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METHODOLOGY TO REDUCE VAMPIRE POWER USING PIC MICROCONTROLLER

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ABSTRACT

In the rapidly developing world, energy saving has become one of the major aspect in day-to-day's life. For an efficient energy saving, all parts of the world are working in all possible ways to avoid the energy crisis in order to conserve it for the future generation. Among the various sources of energy crisis, vampire power plays a major role. Most of us are not aware that the electrical device consumes power even when they are in standby or sleep mode. Those are the power which must be paid as tariff to the government. In olden days, vampire power was not taken into account since they did not contribute much to the wastage of energy. But now-a-days, due to the invention and introduction of many advanced electrical and electronic equipment, there is a large amount of wastage of energy due to vampire power which must be taken into account. It contributes to about 20W of the total energy supplied at our residents. This rating depends on the type and model of the appliance used. So, our project proposes a system that controls the vampire power using a microcontroller depending on the relation within the different home appliances and the user's behaviour with the devices, thereby saving the energy benefitting a safer future and reducing the tariffs of electricity bills.

Keywords: vampire power, tariff, energy crisis, standby or sleep mode.

INTRODUCTION

An energy saving system refers to a system that saves the energy consumed in a resident or an industry, by cutting off the wasted electric power such as vampire power. Vampire power is defined as the energy consumed by the electrical and electronic appliance when it is in sleep mode or standby mode, when they are not doing their primary function. They are termed as 'vampire power' because a vampire is assumed to suck the blood enormously. Similarly the vampire power draws a large amount of current during night times predominantly. As of now, the smart electricity meters are launched on the market for vampire power. However these meters can only monitor the functioning of devices and measure the vampire power but not controlling it, whereas an energy saving system can monitor the power and control the function. This power is mostly used to maintain an internal clock and to receive the remote signals. Although the power needed for functions such as displays, indicators, remote control functions is relatively small, the large number of such devices and their being continuously plugged in resulted in energy usage which is estimated to be 32 to 87W and around 10% of the total residential consumption.

The reasons for which the vampire power must be controlled are vampire power is the power which must be paid for. The total energy consumed maybe of the order of 10% of the electrical energy used by a typical household. As electricity consumption increases, more power stations are needed with associated capital and running costs which will ultimately result in exhaustion of hydrocarbons on generation of electricity. Risk of fire from devices in standby mode especially televisions, when plugged in but switched off. The power in the standby mode is dissipated in the form of heat. Most devices suffer from vampire power. They are as follows instrument transformers, devices that can be made on instantly with the help of a remote control, timer devices, UPS, motion sensors, security systems and fire alarms. Each appliance consumes different rating of vampire power. The basic ways of controlling the vampire power are by using a power strip or by using energy star products, or by unplugging the devices. However, the power strips cannot regulate the current and it is affected by surges or spikes which causes firing of electric appliances. Also, unplugging the products quite often may cause electrocution. But our proposed system does not have these advantages. Meanwhile, more devices are available in the market like smart energy meter that measures the vampire power but do not control them. The main functions of our proposed system are as follows.

Dynamic control: One of the major problems in the existing system is that the devices do not know when they have to recover from the standby mode and when to cut off the standby power. It is important to decide the time for recovering to standby mode. So this project focuses on a method to cut off the standby power and to recover to standby mode. The above cooperation between the home appliances is represented. Among them, the refrigerators and phones are isolated systems which do not have any connection with the other appliances. Whereas, television is the main system in controlled appliances and set top box, home theatre, video games, speakers are considered to be the sub system. When all the devices in the superior layer are off, the appliances in the sub layers are also made off. Similarly, a personal computer can be known for its relation between some other appliances like monitor, printer, scanner, speaker, etc. If the superior device in the main system, PC is turned off, the sub systems connected to it are also turned off automatically. Such a co-operation between the various appliances is taken into main considerations for the control of vampire power. The representation of such related appliance is given as in the figure below.

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User friendly device: Most existing systems do not use the sensors but our system makes use of a passive infrared sensor which is used to detect the presence of a motion inside the residents. It makes use of the infrared radiation which keeps sensing the movement and when no presence is detected, the entire set up cuts off the vampire power. In such cases, it is a user friendly device.

EXISTING METHODOLOGIES

Several studies were conducted on vampire power reduction on different aspects at different locations. Some of the related papers are as follows:

Te Huang *et al* [1] has proposed a system that improves the power efficiency by modifying the s3 state into a deep s3 state in order to save power consumption by means of the suspend to RAM mode. Seungwoo Lee *et al* [2] has proposed a system that actively manages the vampire power utilization by predicting the probabilities of the future appliance usage. Joon Heo *et al* [3] have presented the system that has a Zigbee protocol for communication between the host and agent for control mechanism. Mrazovac *et al* [4] proposed a user controllable smart outlet which executes the operation based on energy tariffs. Whereas, Abe et al [5] presented a smart tap type home energy management system that comprises of a smart tap to measure the consumption of power of each electrical appliance and sends the values to the server that controls the appliance. Kau *et al* [6] proposed an energy management system that is performed using cloud networks. But these systems require user intervention for reducing the energy consumption. On the other hand, Cho *et al* [8] designed a system for locating the appliances from multi-hop tree structures of power strips type smart meters. But these systems require more additional costs and user inconvenience is caused. Zufferey *et al* [7] proposed a machine dependent learning approach that measures the amount of power consumed by an electrical appliance at a very low frequency. Morsali *et al* [9] used a magnetic sensor and finds the appliance by sensing the label that is mounted on the plug that has a specified code depending on the modelling of the appliance. Todorovic *et al* [10] designed a system that used vampire power consumption as one of the factors that focuses on achieving a zero energy home. Rather our proposed system focuses on the vampire power control as a main aspect.

PROPOSED SYSTEM

Operation

The block diagram representing the main system and subsystem are depicted as follows. It consists of a power supply unit, microcontroller, transceiver, transformer, solid state relay, LCD display, load and an RPS.

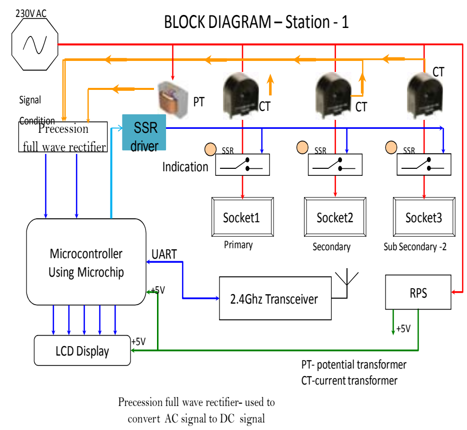

Figure-1.

The set-up is similar to the sub system where another microcontroller is used and it acts as a slave processor.

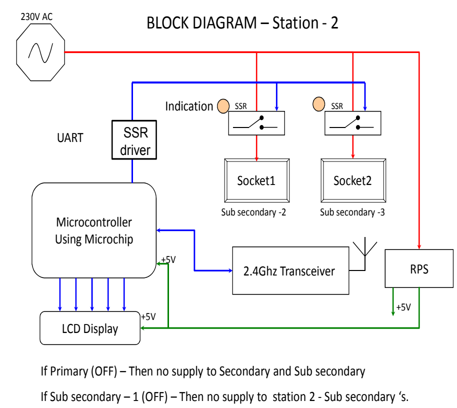

Figure-2.

The two microcontrollers communicate with the help of an radio frequency module through ZigBee protocol. The supply to the microcontroller and the LCD display are limited to +5V and so the source voltage from the power supply is regulated to 5V using an IN7805 regulator. The supply is given to the loads from the sockets through the solid state relay. It consists of a TRIAC device and a transistor that operates as a switch. The instrument transformer measures the current and voltage and when a change in the values of current is sensed by the microcontroller, they send a signal to the solid state relays to turn the load off and cutting off the vampire power. Meanwhile, the data is being sent to the controller in the sub system that acts as a slave processor. Depending on the priority that is being set in the microcontroller, the related appliances in the sub system are also turned off. The ratings of parameters of each socket is stored and displayed in the LCD display. The regulated power supply that supplies 5V to the controller and display unit is shown below.

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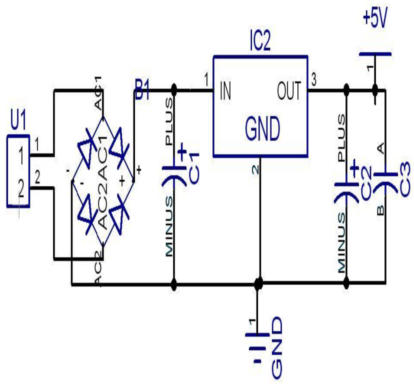

Figure-3.

It consists of a 230V supply that is stepped down by a stepdown transformer. It has a rectifier that conerts ac to dc. On its conversion some amount of ripples are present that are removed by filters. Then, these obtained voltages are regulated to the desired voltage and then filtered again to remove the ripples. This output is fed to the microcontroller and display units. The flowchart explaining the vampire power reduction is as follows. When an electric appliance is initialised and operating, it checks whether the output power of an electrical appliance is lesser than the normal power of the appliance. If yes, then it checks for the condition whether the device is subjected to any user interfere, else it goes to the first stage again.

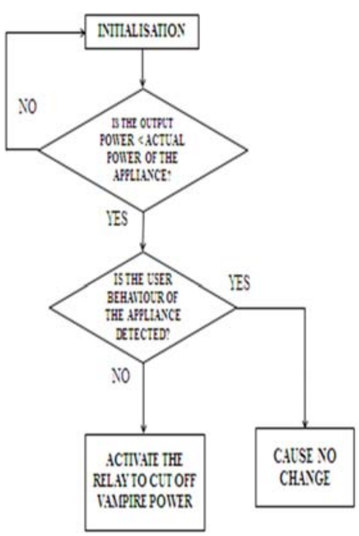

Figure-4.

If any user behaviour is detected, then it does not cause any damage to the system. If no user behaviour is detected for a particular period of time, the signal is sent to the solid state relays to turn off and the vampire power is being cut off and energy is saved. Moreover, a passive infrared sensor is used for motion detection. It is incident with the infrared rays that converges to a point and amplified. This is used when there is no detection of movement is sensed, it puts the microcontroller itself to be in a standby mode thereby saving more energy. The microcontroller used here is 16F887 consisting of 5 ports and 40 pins. Each port is defined for a predefined function like serial I/O, analog I/O and UART.

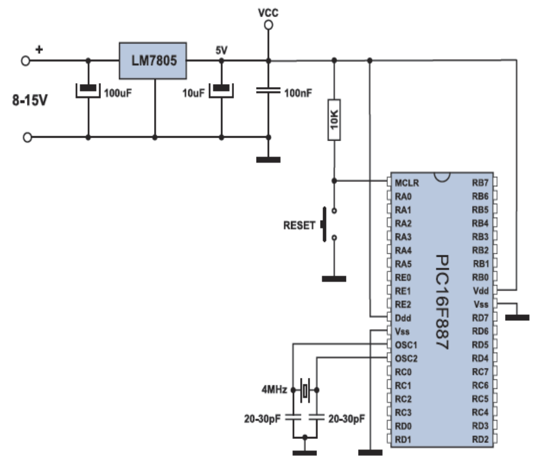

Figure-5.

IMPLEMENTATION

The software used in our proposed system is Proteus. It is an electronic software used for simulating and is extensively used in devices with microcontrollers. And the software used for compilation is custom computer service (CCS). A compiler is a computer program (or set of programs) that transforms source code written in a programming language (the source language) into another computer language (the target language, often having a binary form known as object code). The most common reason for wanting to transform source code is to create an executable program.

This integrated C development environment gives developers the capability to quickly produce very efficient code from an easily maintainable high level language. The compiler includes built-in functions to access the PIC microcontroller hardware such as READ_ADC to read a value from the A/D converter. Discrete I/O is handled by describing the port characteristics in a PROGRAM. Functions such as INPUT and OUTPUT_HIGH will properly maintain the tri-state registers. Variables including structures may be directly mapped to memory such as I/O ports to best represent the hardware structure in C. The hardware consists of two microcontroller units among which one acts as a master processor and the other as a slave processor. They communicate with each other by using a RFM transceiver. The corresponding parameters for each socket are displayed in the LCD display. As mentioned above, the process is carried out and the vampire power is cut off and thereby energy is saved.

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RESULTS AND DISCUSSIONS

The following are the experimental results of the proposed system. The Figure-6 portrays the loads in the main system. It has a solid state relay which turns the load on or off depending on the vampire power consumption. It consists of two lamp loads per circuit among which one is to measure the normal power flow and the other to react during the presence of vampire power. Figure-7 represents the sub system which has two loads and is similar to the main system.

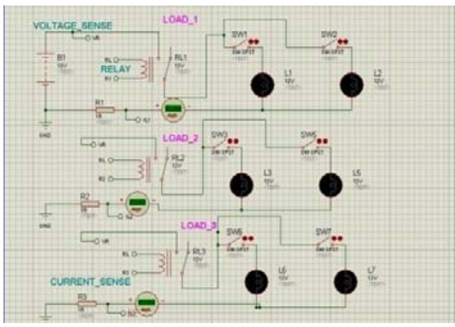

Figure-6. Main system.

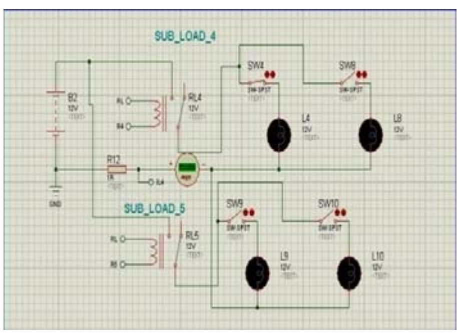

Figure-7. Sub system.

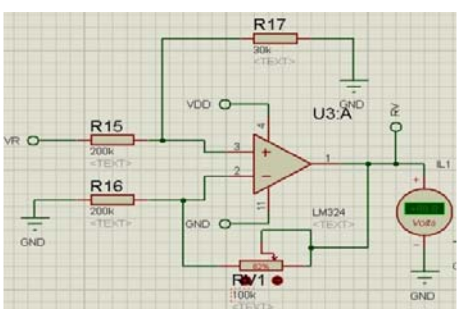

Figure-8. Signal conditioning.

For signal conditioning, we use operational amplifiers for each load and are represented as Figure-8. The microcontroller and its display are depicted in Figure-9.

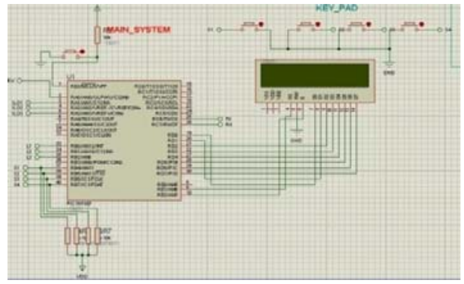

Figure-9. Microcontroller and LCD display.

The various measures of the sockets are displayed in the LCD as follows in Figures 10, 11, 12, 13.

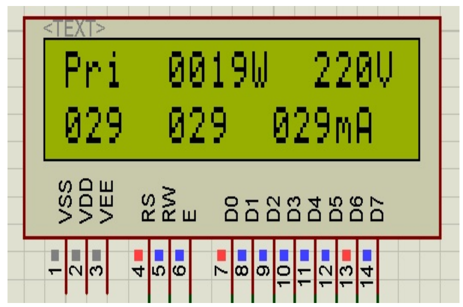

Figure-10. LCD display showing primary details.

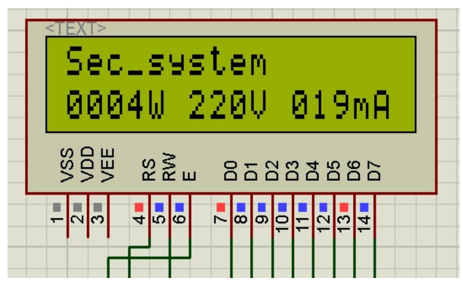

Figure-11. LCD display showing secondary details.

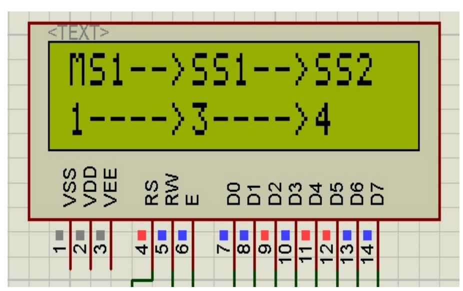

Figure-12. First priority.

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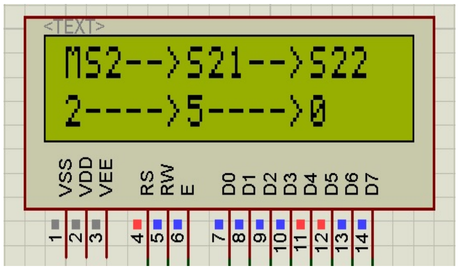

Figure-13. Second priority.

The above results are obtained through simulation in Proteus software.

CONCLUSIONS

In our proposed system, we have introduced the control of vampire power by connectivity between the home appliances at residents. This would reduce the response time and increases efficiency of the systems. The installation costs are much lesser and the operation is stable. Thus, our system effectively saves the energy for our future generation and reducing the energy auditing and tariffs paid for the consumption of power in the residents.

REFERENCES

[1] Te Huang, Ying-Wen Bai, Po-Yang Hsu. 2013. Reducing the standby power consumption of the s3 state for PCS. IEEE Canadian conference. 10: 1-6.

[2] Seungwoo Lee, GilyoungRyu, Yohan Chon, RhanHa, Hojung Cha. 2013. Automatic standby power management usingusage profiling aand prediction. IEEE Trans. On. 43(6): 535-546.

[3] Joon Heo, Choong Seon Hong, Seok Bong Kang, Sang SooJeon. 2008. Design and implementation of control mechanism for standby power reduction. in IEEE Trans. on consumer electronics. 54(1): 179-185.

[4] B. Mrazovac, M. Z. Bjelica, N. Teslic, and I. Papp. 2011. Towards ubiquitous smart outlets for safety and energetic efficiency of home electric appliances. in Proceedings of the IEEE International Conference on Consumer Electronics - Berlin. pp. 322-326.

[5] K. Abe, H. Mineno, and T. Mizuno. 2011. Development and evaluation of smart tap type Home Energy management System using sensor networks. in Proceedings of the Annal IEEE Consumer Communications and Networking Conference. pp. 1050-1054.

[6] L.-J. Kau, B.-L. Dai, C.-S. Chen and S.-H. Chen. 2012. A cloud network-based power management technology for smart home systems. In: Proceedings of the IEEE International Conference on Systems, Man, and Cybernetics. pp. 2527-2532.

[7] D. Zufferey, C. Gisler, O. A. Khaled, and J. Hennebert. 2012. Machine learning approaches for electric ppliance classification. In: Proceedings of the International Conference on Information Science, Signal Processing and their Applications. pp. 740-745.

[8] H. S. Cho, T. Yamazaki and M. Hahn. 2009. Determining location of appliances from multi-hop tree structures of power strip type smart meters. IEEE Trans. on Consumer Electron. 55(4): 2314-2322.

[9] H. Morsali, S. M. Shekarabi, K. Ardekani, H. Khayami, A. Fereidunian, M. Ghassemian and H. Lesani. 2012. Smart plugs for building energy management systems. In: Proceedings of Iranian Conference on the Smart Grids. pp. 1-5.

[10] B. Todorovic. 2011. Towardszero energy buildings: New and retrofitted existing buildings. in Proceedings of the IEEE 3rd International Symposium on Exploitation of Renewable Energy Sources. pp. 7-14.