional Communication Capability", 2016 Intl. Conference on Advances in Computing, Communications and Informatics (ICACCI), Sept. 21-24, 2016, Jaipur, India

[5] Zhang Li,Bai Lianping,"Research about bi-directional electronic energy meter and power quality analyzers", 2013 Third International Conference on Instrumentation, Measurement, Computer, Communication and Control