

Automated Energy Saving System Using IoT with PIR Sensors

¹Dr. Balika.J.Chelliah, ²Ananya Asthana, ³Mahima Ladha, ⁴Aayush Parashar

¹Associate Professor, ²Student, ³Student, ⁴Student

¹Department of computer science and engineering,

¹SRM Institute of science and technology, Chennai, India

Abstract : Complete home automation using IOT has become a step man has taken to remove human error from almost all his workings. This project aims to achieve similar goals. An IoT project that will facilitate the switching ON and OFF of electrical appliances based on the occupants inside the room. If the occupants of the room forget to switch OFF the appliances when they leave the room, the appliances will automatically be switched OFF when the room is empty and will be switched back ON again when anybody enters the room. If the occupants want the lights and other appliances to be OFF even when they are inside the room they can do so by using manual switches to override the system. The main purpose of this project is to prevent the wastage of electricity caused by the forgetfulness of people in switching off appliances upon exiting the room. The most common form of excess wastage is when appliances are left ON when they aren't required. This is the problem that this project solves, by automatically switching OFF the energy consuming appliances when not in use, thus saving a large amount of electricity.

IndexTerms – IOT, Arduino, PIR Sensors, Home Automation, Internet, SmartHome, Sensors.

I. INTRODUCTION

IOT (Internet of Things) is one of the most promising fields of research in today's world, with applications in every walk of life. Home automation is a sub-field that applies IOT to create smart homes with various features. Our project implements this concept to conserve electricity. The way this project functions is by using PIR (Passive Infrared) sensors to detect the presence or absence of people. A passive infrared sensor is an electronic sensor that measures infrared light radiating from objects in its field of view. They are most often used in PIR based motion detectors. These sensors detect if there is any motion in the room. If not, it sends a signal to the buzzer and the bulb, which we are using to represent all our appliances. The buzzer and bulb automatically switch OFF. Once motion is detected, the buzzer and bulb once again start to function. The entire project is built upon an Arduino Uno board that helps relay these signals across the connections. When executed successfully, this project will eradicate any and all human error that leads to wastage of electricity due to forgetfulness.

II. LITERATURE SURVEY

A. Smart Home Energy Management System by Mulham B. Soudan, Homam M. Al Rifaie, Taha M. Asmar and Sohaib Majzoub, Department of Electrical Engineering, University of Sharjah, Sharjah, UAE. This project aims at minimizing energy wastage by using microcontrollers and microprocessors. It provides various techniques to reduce energy wastage and also to save the excess usage of unnecessary power. It uses IoT to check the workplace power consumption and reduce it. It also has a mobile app that helps with the same.

B. IoT based Smart Home Automation System using Sensor Node by Himanshu Singh, Vishal Pallagani, Vedant Khandelwal and Venkanna U., Dept. of Computer Science and Engineering, DSPM-IIIT Naya Raipur, India. As the automations industry is booming, there is a need to automate every kind of appliance that can possibly be used in a household. This includes everything from the kitchen to the living room. This project aims to automat every aspect of the household using IoT. This achieves the desired effect of complete home automation. The house once automated requires less human effort than before, resulting in an easier lifestyle and smoother workflow.

C. Internet of Things for Smart Cities by Andrea Zanella, Senior Member, IEEE, Nicola Bui, Angelo Castellani, Lorenzo Vangelista, Senior Member, IEEE, and Michele Zorzi, Fellow, IEEE. This project aims to implement Urban IoT technologies that aim to support the Smart City vision, which will change the communication methodologies to provide more help to the citizens and the entire city. These services will have more added value and will follow the belief system of the city as a whole. This paper provides the Urban IoT technologies and infrastructures required for execution.

D. Customary Homes to Smart Homes using Internet of Things (IoT) and Mobile Application by Vignesh Govindraj, Phanini Academy of Education Bangalore, India, Mithileysh Sathiyarayanan, Count on Us - R&D Bangalore, India, Babangida Abubaka, Katsina State Institute of Technology & Management, Nigeria. IoT has helped convert all structures to wireless entities and this paper aims to take advantage of this fact to create a home automation system that is cheap, wireless and cloud networking employing. This uses a combination of cloud networking and wireless communication to create a technologically advanced system.

E. EPSSR: Energy Preserving System for Smart Rooms by Khalid M.O Nahar, Department of Computer Sciences, Faculty of Information Technology and Computer Sciences, Yarmouk University Irbid-21163, Jordan, Ra'ed M. Al-Khatib, Department of Computer Sciences, Faculty of Information Technology and Computer Sciences, Yarmouk University Irbid-21163, Jordan. The wastage of energy requires a lot of measures to be taken in order to compensate for the amount of depleting natural resources. This project provides an actual practical model that can conserve the energy being utilized in seminar halls, classrooms, commercial buildings etc. Using the ESP8266 chip which is a Wi-Fi chip with full TCP/IP stack and MCU capability, an energy saving module can be developed.

III. PROPOSED SYSTEM

The proposed system involves the automatic switching OFF of all the appliances in the room once the room is empty without the need for any manual action, unless required. Once an occupant enters the room, the appliances are switched on again automatically using Passive Infrared (PIR) sensors. This automates the entire process of appliance usage and streamlines the functions involved. The hardware system is mounted in the desired room and the manual switch is not activated. This way whenever the room has no occupants, all the appliances are switched off automatically.

Advantages:

- No risk of electric shocks even in the case of a faulty circuit.
- Corrects human error i.e. forgetfulness or carelessness that can cause major loss of electricity.
- Simplifies the energy saving system by taking away the factor of manual action.
- Data can be collected to implement a theft prevention system based on the status of the appliances, by making the same system more advanced.

Reduced electricity bill and increased cost saving due to reduced unnecessary usage of electricity, resulting in saved money. Streamlines the process of proper appliance usage and prevents overloading on the appliances

3.1 Architecture Diagram

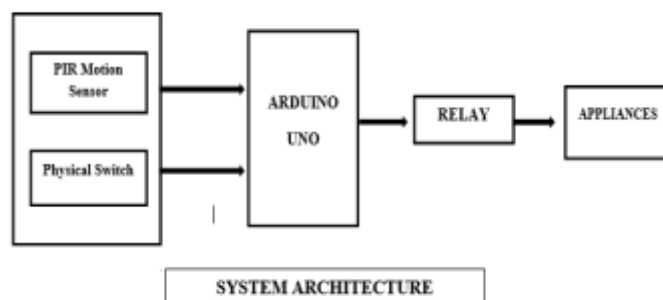


Fig 1 System Architecture

This diagram shows the physical architecture of our proposed system:

- The PIR sensor and the physical switch form the input or stimulus block of our model.
- The Arduino Uno board has connections to the sensor-switch block as well as the appliances. For sake of explanation, appliances include a bulb and buzzer.
- The signals received by the board are sent via a relay to the appliances which either switch OFF or switch ON depending on the signal.

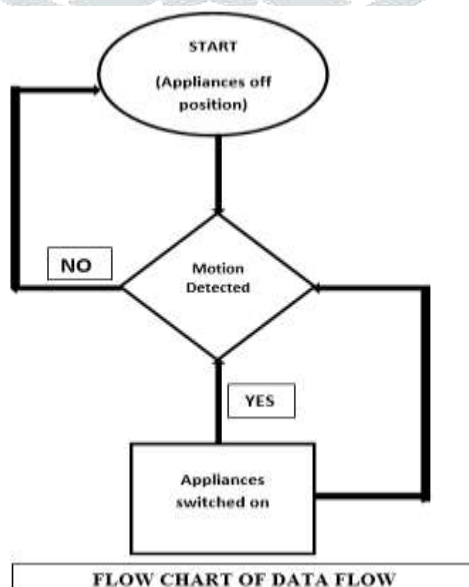


Fig 2. Data Flow Chart

3.2 Working of Passive Infrared Sensor

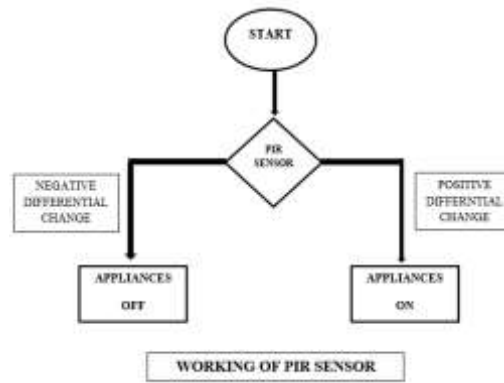


Fig 3. Working of PIR Sensor

The PIR sensor has two slots in it, each slot is made of an IR sensitive material. The lens used here is not really doing much and so we see that the two slots can 'see' out past some distance (basically the sensitivity of the sensor). When the sensor is idle, both slots detect the same amount of IR, which is the normal amount reflected off of walls of a room. When a warm body like a human or animal passes by, it first affects the first half of the PIR sensor, causing it to generate a **positive differential change**. This charge is generated between the two halves. When the warm body leaves the sensing area, the reverse happens, that is, the sensor generates a **negative differential change**. These change pulses are what are detected and transmitted to the Arduino Uno board to be relayed onto the appliances via a connecting grid inbuilt in the board

IV. Architecture of Modules

In the considered system, the cycle starts at the entry of occupants in a previously empty room. If the cycle starts at the exit of occupants from a previously occupied room, all the modules will be reversed.

For this explanation, we assume that the manual switch has been activated before it's position is changed.

MODULE 1: Activation of motion sensing system

MODULE 2: Data analysis

MODULE 3: Switching ON of appliances

MODULE 4: Repeated data analysis

MODULE 5: Switching OFF of appliances

MODULE 1: Activation of motion sensing system

When a human enters the room, the motion of the body along with the body heat gets detected by the sensor. Sensor used: PIR sensor (Passive Infrared Sensor) Working of sensor: The PIR sensor has two slots in it, each slot is made of an IR sensitive material. The lens used here is not really doing much and so we see that the two slots can 'see' out past some distance (basically the sensitivity of the sensor). When the sensor is idle, both slots detect the same amount of IR, which is the normal amount reflected off of walls of a room. When a warm body like a human or animal passes by, it first affects the first half of the PIR sensor, causing it to generate a positive differential change. This charge is generated between the two halves. When the warm body leaves the sensing area, the reverse happens, that is, the sensor generates a negative differential change. These change pulses are what are detected and transmitted to the Arduino Uno board to be relayed via connecting surfaces onto the appliances via a connecting grid inbuilt in the board.

MODULE 2: Data analysis

If a positive differential change is induced between the two halves of the PIR sensor, the system concludes that there are occupants in the room. The positive differential change indicates that the room is now occupied and usage of appliances is required. Once this analysis is completed, the signal to switch ON the appliances is transmitted via the Arduino Uno board to the appliances. (This analysis always leads to switching ON the appliances UNLESS the manual switch is in OFF position. But this is highly unlikely since this is the first half of the cycle and leaving the switch OFF while the room is empty would render the system useless as upon entering the appliances won't automatically switch ON. So, we check for the manual switch position only in the second half of the cycle.)

MODULE 3: Switching ON of appliances

The Arduino Uno board is a microcontroller based on the ATmega328. It has 14 digital input/output pins in which 6 can be used as PWM outputs, a 16 MHz ceramic resonator, an ICSP header, a USB connection, 6 analog inputs, a power jack and a reset button. This contains all the required support needed for a microcontroller. The appliance uses a low-voltage control signal from the Arduino to control a relay, which is capable of handling and switching high-voltage or high-power circuits. A relay consists of an electromagnet that, when energized, causes a switch to close or open. Once it is closed, the circuit is complete and the appliance is switched ON.

MODULE 4: Repeated data analysis

Now the appliance is in the ON mode. Now the circuit will remain in this same condition till the PIR sensors sense some change. This change can either be a negative differential change between the two halves of the PIR sensor, or it can be the change in the position of the manual switch to OFF to facilitate the switching OFF of appliances even when occupants are in the room. Both of these changes indicate the same situation, one where the appliances are to be switched OFF. (If we had considered a scenario where cycle starts at exit of occupants, then during repeated data analysis the change would be either positive differential change or the change in the position of the manual switch to ON to facilitate the switching ON of appliances even when the room is empty. In this case the appliances would be switched ON)

Once this analysis of both the differential change and the manual switch position is complete, the signal to switch OFF the appliances is transmitted via the Arduino Uno board to the appliances.

MODULE 5: Switching OFF of appliances

Now the state of the appliances has to be changed from ON to OFF as either the room is now empty OR the manual switch has been moved to OFF.

The procedure is similar to the last time the state of the appliances was changed. The appliance uses a low-voltage control signal from the Arduino to control a relay, which is capable of handling and switching high-voltage or high-power circuits. A relay consists of an electromagnet that, when energized, causes a switch to close or open. Once it is open, the circuit is broken and the appliance is switched OFF. And this cycle continues as occupants either enter the room OR the manual switch is shifted to ON position.

V. FUTURE ENHANCEMENT

This system can be modified in the future to serve a variety of purposes:

- Modified to form an anti-burglary system that can protect entire establishments against theft. The system can be trained in such a way that whenever the house is empty and the system has been provided with this information, it can alert the user whenever an appliance comes on, as this would imply that somebody's motion has been detected.
- A mobile application-based system can be developed to enable remotely controlling the system from a distance.
- Implementation in public spaces and educational institutions to facilitate large scale energy saving

VI. CONCLUSION

The automated room energy saving system is a valuable step towards correcting human error that results in huge amounts of energy wastage. With our depleting resources, the least we can do is ensure that appliances aren't ON unnecessarily. When executed correctly, this project will eradicate human error almost completely in this field and help conserve both energy and money. The environmental benefits are multiple, and there is also a multitude of benefits in the field of IOT due to the application of this particular sensor (Passive Infrared Sensor).

In conclusion, we have developed a system that eases the usage of electronic appliances and eradicates wastage of electricity due to human error and forgetfulness.

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