International Journal of Research in Engineering, Science and Management
Volume-2, Issue-5, May-2019
www.ijresm.com | ISSN (Online): 2581-5792

Wireless Monitoring and Controlling of Automatic Room Light Control System

Ashwin L. Abhang[1], Dhananjay J. Gorde[2], Sneha A. Kadam[3], Yogesh S. Angal[4]
[1,2,3]*B.E. Student, Department of Electronics & Telecommunications Engineering, JSPM's Bhivarabai Sawant Institute of Technology and Research, Pune, India*
[4]*Professor & HoD, Department of Electronics & Telecommunications Engineering, JSPM's Bhivarabai Sawant Institute of Technology and Research, Pune, India*

***Abstract*: Most of Colleges and Universities use the traditional lighting system where we have a switch to control the lighting. Most of us i.e. students and faculty members are habituated towards leaving the class room without switching the lights, Fans, Air conditioner etc which leads to unnecessary consumption of energy for organization and paying huge amount of bill. Some of the lighting systems have come with Remote system towards controlling the lighting and fan similar to air conditioner which is being used in homes. But still there is challenge towards leaving the lights and fans unattended when person not in the room. So accordingly, we here in this project have developed Automatic Lighting Control and Monitoring System for the efficient use of energy in class room condition where we have divided the class rooms into grids or nodes. The system developed will control lighting in particular area of class room based on the presence of human using relay control compared to the one placed in ceiling which would switch on or off based on presence of human in room irrespective of position using PIR motion sensor which will sense Passive Infrared Radiation radiated from human body. In case, if the circuit is damaged or there is no need of electricity then the power supply is turned off by using Processing Software.**

***Keywords*: nRF24L01 Transceiver module, 7806 Voltage Regulator, PIR sensor, Relay Unit, Arduino Nano Microcontroller, Processing Software.**

1. Introduction

Lots of people in this world are without electricity and modern lighting. This problem is more severe in rural areas or in cities. The rural electrification varies widely from country to country. Our country India frequently suffers from unreliable and intermittent electricity supply. In some places, people gets electricity only few hours of the day only. Without electricity, it becomes challenging for adults towards concentrating on their professional work or study. Rural communities of course needs a reliable and sustainable solution for lighting towards providing a brighter future.

The country has made significant progress towards the augmentation of its power infrastructure. Moreover, poor quality of power supply and frequent power cuts and shortages impose a heavy burden on India's fast growing trade and industry.

So current scenario insists towards highly efficient and effective usage of any form of power in educational institutions like Colleges and Universities where we use power for our teaching in class room or labs. It is common practice that most of us leave the class rooms or labs with Air conditioner, Fans and lighting on even if no students or faculty members present. In some cases, we see only few students sitting in one corner of the class room or lab and entire fan, light and air conditioner going. All these amounts to unnecessary wastage of power contributing to country energy resource.

Lots of research been conducted on smart lighting system where automated lighting system with visitor counters been implemented. This system used in controlling the lights and fans in a room keeps track of number of persons or visitors entered or exit from the room.

Researchers also have employed vacancy sensor that replaced the standard wall switches. Using Passive Infrared Technology called PIR, these sensors combined the occupancy detection and voltage switching in a single package. These units automatically turn off the light in a room or an area if it is vacant for 5-10 minutes.

In addition to home based lighting control, there has also been research conducted on street lights towards controlling the energy saving. But in all the research discussed, there are some few limitations like two people entering room at the same time if doors are wide open, range of sensors to cover the large room and also cost effectiveness.

So we here have developed a Wireless Automatic Lighting Control for classrooms by considering our class rooms being divided into grids or nodes. In here we have one PIR sensor placed at the entrance of class room and also another PIR sensor inside the class room where classrooms divided into grids or nodes to sense the presence of human. The reason behind placing sensor in grid or node fashion is that the ceiling mounted sensors are expensive and that these sensors can sense object/personnel to a limited range only. This means that one sensor might not cover a full room and as such requires additional wiring in case of wired sensors.

The advantage of our system is that electrical appliances be switched on or off in a particular area in class room based on the presence and also according to the need of electricity, the

power supply is turned on or off by using Processing Software.

The ultimate objective of this system is to save the energy as well as to design wireless monitoring of automatic room light control system by turning off all the AC appliances when nobody is there in the room. This system possesses sets of PIR sensor and PIR sensors to detect the persons in the room. Other objectives are to minimize the human effort and to consume the less power system.

2. Literature survey

In order to conserve energy, automated lighting system using Raspberry Pi that monitors the electrical lighting and the running of the fans were proposed. The experimental results showed that we can reduce our bill to the extent of 50% if the electrical appliances are switched OFF promptly when not in use. The proposed method has shown promising results [1].

In [2], the researchers talk about automated lighting system with visitor counters. System here requires no manual operation towards switching the lights to ON/OFF when person enters or exits a room. The PIR sensor is placed at the entrance of the room door which senses a person entering or exiting the room. As a person enters the room, the counter is incremented and accordingly lights switches ON by the program embedded inside the microcontroller. Similarly, when a person exits the room, the counter decremented and accordingly microcontroller switches OFF the light too. The lights in room be switched off only when all persons in the room exit and room in unoccupied. The challenge in this system is that room door should not be wide enough as it allows two or more people to enter the room at the same time.

Also research carried out by employing vacancy sensor [3] which is a direct replacement of standard wall switches. Passive Infrared technology is combined with these sensors towards detecting the presence of personnel in the room and also voltage switching in a single package. This system automatically turns off the lights in a room if the room is vacant for 5-10 minutes. These sensors are mounted to ceiling having a 180 and 360 degree filed view to cover up to 1000 square feet of area. But these sensors also got some drawbacks which is limited range i.e one sensor might not cover a full room and also it requires lot of additional wiring in case of wired sensors.

Researchers also performed work [4] towards developing a new system for energy saving and control of street lights. This results in considerable amount of energy been saved without compromising on lighting requirement. The system is developed based on Zigbee Sensor technology.

Also the authors in [5] talks about street lighting based on Programmable Logic Controller (PLC) and input sensing devices. In here, researchers developed a method for controlling the street lighting system using millennium 3 PLC. The system here uses a Light Dependent Resistor (LDR) as a replacement for the seasonal variation.

3. System design

A. 7806 Voltage Regulator

7806 is a 6V Voltage Regulator that restricts the voltage output to 6V and draws 6V regulated power supply. The 7806 is the most common, as its regulated 6-volt supply provides a convenient power source for most TTL components.

Features of 7806:

1. Fixed 6V voltage regulators.
2. Thermal overload protection.
3. Short circuit protection.
4. Output transition SOA protection.
5. Heat-sink is required.

How to use IC 7806?

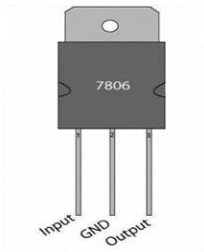


Fig. 1. Pin Diagram of 7806

The 7806 IC have 3 pins, Pin 1 is a positive input, Pin 3 is a positive output and Pin 2 is negative common ground between both input as well as output voltage. When using the voltage regulator setup, you need to take care of the current through the voltage regulator IC do not exceed beyond the capacity which is mentioned in the datasheet or else it may blow off. You also have to be careful with the connection you are making with the voltage supply. Reverse polarity does get the IC heat up really quickly, you can also use a PN junction diode in order to prevent such a condition.

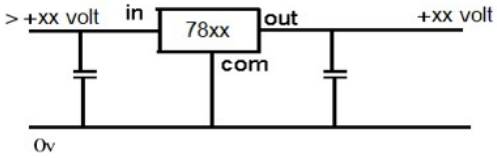


Fig. 2. Circuit Diagram of 7806

- 7806 voltage regulator IC does not require any component to balance or saturate their output voltage.
- The 7806 IC has a built-in protection from the high current
- There is a heat-sink with the common ground connected with which is helpful in order to prevent our regulator IC from overheating and short-circuits making it uncompromising in the most application.

B. PIR Sensor

PIR sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low-power, easy to use and don't wear out. They are often referred to as PIR, "Passive Infrared", "Pyroelectric", or "IR motion" sensors. PIRs are basically made of a pyroelectric sensor (which you can see below as the round metal can with a rectangular crystal in the center), which can detect levels for infrared radiation.

PIR Sensor Features

- Wide range on input voltage varying from 4V to 12V (+5V recommended)
- Output voltage is High/Low (3.3V TTL)
- Low power consumption of 65mA
- Can distinguish between object movement and human movement

The sensing unit primarily deals with the input parameters required for automation. According to the selected area, the following points need to be kept in mind which is:

- Dynamic human motion
- Feasibility
- Economical

So based on the above points, we have selected PIR (Passive Infrared Radiation) sensor for detecting human presence as shown in Fig.3.

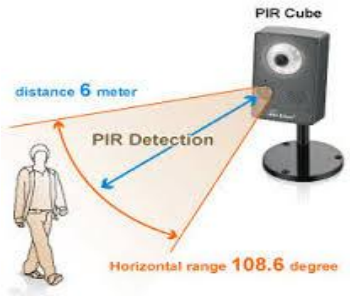


Fig. 3. PIR Sensor

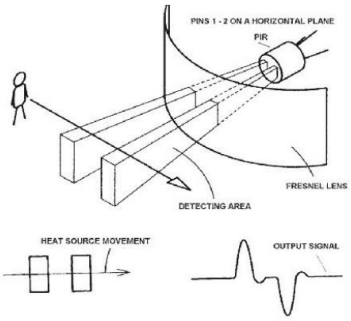


Fig. 4. PIR Working

PIR sensors sense the motion of a person whether they are in the range or outside the range. These sensors are small, inexpensive, low power, easy to use and don't wear out. This is one reason as why these sensors seen in appliances and gadgets in home or business. They are often referred to as PIR, "Passive Infrared", "Pyroelectric", "IR motion" sensors. These are shown in Fig. 4.

C. Relay

Relay is an electrically operated switch which uses an electromagnet towards mechanically operating a switch. There are other operating principles such as solid state relays too. Relay are used in appliances where it is deemed necessary to control a circuit by low power signal or when several circuits need to be controlled by a signal. This is shown in Fig. 5.

Fig. 5. Relay Unit

D. nRF24L01 Transceiver Modules

The nRF24L01 is designed for operation in the world wide ISM frequency band at 2.400-2.4835GHz. An MCU (microcontroller) and very few external passive components are needed to design a radio system with the nRF24L01. The nRF24L01 is configured and operated through a Serial Peripheral Interface (SPI). Through this interface the register map is available. The register map contains all configuration registers in the nRF24L01 and is accessible in all operation modes of the chip.

It uses the 2.4GHz band and it can operate with baud rates from 250 kbps up to 2 Mbps. If used in open space and with lower baud rate its range can reach up to 100 meters. The module can use 125 different channels which gives a possibility to have a network of 125 independently working modems in one place. Each channel can have up to 6 addresses, or each unit can communicate with up to 6 other units at the same time.

The pins CSN and CE can be connected to any digital pin of the Arduino board and they are used for setting the module in standby or active mode, as well as for switching between transmit or command mode. So once we connect the nRF24L01 modules to the Arduino boards we are ready to make the codes for both the transmitter and the receiver.

Fig. 6. nRF24L01 Transceiver Module

E. Arduino Nano Microcontroller:

Arduino Nano is a small, compatible, flexible and breadboard friendly Microcontroller board, developed by Arduino.cc in Italy, based on ATmega328p. It comes with exactly the same functionality as in Arduino UNO but quite small in size. It comes with an operating voltage of 5V, however, the input voltage can vary from 7 to 12V. Arduino Nano pinout contains 14 digital pins, 8 analog pins, 2 reset pins and 6 power pins.

Features of Arduino Nano:

- It supports different ways of communication, which are:

SPI Protocol
I2C Protocol

- It has crystal oscillator of 16MHz
- It's operating voltage vary from 5V to 12V

Fig. 7. Arduino Nano Microcontroller

F. Processing Software

Processing is an open source graphical library and integrated development environment (IDE) / playground built for the electronic arts, new media art, and visual design communities with the purpose of teaching non-programmers the fundamentals of computer programming in a visual context. Processing uses the Java language, with additional simplifications such as additional classes and aliased mathematical functions and operations.

4. Process development

A. Node 00

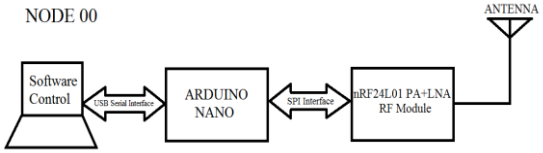


Fig. 8. Block Diagram of Node 00

1) Operation of Node00

This is the base node. It communicates with all other three nodes wirelessly. Arduino is connected to control software by using USB cable. It also gets power from USB cable. This node also communicates with the computer software via USB serial communication. When the button pressed on the software then it sends particular integer to node 0 Arduino via USB cable and Arduino transmits it to the all three nodes by using nRF24L01 module. nRF24L01 module communicates with Arduino with SPI (Serial Peripheral Interface) Protocol.

2) Node 01, 02, 03

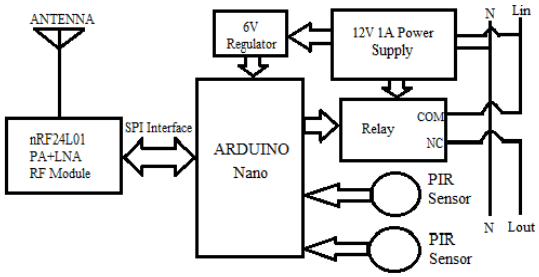
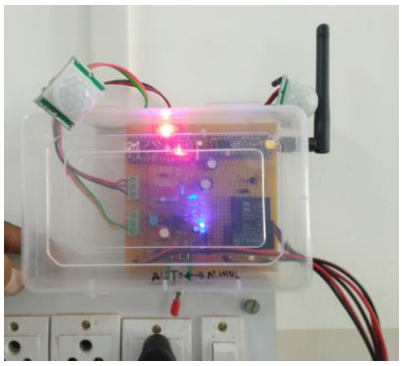


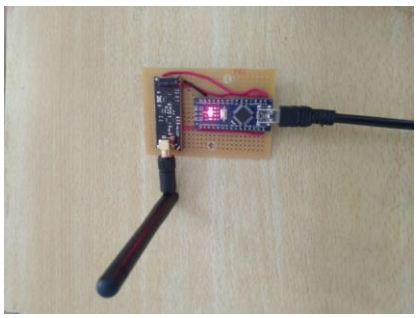
Fig. 9. Block Diagram of Node 01, 02, 03

3) Operation of Node 01, 02, 03

When the data is received from the base node, then the data is checked for whether the received data is for this node? This is done by checking the data and according to that to control relay on/off or status checking. The PIR sensor is used to detect whether the humans are present inside the room or not, if present then it turns off the relay and the supply to the appliances is connected. After turning off the relay the timer starts counting for 60 seconds and while counting if the PIR again detects human being then it resets its count and again starts counting from zero. For power supply for relay and Arduino is given from the 12V 1A adapter. The output of adapter is given to 6v voltage regulator and then output of regulator is given to Arduino. nRF24L01 works on the 3.3V. This voltage is given from the Arduino board.

5. Experimental setup





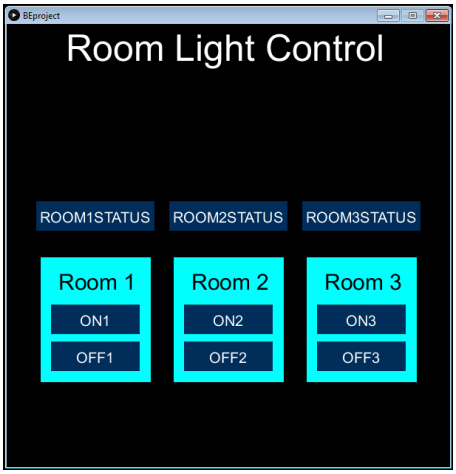


Fig. 10. Experimental setup

6. Conclusion

Energy is maximum amount of electricity is observed to be the educational institutions. Most of time we are habituated towards leaving the lights, Fans etc. switched on in the classroom when no one is there. So towards this there has been lot of research carried out using Sensor towards computing the occupancy of human and accordingly switching lights On or Off accordingly. But there are some drawbacks in the existing ceiling mounted sensor due to coverage, cost and other factors.

So accordingly we here have developed Wireless Monitoring and Controlling of Automatic Room Light Control System where class room divided into grids or nodes and PIR sensor placed towards capturing the entrance of human inside class room and also presence of human in the appropriate Grid or Node for switching appliances on or off by sending signal to relay control.

Also work can also be carried out towards if the circuit is damaged or there is no need of electricity then the power supply is turned off by using the Processing Software.

References

[1] Suresh S., H. N. S. Anusha, T. Rajath, P. Soundarya and S. V. P. Vudatha, "Automatic lighting and Control System for Classroom," *2016 International Conference on ICT in Business Industry & Government (ICTBIG)*, Indore, 2016, pp. 1-6.

[2] "Indian Energy Sector- An Overview", http://www.indiaenergyportal.org/overview_detail.php

[3] A. Maslekar, K. Aparna, K. Mamatha and T. Shivakumara, "Smart Lighting System using Raspberry Pi", International Journal of Innovative Research in Science and Technology, Vol. 4, Issue 7, July 2015.

[4] "Automatics Room Light Controller with Visitor Counter", http://www.projectsof8051.com/automaticroom-light-controller-with-visitor-counter/

[5] "Occupancy and Vacancy Sensors", http://www.womackelectric.com/wp-content/uploads/2011/05/PS-Occupancy-and-Vacancy-Sensors-Catalog.pdf

[6] A. Rahul, K. Haripriya and E. Sneha. "Smart Energy Management System Based on Zigbee Tecnology". https://www.academia.edu/2052498/Smart_Energy_Management_System_Based_On_Zigbee_Technology

[7] D. V. Pushpa Latha, K. R. Sudha and S. Devabhaktuni. "PLC based Smart Street Lighting Control", International Journal of Intelligent Systems and Applications, Vol. 6(1), 2014, pp. 64-72.