PIR Motion Sensor for Home Appliance

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ABSTRACT

In this paper we present a way to reduce the standby power consumption of a PIR-sensor-based lighting device. Generally, although a PIR-sensor-based lighting device will turn on when motion is detected and turn off when the motion is no longer present, this device still consumes 1-3 W of power when the lamp is off. In this design the device consumes 0.004 W when the light is turned off, and it is not only easy to set up but also inexpensive. Our circuit supplies the lamp with power when motion is detected; when the motion disappears it turns the lamp off, and the electric power is shut off to reduce the standby power. We use an MCU receiving signals from a PIR sensor which detects any individual approaching the device. The MCU controls the SSR On/Off when used as a light switch for shutting off the standby power. The MCU monitoring program provides automatic detection of any individual by means of the PIR sensor. The MCU has internal modules to simplify the hardware circuit design.

Keywords--- Lighting control, Policy, FET

I. INTRODUCTION

A smart home is a space or a room which is provided with the ability to get accustomed by itself to certain situations to make the occupants feel comfortable. Today, the term smart home is no longer alien to anybody as it was a few years ago. Smart homes can also refer as Intelligent Homes or Automated Homes. However, the term smart homes simply indicate the automation of daily chores with reference to the equipments in the house.

Smart homes could be simple remote control of lights or more complex functionalities such as remote viewing of the house interiors for surveillance purposes. With the recent expansion of communication networks, smart home applications can be further enhanced with new dimension of capabilities that were not available before. In particular, wireless access technologies will soon enable exotic and economically feasible application.

As human activities increase and inventions are made, the importance of electricity continued to be on the ascendance. Based on increase in human activity, there has been astronomical rise in the demand for electricity. Indeed the level of electricity consumption has become a major index being used in measuring the level of development of nations of the world nowadays. However despite the importance attached to electricity, it has remained one of the most wasted and abused resources especially in the third world countries. It is not uncommon to see lightings left ON in unoccupied classrooms, offices, and homes for many hours. It is estimated that approximately 45% of the electricity generated in most third world countries (including Nigeria) is wasted. This is due to poor energy conservation policy (of the country) or and lack of public awareness of need for efficient utilization of electricity. Nigeria’s electricity demand is growing faster than the country’s population.

II. REVIEW OF LIGHTING CONTROL SYSTEMS

There are six most common strategies used in advanced lighting control to reduce electricity consumption viz; daylight harvesting, occupancy sensing, personal control, time scheduling, task tuning, and variable load control. ABB carried out series of tests to examine the specific potential saving values of implementing constant lighting control. The tests were performed in an office building with seminar rooms. Constant lighting control were used – in contrast to a lighting that is fully switched ON– the required lighting intensity in the room is achieved by the continuous and controlled addition of “artificial lighting” required to maintain a defined level of brightness (in these measurements: 500 Lux). Only the amount of energy that was necessary for the artificial lighting was consumed. Results from experiments has shown that a high-level of potential energy savings is possible with constant lighting control and constant light control always.
yielded savings of more than 25% in comparison to manual lighting operation.

2.1 Energy Savings Due to Occupancy Sensors

Passive Infrared Sensor (PIR): The pyroelectric sensor is made of a crystalline material that generates a surface electric charge when exposed to heat in the form of infrared radiation. When the amount of radiation striking the crystal changes, the amount of charge also changes and can then be measured with a sensitive FET device built into the sensor. The job of the passive infrared is to sense the presence of human body within a particular radius (in this case 5m). The application of occupancy sensors has many motivations over other methods mentioned above. The prominent among which are listed below: People do not occupy spaces for a large percentage of time, and are not diligent about controlling the lighting in their spaces both during the workday, and after hours and weekends. This applies to both public spaces as well as personal spaces.

For lighting energy conservation and peak demand savings, the most important issue is not the installed lighting power density, but how lightings are utilized. Ultrasonic sensors generate an inaudible signal at 20 to 40 kHz which is put out into a space. The signal bounces off surfaces and returns to a receiver unit within the sensor, similar to radar. When there is motion in the space, the signal returns to the unit at a slightly different frequency which triggers the sensor to open the lighting circuit in what is referred to as the Doppler effect. They have limited sensitivity around obstacles such as walls or cubicles. Ultrasonic sensors cover the entire space and do not need a line of sight. As a result, they can detect people behind obstacles. They are also more sensitive to minor motions, such as hand movements. Small hand motions can be detected up to 6 m away. The other variant of sensors used are the infrared sensors. Infrared occupancy sensors respond to occupancy by detecting changes in temperature and movement of humans. They're designed to detect the peak wavelengths of heat that are emitted by humans, not other heat-generating objects such as computers and copiers.

A passive infrared sensor detects heat only within its "line of sight." It cannot detect the heat through walls or other obstacles. They detect motion within a fan shaped pattern. The sensor's ability to detect motion also depends on the distance between the sensor and the location of the motion. At short distances, within 3 m, the sensor can detect very small motions such as hand movement. As the distance between movement and the sensor increases, larger motions are required to trigger the sensor. When a person is 9 m to 12 m away from the sensor, it will only detect large movements such as a person walking around. Infrared sensors have a lot of advantage compare with other sensors. This sensor is simple, reliable, highly resistant to false triggering, quite inexpensive and do not emit ultrasound or microwaves.

III. WORKING OF PIR SENSOR

Here, we are using a PIR motion sensor. PIR stands for Passive InfraRed. This motion sensor consists of a fresnel lens, a infrared detector and supporting detection circuitry. The lens on the sensor focuses any infrared radiation/wavelengths present around it towards the infrared detector. Our bodies of one minute as soon as it detects us. It offers a tentative range of detection of about 6-7 m and is highly sensitive generate infrared heat and as a result this gets picked up by the motion sensor. The sensor outputs a 5V signal for a period. The output from the sensor (5V) is used to trigger a transistor BC547. The transistor then switches on a 5V relay. The relay correspondingly switches your appliance ON.

IV. CIRCUIT DIAGRAM

Depending on what you wish to control using the PIR motion sensor may it be a light bulb, fan, music player, etc., split one of its input AC terminal wires. While ensuring the other line is connected to AC neutral. At one terminal of the screw connector on the board, connect an AC power line. At the other terminal connect the wire (you just split) for the appliance you wish to control.
IV. SYSTEM DESIGN

4.1 Microcontroller Stage

A microcontroller ATMEGA8 is at the heart of the system design. It housed the program that controls the functionalities of other sub-systems that are coupled with it. The design uses a Passive Infrared detector (PIR detector) to detect human presence in the room. The PIR output is fed to PORT D0 of the ATMEGA8 microcontroller (configured as inputs). Once the signal is received in the microcontroller, the lines of instructions to switch the lightings ON are called. These instructions are converted to an electrical signal, which drives the transistor to saturation, so that the relay is energized to switch ON the lightings. If there is still detection of human in the room, the process repeats itself, creating a loop in the program. Until the sensor output gives a zero (i.e. empty room), and the loop is broken to trigger the lights OFF. When a human is sensed, the same process is repeated. The microcontroller does all the timing and control functions. While PORT C0 is configured as output, which is responsible for switching the transistors and interfaces the LCD.

4.2 Transistor Switching Design

Transistors Q1 and Q2 are BC547 which are operated as switches for relay and optocoupler. The relay is rated 12V DC, 30mA and a resistance of 400Ω. The resistances of the relay coil(400Ω) act as the collector resistance of transistor. An Optocoupler(MCT2E), also known as an Opto-isolator or Photo-coupler, is an electronic component that interconnects two separate electrical circuits by means of a light sensitive optical interface. It is a six pin device.

V. CONCLUSION AND FUTURE SCOPE

The paper presents one of the simple and effective ways of saving energy automatically in any room of any building or organization. This was achieved by the application of the microcontroller ATMEGA8 and Passive Infra-red sensor as the major building blocks. A randomly selected test for a duration of 3 hours using the module showed a 15% saving in the energy consumption and the translation to the number of active working hours of lighting type used. This is based on the premise that the manual control switches are operated with 50% accuracy.

In this PIR Sensor Based Security System, we have used low power, low cost PIR sensor that are easy to interface with other components. By using this system we were able to reduce the power consumed and memory space of the system. Currently, we have used only one webcam in our project which could only capture the area facing to it. The system may not work if the intruders enter from other side. The software developed for the recording of the video captured by the webcam is experimented only with a webcam connected to the system also there was some delay in recording video captured by the webcam.

Considering all above points, followings are our future works set to improve the system:

- Work to reduce human efforts.
- To save electricity from waste.
- To improve security system.
- Work on to reduce the delay time in recording the video captured by webcam. Use more than one webcam and integrating these webcams with the system.
- Work on the software to record videos from many webcams installed.

REFERENCE


