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Standby Power Reduction System

Reshma AR
P.G.Scholar, Indira Gandhi Institute of Engineering & Technology for Women, Kerala, India
Indira Gandhi Institute of Engineering & Technology for Women, Kerala, India

Abstract*— Standby power is the power consumed by a product when it is switched off or is not performing its primary purpose. All electronic devices continuously consume electric power while waiting for a remote signal; in fact, surveys show that total standby energy is about 10 % of the electricity used in a home. This paper presents a new remote control system that consumes absolute zero power in standby mode. In this new technology, the device is disconnected from the AC power line by a latch-type power relay in standby mode. The laser diode mount on the remote emits the laser beam to turn on the home appliance; the light dependable resistor mounted on the home appliance receives and accumulates the light energy in a storage capacitor. Latch relay connects the power line to the appliances. And the when the user wants to off the devices by pressing the off button on the remote ,the latch relay reset and cutoff the appliances from the AC power line. The temperature sensor senses the consuming of electricity by the appliance. When it reaches a threshold value the appliances will turn off by resetting the latch relay.

***Index Terms*—Standby power, latch relay, LDR, laser diode.**

I. INTRODUCTION

Standby is condition of the device when it is switched off or the device is not performing its purpose [2]. Power can be saved by disconnecting the appliances from the power line, but is very cumbersome due to human laziness. An uninterruptible power supply could be considered to be wasting standby power only when the computer is off. To avoid standby power leakage the easiest way is manually switch off the appliances, but it is worst inconvenient. The growing awareness of and concerns about environmental issues have been caused by increases in the use of fossil fuels such as coal, oil, and natural gas [3]-[4]. Based on this awareness, policies that categorize highly energy-efficient appliances into environmentally friendly groups and encourage consumers to buy them are enforced in many countries. One of the largest energy -saving efforts involves reducing standby power in consumer electronics. . All home appliances continuously consume electric power while waiting for a remote signal; in fact, surveys show that total standby energy is about 10 % of the electricity used in a home .One of the most usually ways in which electricity is wasted, is the equipment which is never completely switched off. Many types of electronic equipment can be placed in a "standby" mode whereby they are not in active mode or not in previous purpose, but they are still consuming some power. Recently published papers have shown that various attempts have been made to improve power supply conversion efficiency through varying the duty ratio of transformer according to appliances' instantaneous power consumption[7] – [9]. Absolute zero standby power studies are just starting and published. Absolute zero standby power technology using RFID technology was introduced in earliest year, the main drawback of that technology are, a large antenna was required on the remote controller and a battery was required. Tsai et al proposed a power socket with photovoltaic (PV) cells for ambient light energy harvesting and a PIR sensor to detect the user's approach of the socket [6].However, in a dark room, the socket has to consume standby power from the AC power line and may unintentionally connect appliances to the AC power line every time the user approaches it. Radio Frequency Identification (RFID) system has shown remarkable progress [5], On the other hand, reducing the RFID power consumption is very important to obtain an efficient energy. Reducing power consumption is a major challenge in wireless sensor networks (WSNs) when network nodes or "tags" must be battery-powered. ZigBee, a wireless protocol built upon the IEEE 802.15.4 standard, is easier to use and is cheaper than other similar WPAN standards. To this end, RFID tags based on IEEE802.15.4 is designed as concept in order to maximize RFID tag lifetime. This paper describes possible ZigBee implementation in active RFID deployments, its involvement in the system and the advantages of ZigBee integration in the active RFID tag. The successful example proved the network flexibility of ZigBee. RFID is an automatic identification method that uses radio frequencies between RFID readers and tags. The RFID system consists of the RFID tags (a microchip with a coiled antenna), the RFID readers, and the computer network. The necessity of modified RFID tags devices to be made available is due to the high demand for these devices. The development has been slow because of anticipated implementation difficulties in areas such as signal quality and energy efficiency when monitoring and tracking items in real time . Energy efficiency is a central challenge in implementing RFID tags. Energy-efficient protocols are used for wireless sensor networks, which are composed of a significant number of sensor nodes that can be deployed on the air, inside buildings, or even in human body fitting because it is designed for use in low-rate wireless personal area networks and low-cost and low-power applications. This paper further enhances our previous technology to reducing the standby power. Turned-off electric home appliances generally still require standby power when they are plugged in .Through this system we present a way to reduce the standby power of a socket [6]. Here a socket is used to supplies the w

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power when the user wants to turns on. When the user turns them off, the socket itself shuts the electric power off and thus reduces the standby power .in this system we used microcontroller which receives signals from a PIR sensor which detects the user approaching the socket. The MCU controls the solid state relays On/Off when used as an appliance switch for shutting off the standby power. The MCU monitoring program provides both automatic detection of the user by the PIR sensor and detection of the load current. In technology has several internal modules to simplify the hardware circuit design. The PV array or the solar array is used in our design to reduce the electric power consumption from the local electric power company. That is PV array convert solar or any other form of light energy into electric energy. With this system we can reduce the standby power up to 7mw in darkroom and less than 7mw in non-dark room. In this paper, we propose a new light-powered remote control system to achieve absolute zero standby power for home appliances [1]. In our system, a 15mW laser diode is mounted on a commercial remote controller. A light dependable resistor, an autonomous connection circuit (ACC), and latch-type power relay are mounted on a receiver unit that does not have any other power source. This receiver that does not have any power source, the only available energy is the extracted electrical energy that receives light energy, revives from death, and connects the home appliance to the AC power line once the stored energy is high enough to drive the relay. The home appliance is turned off in the usual way using a commercial remote controller, but the latches in receiver section off the relay to physically disconnect the appliance from the AC power line.

II. PROPOSED SYSTEM

The easiest and most tangible way to achieve absolute zero standby power is to unplug or manually switch off an appliance, but this solution is cumbersome and not very effective due to human laziness. To reduce this problem and achieve absolute zero standby power, we have designed and herein present a new light-powered remote control system.

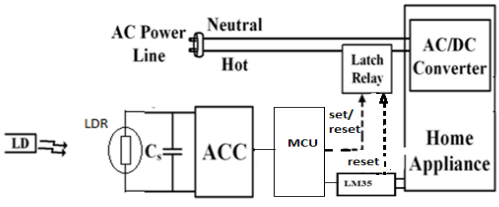

Fig. 1. Block diagram of proposed system

The home appliance is initially disconnected from the AC power line by the latch relay. When a laser beam emits from the laser diode, and that is impinges upon the LDR to turn on the appliance, its resistance is decreases as incident light energy increases and output a voltage. That voltage is stored in to a storage capacitor. In order to prevent energy leakage during this energy accumulation stage, the latch relay is separated from the storage capacitor by the ACC until sufficient energy is accumulated in the storage capacitor. When the amount of accumulated energy is sufficient to drive the latch relay, the ACC autonomously connects the storage capacitor to the control port of the latch relay, and the relay connects the home appliance to the AC power line. The operating appliance can be turned off using a commercial remote controller as conventional way, but in our system, the receiver unit latches off the relay to physically disconnect the appliance from the AC power line and return it to standby mode consuming absolute zero power. As explained, a dead receiver receives the light energy, revives from death and connects the appliance to AC power. The temperature sensor is used to sense the heat or electricity consumed by the appliances. When the threshold of the sensor is reached it automatically turn off the device by reset the latch relay .That is by using this system we can preserve our energy in two ways.

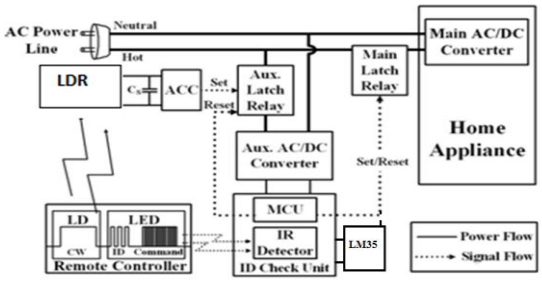

Fig. 2. Block diagram with function of identification

The remote control system shown in Figure 1. Can be directly applied to low-power (a few tens of watts) home appliances however the high power appliances require too much power to be activated by light power transmission. That is high power relay is mount on the appliances. Also the system shown in Figure is affected by the light noises of adjacent appliances. That is the current system is modified into new system that can be applied to high -power home appliances that has identification (ID) function is proposed here. The block diagram of this new system is shown in Figure 2.Unlike the system in Fig 1. , a small capacity auxiliary latch relay and a small capacity AC/DC converter are utilized to supply power for an ID check unit. As with the system shown in Figure 1, the home appliance is disconnected from the AC power line by a main latch relay, there by it consume absolute zero power. When ON button on the remote controller is pressed, a 15mW, 830 nm laser diode (LD) mounted on the remote controller continuously transmits a laser beam for 1 s followed by the coded ID and ON command signals as shown in Fig. 2. The coded ID and ON command signals are transmitted from the IR light-emitting diode (LED) of the remote controller. Using laser beam energy, the ACC sets the auxiliary relay and then the auxiliary AC/DC converter supplies power for the identification check unit, which checks whether the received ID and command signal from the remote match the appliance's ID and command on the device. If it matches, the microcontroller unit (MCU) in the ID check unit sends a pulse to set the main relay, we can turns on the appliances.

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After that, the auxiliary AC/DC converter and ID check unit remain live and wait for another command from the conventional remote controller. If coded ID and ON command signal do not match, the MCU sends a pulse to reset the auxiliary latch relay as shown in Figure 2. In this situation, the main latch relay stays in a cut-off state in which it consumes absolute zero standby power. By adding the temperature sensor besides the appliances, it can estimate the heating of the devices. All the devices are heating as it consumes electric power, the sensor detect that temperature and it will cut off the appliances by resetting the latch relay when it reaches it threshold value. The ID check unit that is embedded in the appliance is taken out from the appliance and modified to include the latch relay controller. The operating power of the main relay is about 10 times higher than that of the auxiliary relay. When the OFF command from the remote is received by the ID check unit while the appliance is working, the receiver unit sends two pulses, one pulse is to reset the main relay to cut off the appliance and the other to reset the auxiliary relay to cut off the receiver itself returning to an absolute zero power standby mode .Because of some times only the ON button is pressed decline in the battery life time of the remote controller is considered insignificant.

III. SYSTEM DESIGN

A. ACC Design

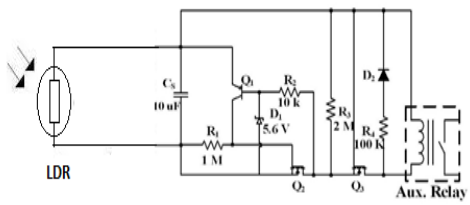

Fig. 3. Schematic of the autonomous connection circuit

This Figure shows schematic of the ACC connected to the auxiliary latch relay as a load. This working of the circuit is. Transistors Q1, Q 2, and Q3 are initially off, meaning that the ground is floating due to the off state of Q2 and Q3, and the latch relay is unpowered. Since there is no discharge path for the storage capacitor Cs, charges generated by the light dependent sensor is accumulated on the capacitor Cs. The leakage exist in this accumulation stage consists of an emitter -collector leakage current of Q1 and a leakage current of the Zener diode D1. As the storage capacitor voltage increases to values comparable to the Zener voltage, the leakage currents also increase and induce low voltage on the Q2 gate. This low gate voltage and a large resistance R3 force on Q2 operate in the sub-threshold region. Since the current in sub threshold is in the order of pA is much smaller than the photo-generated current, the storage capacitor voltage keeps increasing. When the storage capacitor voltage increases to V_{ACC} (i.e., the Zener voltage plus the base-emitter voltage drop of Q_1), Q_1 turns on and the emitter-collector current abruptly increases. The increases current subsequently increases the gate voltage of transistor Q_2, resulting in its turned on. Voltage across R_3 then increases, and Q_3 gate voltage increases and it causes activation of Q_3. This causes the ground line to the complete discharge loop of the storage capacitor through the latch relay coil, and a large current then flows through the relay coil to latch the relay. As soon as the discharge current flows through the coil of the relay , the storage capacitor voltage drops sharply below the threshold gate voltages of transistors Q_2 and Q_3,. If the relay was directly connected to Q_2 without Q_3, the storage capacitor voltage would never reach to the V_{ACC} since the relatively large discharge current flows through the low impedance of the relay coil. Finally, R_4 and D_2 were included to protect FETs from counter-electromotive forces in the relay coil and further incoming laser beam will increase the storage capacitor voltage.

IV. EXPERIMENTAL RESULT

The working of the relay is based on the switch. when the switch is pressed the relay is ON or it set and thereby we can connect the appliances to the AC power line then the switch is releases the relay is off and disconnect the appliances from the AC power line.

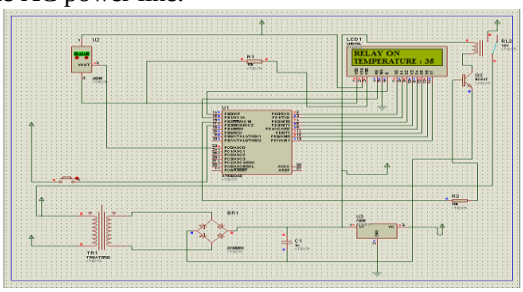

Fig. 4. Simulation Result

When the device is working, obviously it consumes electric power and the device become heat. The temperature sensor used here is detect the temperature and off the device when the threshold value is reached by resetting the latch relay and the user get an awareness about the usage of electricity and conservation of energy.

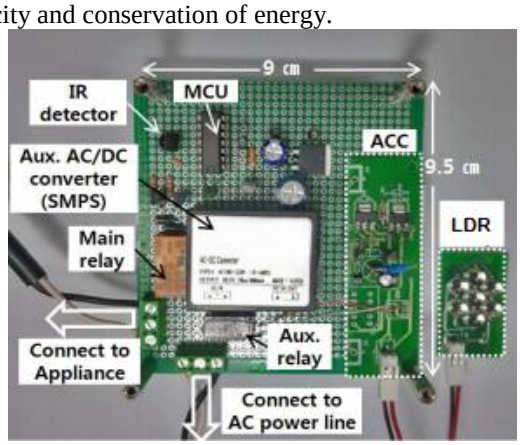

Fig. 5. Constructed receiver unit

Figure 5 shows the PCB (9 cm x 9.5 cm) of the constructed receiver unit, which includes a LDR, an IR detector, a MCU, an auxiliary AC/DC converter, an ACC and two relays

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V. CONCLUSION

Standby power is electrical power used by appliances and equipment while switched off or not performing their function. Power can be saved by disconnecting such devices, causing at worst only inconvenience. The home appliances have become more efficient, causing a gradual decrease in standby power consumption in recent years. However, thetotal standby power is probably growing in the future as the number of home appliances increases. In this system, we implemented a new system that decreases the standby power to absolute zero. One idea is to mount an LD on a remote controller to transmit the light energy to the remote receiver unit, while another involves using an elaborate ACC. Using incoming light power , the ACC can store the energy, , and autonomously connect the device once the stored the energy level is sufficient to drive the device or load. Implementing these two ideas in a commercial appliance, a zero standby power system is constructed. And also the temperature sensor added is the another effort to save the energy by means of the appliances become hot as it consumes electric power. When it reaches it threshold value the device automatically offs by reset the latch relay. We can conclude, with this light powered remote control system we can preserve our energy by two ways.

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