Automatic Lighting And Control System For Classroom

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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, Fan, Aircon etc which leads to unnecessary consumption of energy for organization and paying huge amount of bill from their budget. 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 research have developed Automatic lighting and control using Arduino for the efficient use of energy in Class room condition where we have divided the class room intro grids. 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. In addition to relay control, we have also provide mobility and remote command execution to system using Android mobile App via Bluetooth to control lighting based on voice command

Keywords—GSM, Arduino, Android

I. 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 get electricity only few hours of the day only. Without adequate electricity, it becomes challenging for adult 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.

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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 insist 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, Fan 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 aircon going. All these amounts to unnecessary wastage of power contributing to country energy resource

Lot of research been conducted on smart lighting system [2-3],[5-6] where automated lighting system with visitor counters been implemented. This System used in controlling the lights and fans in a room and keeps track of number of persons / 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 Automatic Lighting control with Mobile application for classrooms by considering our class rooms being divided into grids. 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 to sense the presence of human. The reason behind placing sensor in grid 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.

Also in addition, mobile application provided for controlling the lighting as on or off based on voice input which is sent via Bluetooth. The advantage of our system is that electrical appliance be switched on or off in a particular area in class room based on the presence. The rest of the paper is organized as follows. Section 2 talks on Literature Review pertaining to research work. Section 3 talks on hardware and software design pertaining to Smart Lighting system. Section 4 gives the implementation of Smart Lighting Control System using Arduino and Android App. Section 5 is the conclusion and Future Work.

II. Literature Survey

In this section, latest research pertaining to Smart lighting employing sensors for energy efficiency been discussed.

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."[2]

In [3], 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 programme 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 is 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 [4] 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 turn 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 [5] 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 [6] talk 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.

III. System Design

The entire smart lighting system for class room are divided into two parts which are Hardware sensing unit, Hardware processing unit, Hardware control unit, Network module and Mobile application modules. These details are discussed below

A. Hardware Sensing Unit

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) sensor for detecting human presence as shown in Fig.1

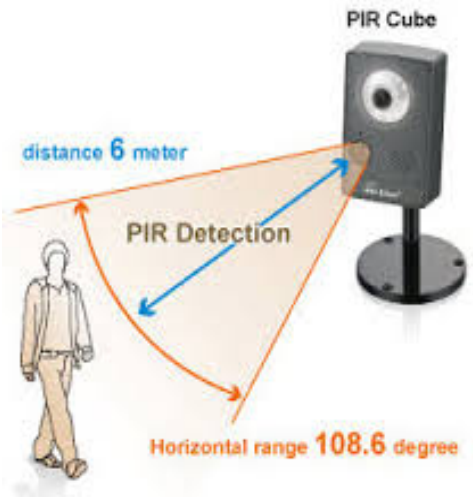

Fig.1 PIR Sensor

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", or "IR motion" sensors. These are shown in Fig.2

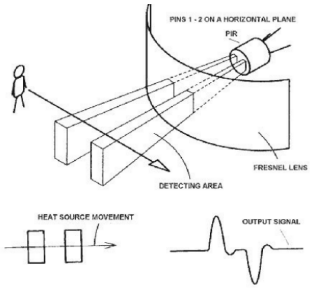

Fig.2 PIR Working

B. Hardware Processing Unit

The earlier stated parameters are been analyzed, processed and corresponding action according to the stats are been triggered. Keeping the economical and ease of operation **ARDUNIO UNO** board has been opted as shown in Fig 3.3. Arduino board will process the input parameters according to the program burnt on the board.
Arduino is a micro-controller and has its own programming language, used to control its functionality which is burnt on the board. Arduino Uno is a microcontroller board based on the ATMega 328P. It consist of 14 digital I/O pins, 6 analog inputs, 16 MHZ Quartz Crystal, USB connection, Power Jack, ICSP header and reset button.

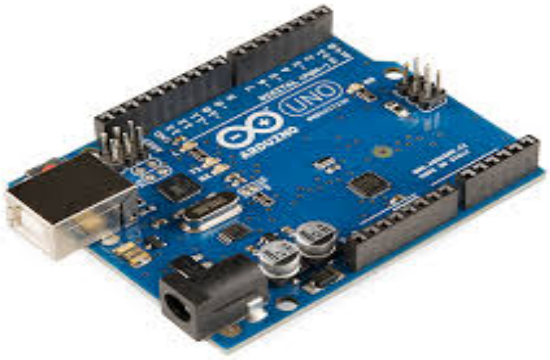

Fig.3 Arduino Uno

C. Hardware Controlling Unit

The following sum up the unit-

- Relay
- Electrical Appliances, the signals will be sent to processing unit.

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.4

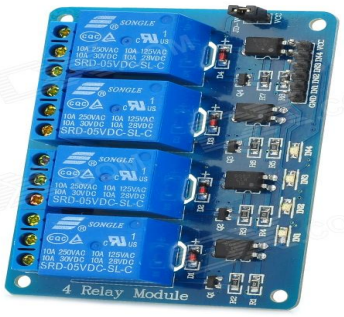

Fig. 4 Relay Unit

D. Networking Unit

Interaction of the entire hardware unit will be wired and wireless. The networking focuses on the wireless interaction of devices i.e.

- Sensor controller
- Data transfer media i.e. Bluetooth, ZigBee or Wi-Fi.

With respect to the resources available we opt for Bluetooth as our networking medium. Bluetooth is an wireless technology standard towards data exchange over short distances at an ISM frequency band of 2.4 to 2.485 Mhz. These bluetooth can connect several devices like fixed, mobile and so forth overcoming the problems of synchronization. IEEE standardizes Bluetooth as IEEE 802.15.1. This is shown in Fig.5

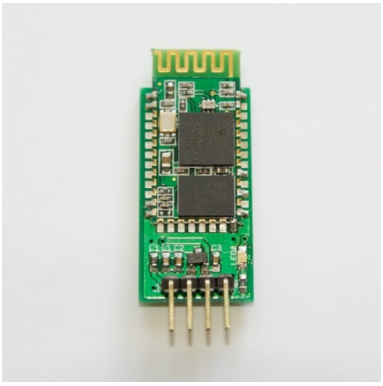

Fig. 5 Bluetooth Module

E. Mobile Application Module

Android Phone will be used for super control over the autonomous system. Precisely, an App will be created through which user will send commands to Arduino which will be processed by it for controlling the lighting in addition to automatic control by relay switch based on the input from PIR sensor. The working of the entire system towards smart lighting been shown as Flowchart in Fig.6

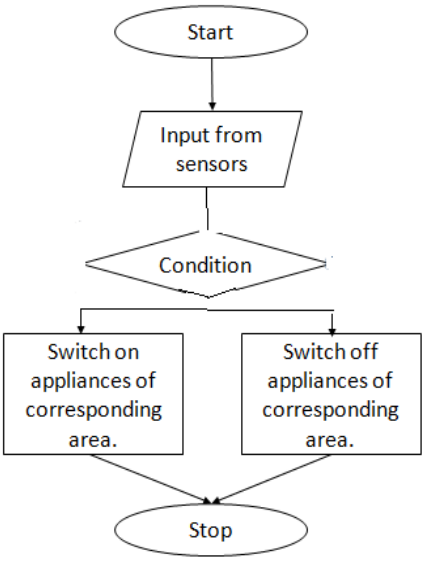

Fig.6 Flowchart of Smart Light System

IV. Implementation Using Arduino

The implementation of the entire Automatic lighting control system been carried out using Arduino Uno board with Atmega microcontroller. The software for controlling the relay switch for switching on and off the light based on the input from two PIR sensor resides inside microcontroller unit of Arduino. In addition the Bluetooth module connected to Arduino and message from Android mobile app which is Bluetooth enabled is interfaced for sending message to Arduino for controlling the lights. The entire system functioning are shown as screenshots.

Fig.7 shows the classroom being divided into grids and each grid represents the different electrical appliances. For each of the electrical appliances LED shown for switching on or off by means of relay control or through Bluetooth enabled mobile device

Fig.7 Classroom Grid Design

Fig.8 shows the wiring of smart lighting system by interfacing two PIR sensors – one for door entrance and one in grid. This is to detect the human presence and accordingly signal the relay control to switch on or off the appropriate electrical appliance say light, fan or ariconcditioner in that grid area as shown in Fig.9. Fig.9 also shows the Bluetooth module being connected to Arduino for sending voice command from Android to switch on or off the light .

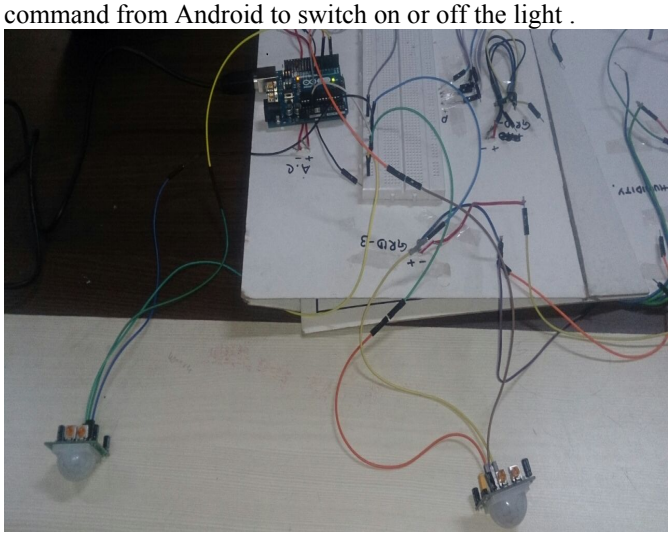

Fig.8 Wiring of PIR Sensor to Arduino

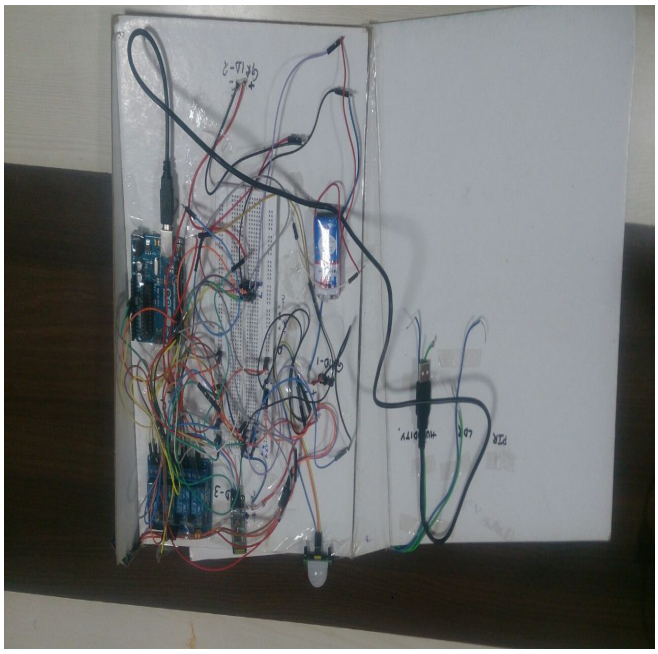

Fig.9 Wiring of Relay and Bluetooth module for Control

Fig.10 shows a scenario where the human present in all grids in class room and accordingly relay switching the electrical appliances in all grids in classroom. Fig.11 and 12 shows a condition where the user gives the voice command from the Bluetooth enable Android mobile phone and accordingly the electrical appliance in that particular grid area

is switched on and rest been switched off. The same lighting control in one particular grid as shown in Fig.12 can be switched on or off based on human presence by means of relay control without any human intervention.

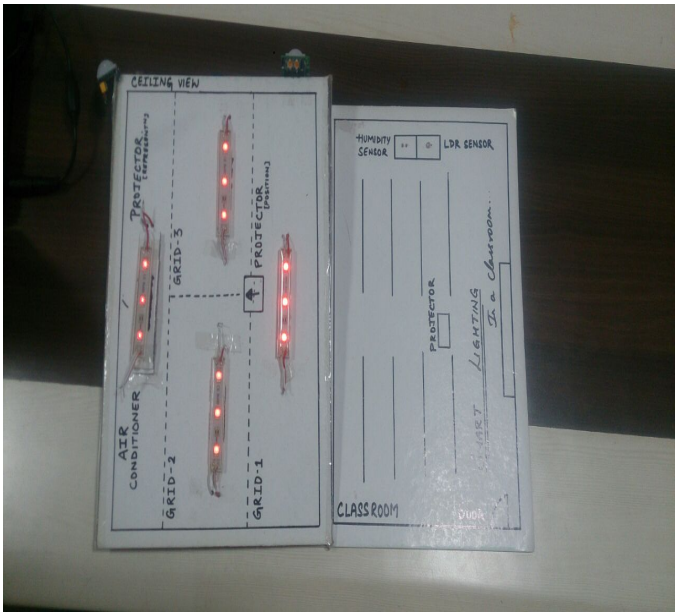

Fig.10 Relay based Lighting control

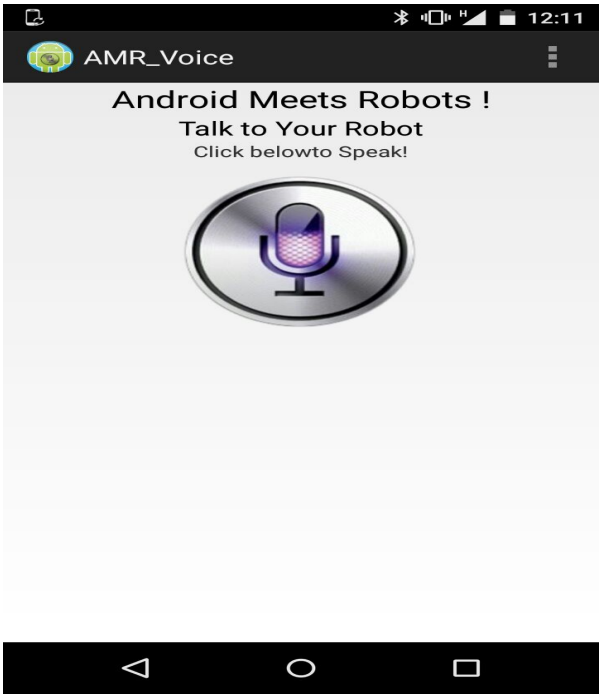

Fig.11 Mobile App for Lighting Control

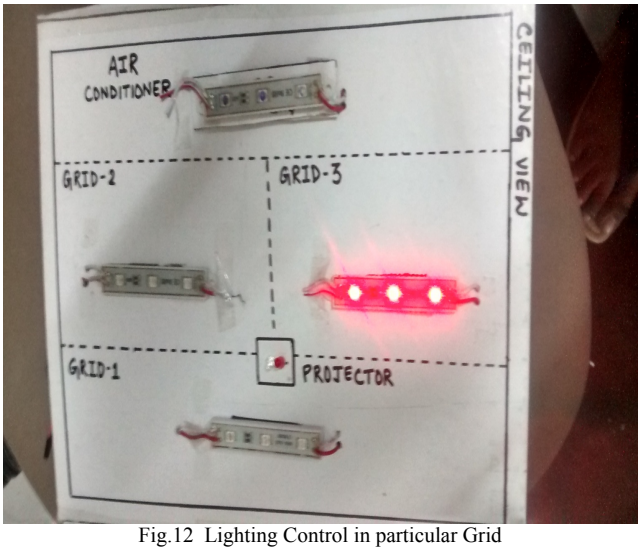

Fig.12 Lighting Control in particular Grid

Fig.13 shows based on smart lighting control in class room based on human presence input and relay control, the energy consumption have lot of improvement as compared to traditional lighting system which is shown as pie chart.

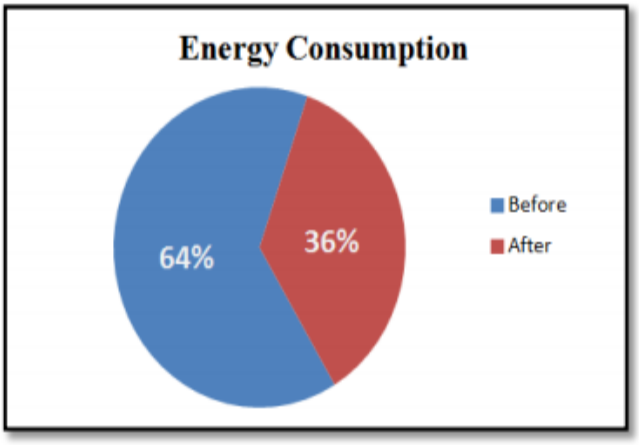

Fig.13 Pie Chart- Energy Consumption

So based on Smart lighting control system developed for Classroom condition, it was observed that the average electric units consumed in the classroom has been recorded with 2.7 units per day for 8 days. The average electricity units consumed in the classroom after calculation and analysis been predicted which shows 1.5 units consumed per day for 8 days. The objective of conserving the energy been achieved by saving 1.2 electricity units for one classroom,. Also the classroom which was consuming 64% of electricity before , the consumption been reduced to 36%. It can be inferred from this that 50% of energy is conserved

V. Conclusion & Future Work

Energy is major input sector for economic development of any country. The major area which consumes 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 Automatic lighting system where class room divided into grids and PIR sensor placed towards capturing the entrance of human inside class room and also presence of human in the appropriate Grid for switching appliances on or off by sending signal to relay control.

In addition mobile application given to the user's towards switching appliances on or off via Bluetooth too. In future, we can also look towards not only switching the appliances on or off but also dimming the light intensity, controlling fan speed, Air conditioner based on time of the day.

Also work can also be carried out towards having by customizing mobile application by having timer control towards automatically sending signal for switching off. This can be extended to machines and server in Institutions too

Table-I: Binary Combination of PIR Sensor

S.NO	Input-PIR 1	Input-PIR 2	APP GRID1	APP GRID 2	RESULT
1	0	0	0	0	-
2	0	0	0	1	GRID2 ON
3	0	0	1	0	GRID1 ON
4	0	0	1	1	GRID1 & 2 ON
5	0	1	0	0	-
6	0	1	0	1	GRID 2 ON
7	0	1	1	0	GRID 1 ON
8	0	1	1	1	GRID 1 & 2 ON
9	1	0	0	0	GRID 1 ON
10	1	0	0	1	GRID 1 & 2 ON
11	1	0	1	0	GRID 1 ON
12	1	0	1	1	GRID 1 & 2 ON
13	1	1	0	0	GRID 1 & 2 ON
14	1	1	0	1	GRID 1 & 2 ON
15	1	1	1	0	GRID 1 & 2 ON
16	1	1	1	1	GRID 1 & 2 ON

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