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IoT materials enabled indoor light illumination monitoring system

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ABSTRACT

The developments in information and communication technology in the digital age are primarily based on the IoT. The IoT-based services are enhancing the real world progress of the domestic/commercial/industrial sector. IoT-based automation is more common and all electrical gadgets are networked to monitor the operating condition without human interference. This helped us to develop an idea to manage the illumination control of electrical systems in the workplace to control the excess heat and light ray reflection. The sensors sense the operations of selected gadgets over a smart phone. The gadgets data are monitored around the globe in real time, either for easy access or security purposes. Gadgets operating information is sent to the cloud via wifi module with ESP8266 and router support. This work uses the Adafruit cloud and obtains data. In order to track the working state, the user can view the data in the Adafruit dash board and also be authenticated to the public to view same.

1. Introduction

The electric energy consumption in light system is one of the anxiety factor and natural light system is suggested during daytime. The light system consumes bulk of electricity in the country and maximum demand raises every day. Cybertecture known as smart home was introduced in 1984 by American association. The implantation of smart home with Emerging technology like Artificial intelligent, Machine Learning, IoT may reduce the consumption and the system is well-suited for consumer [1,2]. Also supports the reduction of carbon. All the electrical gadget can operate remotely for intelligent automation with the support of IoT [4–6]. Now a days, AI algorithms have developed for electrical appliances control but buyer could not ready to change the existing system due to economical factor concern. The consumer can add few things with existence to make smart operation. The information can analyze selected gadget and suggest the control of behavior in the system. Especially light intensity illumination reflection control is crucial and effective control methods are presented in this work. The Table 1 gives the different types of lamp used in our lighting system and its Lumen value. The luminance flux is linear i.e., proportional to control signal. The working environment has light arrangement and also with natural light in the surface. The illumination at single point is$L = (Icos\theta)/d^2$ and full illumination on surface is given by $L = \sum(Icos\theta_i)/{d_i}^2$in [*]. The illumination depends upon resistance $R = 10^{k\lg L+m}$ The R is decreased as the intensity of light increases and vice versa. The analog voltage of LDR is $V = V_{CC}R/(R + R_0)$. Here the V_{CC}, R_0 is fixed as and R depends on lux level.

In modern smart home, the selection of light source and luminous is much essential for energy efficiency and more productive in economical throughout the days. For the satisfactory illumination in the living room, Hall, Kitchen and outdoor the designing of system with luminous will be efficient and reliable to the entire period. The designing parameters are 1. Reflected Glare 2. Level of Illumination 3. Contrast luminance 4. Source configuration 5. Distance between the sources 6. Human factors. The most important criteria for building up the lighting in a living room is luminance level but it is easy to access via IoT model The biggest crises are luminance changes under parallel load on/off condition. Our connected gadget such as sensors and lighting loads may affect under this condition. The LED, CFL lamp are suggested for smart home system but it has power quality issue [3] like harmonics, power factor and inrush current. These issues creates stress on the gadget and bring down time for life. The warm colour-type lamps yield lesser harmonic than cool colour-type lamps. The illumination level has categorised in three modes: photopic, scotopic, mesopic and the spectral response is shown in Fig. 1 for easy understanding.

The productivity in the man-machine working environment is depends on a user sulk, social behaviour and lumens of a room.

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Table 1
Lumen value of different lamps.

Type of Lamp	Watts	Lumen
Incandescent	40	290
	60	840
CFL	9	550
	13	810
LED	6	450
	9.5	800
Halogen	53	940
	75	1500
Metal Halide	250	22,000
	400	36,000
	1000	110,000
HPS	150	16,000
	250	24,000
	400	50,000
LPS	18	1800
	35	4550
	55	7800
LED street Lamp	25	2772
	42	3648
	146	12,642
	202	13,620
PCA	0.9	140
	1.8	77
NBA street lamp	16.4	1147
	20.6	1460
	42.3	3311

The effectiveness in a room, the evaluation is made for how intelligent lighting can support with the user of various interest, needs and preference of one's different from another. This is interesting to the task of the proposed system and to recognize the authentication and validating the user to give nice environment for efficient working condition and store the illumination level data in cloud. This data is used for further research using data tools to establish more effective operation in future.

2. Materials and methods

The cloud based data monitoring is shown in Fig. 2. The authenticated person called as user enters the working zone with smart phone and automatically connects the Bluetooth which will operate in full-duplex mode with IEEE 802.15.1 protocol network. The authenticated user allowed to power ON the main, else it will search an authenticated user gets connected. When main is ON, the user can select 'N' number of connected gadgets to turn ON/OFF through html page by clicking on the ON or OFF button or installed APP in the smart phone. The sensor measures light intensity of all the ON gadget and send to ESP8266 wifi module [7,8] (Protocal: 802.11b/g/n). The speed of data is 30 dpm which is send to the adafruit cloud and the same to be authenticated for public access. All can view the live status of the gadget and suggest the user to control the gadget ON/OFFfurther depends on the lux level. The control process is shown in Fig. 3. The lux produces heat dissipation and can be controlled in the proposed model efficiently. This will help environment and also energy saving in the electrical system. The procedure is explained below.

Step 1: An authenticated person enter the work place with Bluetooth enabled device
Step 2: The Bluetooth network search the connected gadget and validated it
Step 3: Allow the user to switch on main in the panel via security code
Step 4: User can select and switch on the gadget based on requirements
Step 5: The Cds material based sensor detects the light illumination
Step 6: The analog data of sensor is send to ESP8266 module
Step 7: The ESP8266 module is connected to the globe via router
Step 8: The Adafruit reads 30 dpm and graphical data of real time process can view in the user dash board

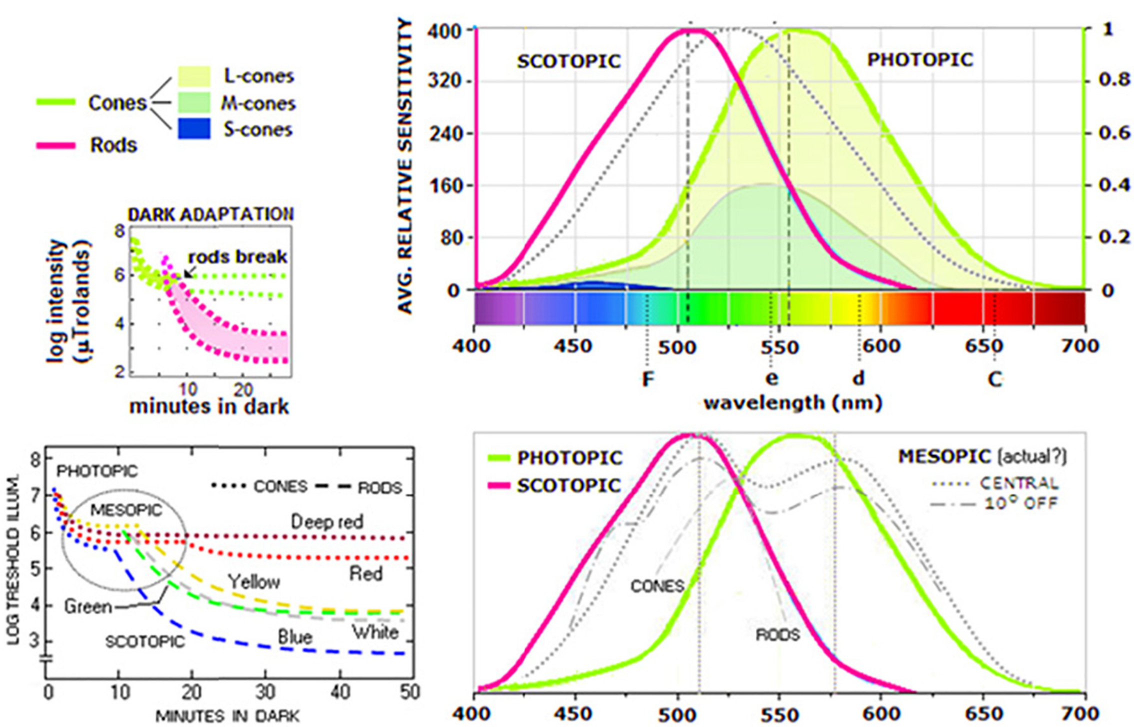

Fig. 1. Spectral Response of illumination.

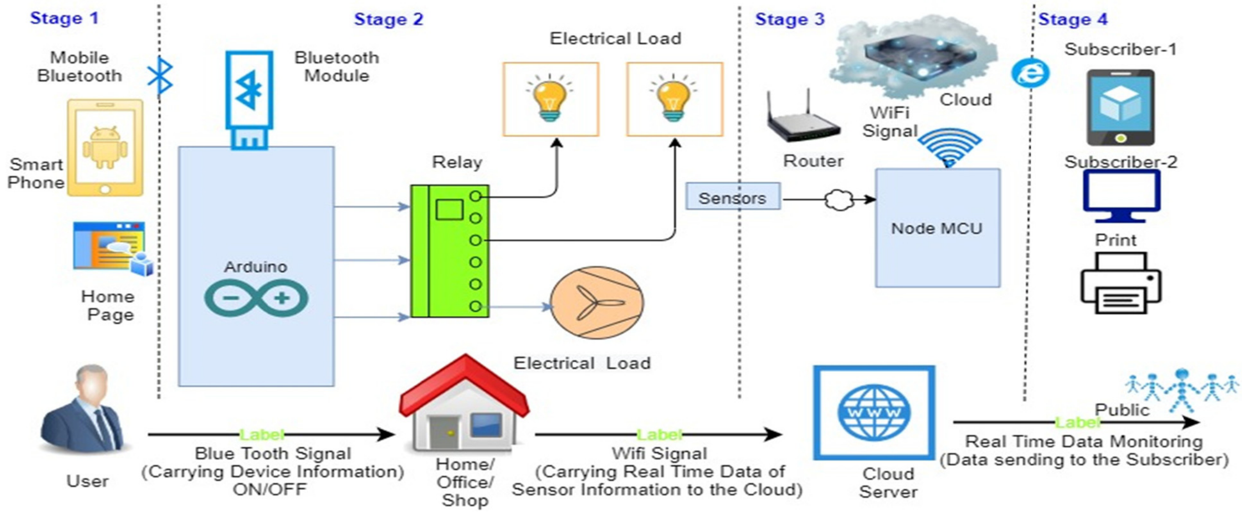

Fig. 2. Architecture of cloud based monitoring system.

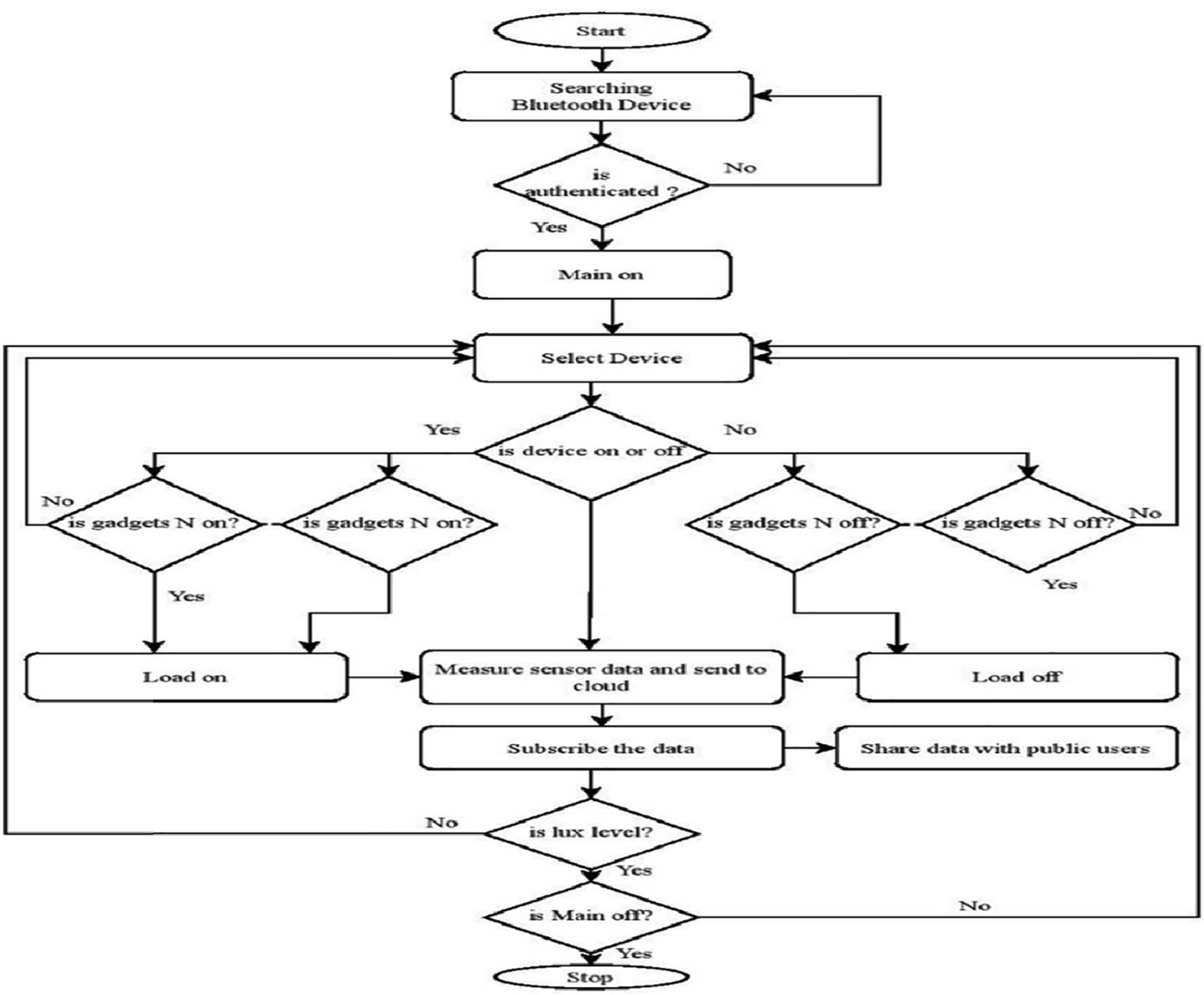

Fig. 3. Flow chart of control process of illumination monitoring system.

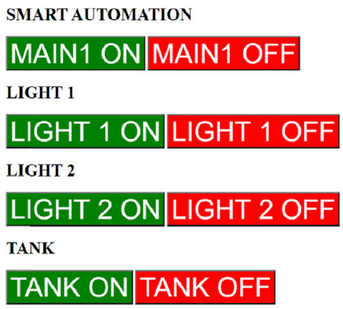

Fig. 4. Webpage of smart automation.

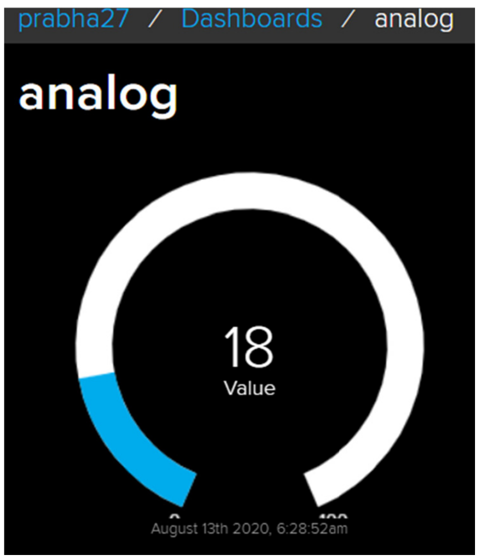

Fig. 5. Lux level indication in Adafruit Dashboard.

Step 9: The user providing an authentication to the public by enabling pubic option in the feeds of the cloud.
Step 10: The user is also sharing the same to many authenticated persons to work concatenately by sharing key of web, API, MQTT in adafruit io cloud
Step 11: The viewer can suggest the lux level and control can be implemented by the user at workplace
Step 12. The user exist the workplace once the process completed

3. Result and discussion

The smart automation web page is created in HTML and alignment made in CSS. The test bench has 1- MCB module (brand: Hager),2-Lamp (L1 & L2), 1-water tank (T1) which are controlled through web in the globe as shown in Fig. 4. The smart gadget can also control at workplace via HC-05 module which cover 10 m of surrounding area of the connected gadget. Asecurity code was made to switch on/off the gadget. The MCB with stand the capacity of 10 A of the connected electrical network and disconnect the live connection beyond the rated value. The loads are lamp (40 W) and 1 hp, 220 V motor which is cable to delivery 40 LPM to the tank and act as parallel load.

The load changes in the connected live line affects the illumination during short span of time. The flickering is not visible in human eyes sometimes but CdS material used to make LDR which detects the changes. The illumination level variation observed at water tank on/off condition in the cloud. The Fig. 5 shows the lux level monitoring of light system in the user dashboard of adafruit io cloud which receive 30 dpm and the variation of lux level is shown in Fig. 6 which is the feeds window of Adafruit IO. The feeds are the primary part of Adafruit IO cloud and metadata of sensor

Fig. 6. Lux value in feeds window of adafruit cloud.

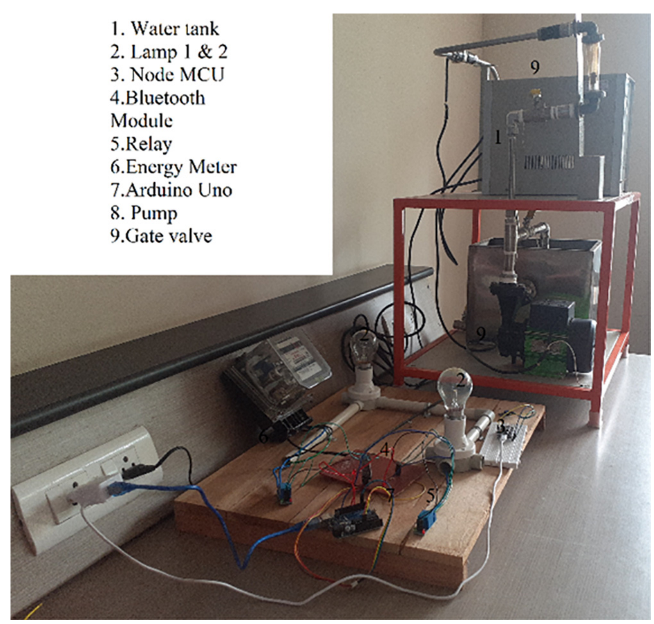

Fig. 7. Test bench of proposed system with parallel load.

Table 2

State	L1	L2	T1	Illumination Level	flicker
0	Off	Off	Off	Natural light illumination	No
1	On	Off	Off	increases	No
2	On	On	Off	increases more	No
3	Off	On	Off	decreases	No
4	Off	On	On	Same level	Yes
5	On	On	On	increases more	No
6	On	Off	On	decreases	No
7	On	Off	Off	Same level	No
8	Off	On	On	Same level	Yes

sent tocloud from gadget. The data can also be extracted .csv format and our proposed system will support to the lux level control. The test bench of illumination system with parallel load setup level is shown in Fig. 7 and the Table 2 shows illumination observation at different state.

4. Conclusion

The Cds material based LDR is used to detect the illumination of proposed architecture and low energy Bluetooth module is to control gadget on/off position. The IoT-based services were pretty and support the monitoring of all electrical gadgets in connected network. The illumination control reduces the carbon emission and energy consumption. The parallel load arrangement is made and observed the power quality issue at different operating position in very short span in the lux level monitoring system. The proposed structure was more economical for illumination measurement and suggesting to add with existing system to full fill the dream of smart gadget. We also suggest to use Lora module for industrial applications which could cover almost 2 km of network coverage.

5. Future scope

The emerging technology such as artificial intelligence, Machine learning, Data science and etc requires the data set to build the model for real world problem. This work helps to build upcoming technology by extraction data in .csv format. Also support for the existing light system by incorporating LDR in the lamp holder which could be very least cost of Rs. 50 INR and made smart light system.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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