

RESEARCH ARTICLE



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## A Low Cost, Highly Scalable Wireless Sensor Network Solution to Achieve Smart LED Light Control for Meeting Rooms

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### ABSTRACT

Nowadays, we are using electrical energy on large scale so our next generation will face the problem of Electricity shortage. So to avoid this problem we have to save energy in any possible ways. Generally in offices unnecessarily light appliances are ON for long time even when no one is present there and it results into energy wastage so to reduce energy wastage in such places Dimming and IOT technology can be used. The proposed system uses PIR sensor and LED dimming technology to save energy in offices conference room and automatic control of lights with different mode selection facility. This system mainly deals with the energy conservation in light appliances.

Keywords: Raspberry Pi, Passive Infrared Sensor (PIR), Internet of Things, IBM Bluemix, Nodered.

### 1. INTRODUCTION

Nowadays the main problem everyone facing is Energy Crisis. This problem is mainly arise due to unnecessarily usage of energy which results into shortage of energy. There are so many ways to avoid energy wastage. The wastage of energy is mainly in industrial area like building offices where the light appliances are ON for long even when no one is there. Also due lack of automatic control and laziness large amount of energy is wasted. The energy wasted in light appliances can be save by using different techniques. For this purpose we design a system for building offices smart meeting room. This system provides advance control and automatic operating system. Generally large structure requires advance control and it should be energy saver structure. Generally, in office after meeting we come outside the conference room and forget to switch off the lights and fans thus unnecessarily

energy is wasted. Sometimes for particular task like presentation or small group discussion we need not require all the lights on, so due to unavailability of dimming technology large amount of electricity is wasted. To overcome all these problems we implement a system for smart meeting rooms. This project is consists of two parts one is manually selecting required mode and other is Automatic Entrance and Absence mode. The first part is for selecting conference room mode like Presentation, Group Discussion, Small meeting and OFF mode. Specific scene is set for specific mode including dimming of particular lights. After selecting the particular mode particular scene will start. Second part is for operating conference room lights according to present condition, if someone enters into the conference room automatically lights glows with particular intensity and if there is no one in conference room, lights will automatically

shut down after some time of interval. This will help to conserve electricity and reduce human efforts. As we are using IOT technology we can operate system from anywhere. This system mainly offers energy saving solutions in light appliances. Due to automatic control we can operate this system from remote place also as we are using IOT technology we can get live status of the meeting room through mail or message anywhere in the world. As we are getting live status so we can store this data and this information can be used for energy management system design.

### 1. INTERNET OF THINGS

Internet of Things is nothing but connecting the devices using internet for receiving and sending data. Nowadays Internet of Things is fast growing technology and most of the systems are based on IOT technology. In IOT technology one IOT device is connected to other device to send or receive information. For this Internet transfer protocol is used. IOT Platforms are used for communication between sensors and data network system. Some of the most widely used IOT platforms all over the world are IBM Bluemix, Microsoft Azure, Amazon Web Services (AWS). In this system we are using IBM Bluemix IOT platform for sending and receiving data from cloud and sensors. Nowadays IOT based light appliances are widely used as large amount of energy is saved in such systems. As the IOT based light appliances can operated from remote place so it gives advance control. So we design a system for offices meeting room using IOT technology so we can operate light appliances in meeting room from remote location also there is availability of lighting modes, so we can set scenes according to our need. As this system is based on IOT technology so it is advance and energy saver.



Fig. 1 Internet of Things

### 2. PROPOSED SYSTEM

The main objective of our system is to provide easy access and advance control of system to the user. Energy saving is the main target of our system so we are using dimming technology for light appliances. The system is consists of two parts: Software and Hardware. Software part is for PIR sensor programming and cloud-device connection. Hardware part is consists of PIR sensors, Raspberry Pi, LEDs, Power supply, etc.

The block diagram of system is shown in Fig.2. As shown in figure block diagram is mainly consists of Raspberry-Pi, Dashboard, LEDs, IBM Bluemix, PIR sensor, Power supply, etc. In this system PIR sensor is used to detect the entry of person in the meeting room so as person enters into the meeting room PIR sensor activates it sends signal to the raspberry pi. Here Raspberry pi is working as a main controller to control the light appliances in meeting room. So when someone enters PIR sensor activates and it gives signal to the raspberry pi. Then specific GPIO pin preset for particular light is triggered and respective light glows. Here to save energy, Dimming technology is used and dimming of LED is done by PWM technique. To operate from remote place this system is connected to cloud using IBM Bluemix IOT platform. The data from raspberry pi is send to cloud using node red. Nodered is the application used to connect

devices to the cloud and to receive-send data to the cloud. There is one dashboard to operate light appliances on which we can select required lighting mode. Also there is one more automatic mode i.e. Entrance and Exit mode. When someone enters into meeting room all lights glow with 40% brightness and when there is no one in meeting room all lights go in off condition after some particular delay. In our system meeting room structure consists of five LEDs. Four LEDs are placed at each corner of meeting room and one LED is placed at center of meeting room. The different modes and their function is as follows:

- 1] Presentation Mode: Glow center light with 30% brightness.
- 2] Welcome Mode: Glow all light with 40% brightness.
- 3] Small meeting Mode: Glow front two lights with 80% Intensity and center light with 70% intensity.
- 4] Group Discussion: Glow 4 lights with 70% and center light with 100% intensity
- 5] OFF mode: Switch off all the lights.

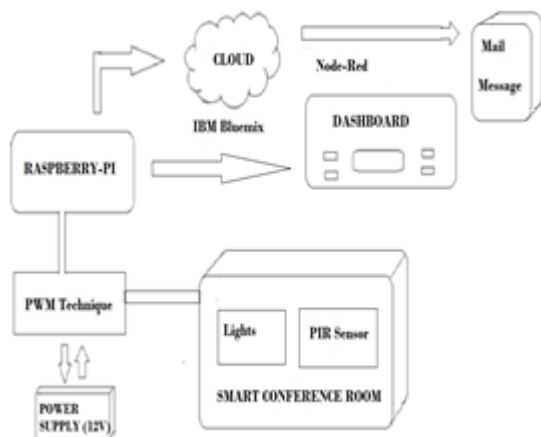


Fig 2. Block Diagram of Conference Room System

### 3. SYSTEM DESIGN

**A. PIR Sensor and LED interfacing:** Passive Infrared Red (PIR) sensor is used to detect individual in particular space. As PIR

Sensor gives signal to the Pi, Pi triggers the particular GPIO pin so LED glows which is connected to that GPIO pin.

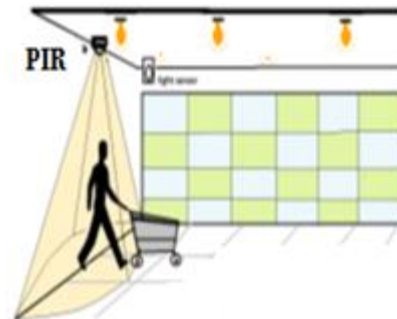


Fig 3. Lights turn ON when Human body is detected

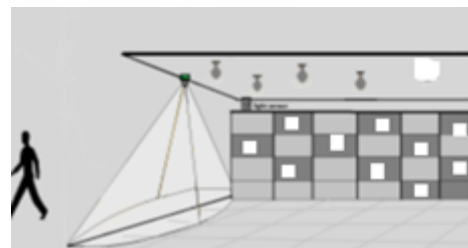


Fig 4. Lights turn off when no human body is detected

**B. Raspberry Pi 3 (Model B):** The Raspberry Pi 3 Model B is the third era Raspberry Pi. This intense credit card shaped single board PC can be utilized for many tasks. Furthermore, Raspberry Pi 3 B has more intense processor, 10x quicker than the original Raspberry Pi. Also it includes remote LAN and Bluetooth network making it the perfect answer for effective associated plans. This Raspberry Pi has Low price and it consists of 802.11n Wi-Fi and Bluetooth 4.1. The main disadvantage of pi is it requires lots of additional hardware for working as a full computer. Raspberry Pi 3 has 40 GPIO Pins so number of sensors and devices can be connected in a system



Fig.5 Raspberry Pi 3 B Diagram

**C. WiFi Router Configuration:** For the communication or connection between the IOT based devices WiFi unit is working as a medium. Also it can be used for security purpose. By using specific command we can communicate Raspberry pi with WiFi.

**D. Proposed IOT Architecture:** IOT Architecture is consists of 4 layers namely Physical layer, Data Link layer, Network and transport layer, Application and presentation layer. In our system physical layer is consists of PIR sensors, LEDs i.e. lighting appliances. Data link layer consists of Raspberry pi and device manager. All the outputs from sensor part is received in this layer also input to the lighting appliances is send from this layer. The internet is used for the Network and Transport layer so the IOT devices can be connected via internet from which they can be easily operated. Application and presentation layer is consists of dashboard from which we are going to set different modes for the system also the live status of our system can be seen on our smart phone or computers using mail and messages. Due to the live status of system we can design Energy management plan for the whole structure which results into energy saving.

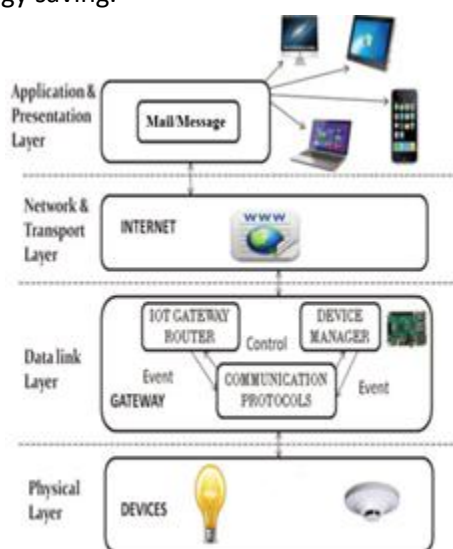


Fig.6 Proposed IOT architecture for system

**E. Graphical User Interface:** Graphical User Interface is nothing but facility provided to the

users to operate embedded sensor devices by using symbols, logos, figures, etc. In our system Dashboard is consists of two sections one is for changing the intensity of different LEDs and other is for selecting the required lighting mode. Dashboard providing easy access to control the system from single place.

**4. IMPLEMENTATION DETAILS**

Implementation part first start with installation of operating system in raspberry pi. In this project we installed Raspbian Jessie O.S. in raspberry pi. After this according to the users need raspberry pi configuration part is done. Then the programming for LED dimming using PWM method is done using Python language. According to the user’s requirement programming is done.



Fig.7. PIR sensor interfacing with Raspberry pi Now the data receiving on raspberry pi is send to the cloud. For this IBM Bluemix IOT platform is used and device connection is done through Nodered. The raspberry pi data is displayed on Computer screen from which we operate the system. The dashboard of the system is shown in Fig.8



Fig.8. Dashboard for user



Dashboard is designed to control and monitor the meeting room of offices. Dashboard is easy to access for any user so anyone can operate this dashboard easily. For the live updates of meeting room schedule you will get the mails and messages on your smartphone.

## 5. RESULTS AND CONCLUSION

### A. Results

The results we obtained after installation of our system are as follows. As the individual enters into the meeting room PIR sensor activates and it sends commands to the controller and as predefined command all lights in the meeting room are glow with 40%.The priority of function is given to the manual mode selection, so if someone selects lighting mode from dashboard Automatic entrance mode goes into off condition and particular mode function starts to work. When no one is in the meeting room, the all lights goes in OFF condition after some time delay. By selecting particular mode we are getting following results:

Particular Mode Working of LEDs

Table1: Specific mode and its working

Particular Mode	Working of LEDs
Presentation Scene	Center LED 3 glow with
	30% brightness
Welcome Scene	All LEDs glow with
	40% brightness
Small Meeting Mode	LED 1 and 2 glow with
	80% brightness and center LED glow with 70% brightness
Group Discussion	LED 1,2,4,5 glows with
	70% brightness and center light with 100% brightness.
OFF mode	All lights glows in OFF condition

So by using this system we can avoid energy wastage and large amount of energy can be saved in industrial area like building offices.

### B. Conclusion

Automatic and different lighting mode system is energy saving system because in this system light dimming technology and energy saver sensors are used. Using LED over other lighting options in the system makes system advance and smart. This proposed system is designed for single room, still large amount of energy is saved so if such system is designed for large structures with advance sensors more energy can be possible to save. As IOT technology is used in this system a remote access facility is available to this system. As we are getting the live status of the system it is helpful to build the energy management plan for big structures.

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