MODERN ENERGY SAVING STABILIZER USING MICROCONTROLLER

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ABSTRACT: The energy consumption is increased day by day. So many conventional techniques are used to reduce energy consumption. This project also used for energy saving in home appliances. The main objective of this stabilizer is to reduce the energy consumption of home appliances in standby mode and it also has the features of ordinary stabilizer. The main merit of this stabilizer is, it's not automatically turned ON after power cut. This stabilizer provides power to the appliances when on working condition only when the appliances are not working or in standby mode, it cut off the main power by SSR switch. This modern stabilizer has more than 3 sockets, so we can control standby power of 4 appliances. The MCU(microcontroller unit) is used to send the signal to SSR switch. The PIR is used to sense whether the user approaches the appliances or not. By using this project we can save energy up to 3w per appliances according to power ratings.

Keywords: Stabilizer, Standby power consumption, SSR relay, PIR sensor.

I. INTRODUCTION

In our homes more number of both electric and electronic home appliances is used like TV, Air conditioner, Refrigerator, Microwave ovens, washing machines etc…These appliances cannot be properly switched off without being unplugged. It consumes power up to 2 to 3 watts. This power is a wasted power in home appliances; it's called standby power[1].This standby power is very small compare to whole power consumption, but sum of the all standby power of all appliances in all houses is very large. The standby power consumed devices are TV, DVD player, microwave oven, air conditioner, audio systems, in homes, and printer, scanner, hi fi sets, computers, cordless phone in offices. This standby power is not used for the main function of the devices; it's used for some auxiliary functions like remote control, continuous display, and the internal timer functions. In [2] Alan Meier presented the importance of conservation of standby power for saving the energy consumed. The efficiency of AC-DC converters in home appliances is very poor, when low power consumption, it consumes 1w to 4w [3] [4].

We need knowledge about the modern electrical and electronic appliances, even those having on/off switches, consume power for standby functions. The standby power consumption devices are increased day by day. Even when they are not performing any operation or are switched off, a small amount of energy is lost in low

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voltage power supplies, mainly due to the cheap transformer switch high core losses. Household appliances and office equipment such as televisions (TVs),video recorders, audio players, telephone answering and facsimile machines, computers, printers and copiers contribute to this standby loss which is relatively low, with typical loss per appliance ranging from less than 1W to as much as 25W. The economic social benefits for the promotion of sustainable energy were discussed in [5]. In NewZeland, televisions consume 40% of the appliances could be operated through remote separately electricity as standby energy. The standby power varies from 14-169w in California household appliances. The average consumption of standby power in California homes like 67w [6].This corresponded to 5%–26% of the homes' annual electricity use. In 1996, the survey conducted in Thailand office electronic appliances .It shows the standby power losses are 90% for printers, and fax machines, and 53% for PC's. [7].

So many electronics voltage stabilizers are available in market. But our modern energy saving stabilizer have some extra features with ordinary stabilizer like standby power reduction, more than 3 sockets. In our proposed method we add some extra features with previous researches. We can improve efficiency is accurate control of the apparatus by both software and microcontroller.

The organization of this paper is as follows. In section II we discuss about the standby power consumption of home appliances. In section III we describe the existing methods. In section IV we describe our proposed method. In Section V we present the block diagram and a flowchart of our modern stabilizer. In Section VI we present the measurement of the power consumption of our design to verify the total power saved. In section VII we present the main circuit diagram of our stabilizer. In Section VIII we show the Mathematical equation for interpreting the zero standby power stabilizers. In Section IX we draw the conclusions.

II. MEASUREMENT OF STANDBY POWER CONSUMPTION

We consider a 5 number of home appliances for this standby power measurement. These appliances are manufactured according to the Indian standards. The appliances and standby power of these products are shown in below Table1.

Appliance name	Product company	Working power(w)	Standby power(w)
TV	Panasonic	80	3
Microwave oven	LG	1400	4
DVD player	Panasonic	35	1.5
Washing machine	LG	500	5
Air conditioner	Samsung	1000	4

Table1: Standby power of different appliances.

Let's say the CRT draws 3W when it's not in use (it is turned off, remains plugged) - i.e. the times when you are away from home or you sleep. Your microwave oven will consume 4W, DVD player consumes 1.5W,Air conditioner consumes 4W, and the washing machine consumes 5W standby power. This will roughly be during half or 2/3oftheday, the standby power will be

(3W+4W+4W+5W+1.5w) * 12 h/day * 365 days = 76650Watt-hours per year...

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Now if you have 2 or 3 appliances, the result multiplies by the corresponding factor.

III. EXISTING METHOD

In existing methods the standby power reduced by different methods like 2 stage ac-dc converter method, multiple output converters, and non-dissipative single sensor methods. These methods are used to reduce standby power less than 1W. And so many remotely controlling home energy management systems are available. These methods have some demerits like less accuracy, single output socket, used only in low power.

IV. OUR PROPOSED METHOD

In our proposed method, the standby power reduction circuit combined with electronic voltage stabilizer. The output comes from the stabilizer is coupled to the standby power reduction circuit. The stabilizer behaves normal stabilizer, i.e. regulates the voltage according to the appliances. And it also has features of reducing standby power less than 1W of more than 3 appliances. In our method, appliances are not automatically turned ON after main power is cut off on the time of appliances working, when the user approaches the appliances after power cut stabilizer provides power to the appliances. The table 2 shows the ratings of our stabilizer model.

Description	Ratings
Single phase input voltage	160-250v
Single phase output voltage	0.5KAV-3KAV 220V, and 5KVA-3KVA 220V
Frequency	50 -60 Hz
Accuracy of voltage stabilization	220±3% 110±6%
Ambient temperature	-5ºc -+40ºc
Waveform distortion	No additional distortion
Load power factor	0.8
Standby power reduction	Less than 1W

Table2: Rating of our modern stabilizer

Our design consists of MCU, PIR Sensor; SSR Relay. These components are consumes some low power from the main power source. But this power is very low compared to the standby power consumption of home appliances. The power consumed by the components is shown in table3.

Module	Power consumption
PIR sensor	5 V·0.7 mA= 0.0035W
AC/DC Converter	0.16 W
MCU	5 V·0.3 mA= 0.0015W

Table 3: power consumed by used components

V. DIAGRAM REPRESENTATION

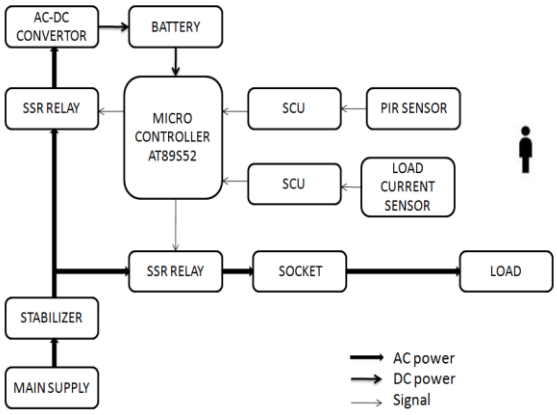

Figure 1:Block diagram of our stabilizer

STABILIZER CIRCUIT:

The stabilizer circuit is connected in front of the socket circuit. This is used to regulate

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the power to the home appliances. The input a voltage of stabilizer varies from 165-260v.The output voltage can be regulated according to the input voltage level, either increased or decreased. Then the output of the stabilizer is coupled with socket unit.

PIR MODULE CIRCUIT

The PIR sensor is used as an electronic device to measure the infrared light radiating from human bodies nearby to detect whether the user is approaching or not, in order to decide whether the main power SSR should supply power to the appliance. The PIR sensor detects motion and generates a small voltage signal which is amplified by the PIR motion detector IC. The output signal is active high and is sent to the MCU external interrupt input pin (INT) to judge whether a user is approaching.

LOAD CURRENT SENSOR CIRCUIT

For the electric home appliances to stay on after the user leaves, the function must continue with power coming from the socket until the work is finished. We use a toroid coil inductor as a load current sensor that detects whether the appliance is working. When an AC current passes through an inductor, a small sinusoidal voltage v is induced. It is converted into digital signal by ADC module then it feds to the microcontroller.

VI. DESIGN OF CIRCUIT DIAGRAM

The heart of our modern energy saving stabilizer is Microcontroller. It's used to give the control signal to the SSR relay driver circuit according to the output signal coming from the PIR sensor. The signal from PIR infrared sensor is send to the microcontroller 89S52 as an interrupt signal. Our design requires the use of DC 3.1-4.2 V from the AC/DC converter as the socket operation voltage, like for PIR, Microcontroller operations. Although the zero standby power socket still requires electricity to work, this socket requires only a small amount of power and the AC/DC converter's power is cut off when the socket is discharging.

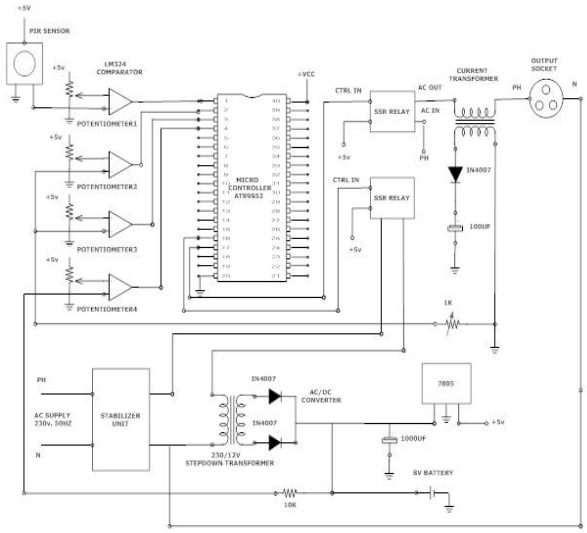

Figure 2: circuit diagram of our installed feature with stabilizer

After that the MCU uses the timer to count the charge time and turns off the SSR. Then the zero standby power sockets consume power from the battery and the VCC voltage decreases. When the VCC has decreased to 3.1 V, the MCU not only detects this by means of the comparator module but also causes the SSR to turn on so that the AC/DC converter charges the battery. And, therefore, as a result, the VCC rises.

The load current detector circuit output signal is an analog and is converted to a digital signal by means of the MCU ADC module. When the PIR sensor sensing the object the stabilizer provides power to the appliances otherwise the power from stabilizer to appliances will be turned off by using of SSR relay. So the appliances are in

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standby mode when the user approaching only.

VII. HARDWARE IMPLEMENTATION

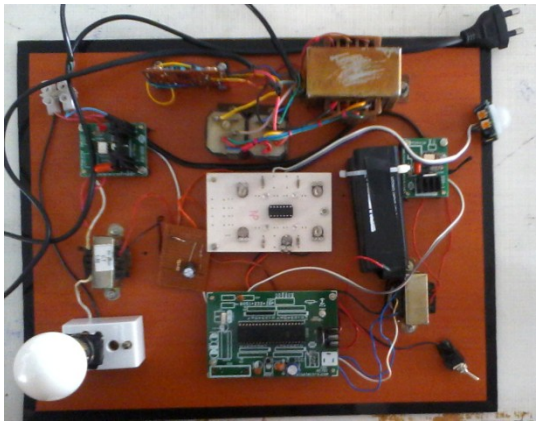

Figure 3: Hardware design

The above hardware design is implemented by using the already mentioned circuit diagram. In here the main heart of our design are microcontroller AT89s52 and load current sensor. Our hardware contains stabilizer circuit, step down transformer, microcontroller, two SSR relays, PIR sensor, comparator, current transformer. The SPST switch showed in our hardware is used to reset the circuit. The battery unit also used in our design, which is used to deliver the power to our stabilizer components. The SSR relay 1 is used to control the load power, then the SSR relay 2 is used to control the battery charging, like after the battery fully charging it will disconnect the input supply to our internal components. The low watts bulb is connected to the output socket to indicate the appliances running in standby mode. The bulb will be glows when the user present in front of the appliances, otherwise the bulb will not be glow. For commercial applications, the electronic appliances are connected to the sockets.

VII. STANDBY POWER IN OUR DESIGN

The standby power reduced by our stabilizer is shown in table.

Appliance name	Product company	Working power(w)	Standby power(w)
TV	Panasonic	80	0.4
Microwave oven	LG	1400	0.4
DVD player	Panasonic	35	0.4
Washing machine	LG	500	0.4
Air conditioner	Samsung	1000	0.4

Table 4: Standby power reductions by our design

The standby power is reduced less than 1W by our design. So by using our modern stabilizer we can save more electrical energy, and save electricity tariff. Also we can use the stabilizer for the following office appliances to reduce the standby power.

Appliances	Standby power(w)
Sub-woofer	2
Game console	1
Audio mini system	3
LCD display	1
Notebook	3
Set of box satellite	5
Scanner	5
Printer	5

Table 5:standby power consumed appliances

VIII. CALCULATION OF STANDBY POWER CONSUMTION

The following formulas are used to find out the working power and standby power

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consumption of appliances throughout the day. In here we take TV for a calculation.

Description	Value
Time Duration	1 Day
Smallest wattage measured during On time	3W
Highest wattage measured during On time	80W
Instantaneous Current	0.383A
Instantaneous Voltage	225V

Table 6: electric parameters measurement in TV

Let us assume the television "On" for "a" hours and "Off" for "b" hours. Consider a+b=24 hours we take ON period=12 hours, and OFF period=12hours.The consumption would be

(3 Watts×12 hours)+ (80 Watts×12 hours) =996WH

960WH as a working power,
36WH as the standby power.

IX.CONCLUSION

The standby power of all electronic home appliances is not a large amount, but the electricity bill of user's will be increased due to the long running standby power. The standby power of single home is not affect the world energy consumption, but when we take all houses in a world, it's a larger amount of energy are wasted for standby mode power. Our design is used to reduce this standby mode power less than 0.4W. We can save more amount of electrical energy, and the electricity bill of user will be reduced by our design.

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