Smart Office Automation System for Energy Saving

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Abstract: *The main motive of this paper is save electricity while peoples are leaving the room. Sometimes peoples are leaving the room without switch off the fan and light. This causes the power waste and money waste. To avoid this problem, we are prepared an article named as smart office automation system for energy saving. In this article light and fan is switched on, when the human beings are entered into the room. After leaving the room fans and lights are switched off automatically with in a small time interval. Light is switched on based on sunlight intensity. If the sunlight intensity is sufficient, then light is switched off. This concept is particularly suitable for working rooms. In this article we are using Light Dependent Resistor (LDR), Pyroelectric Infrared (PIR) sensor, Logic gates, Voltage comparator and Electromagnetic relay. Human being motion is sensed by PIR sensor and Sunlight intensity is sensed by LDR. We are also provided Manual mode and Automatic mode options in this article. Suppose if any problem occurs in this circuit, user can change it into Manual mode. So we are avoiding interruption of fan and light working. This article is also used to detect the idly sitting employees in office.*

Keyword: *Saver; Office Automation; Automatic lights; Light dependent resistor; Pyroelectric infrared sensor;*

1. INTRODUCTION

This article presents a Smart office automation system for energy saving. In many offices fans and lights are unwantedly switched on condition. Reason is employees are forgetting to switch off the electrical appliances while leaving the office. It makes power loss and money loss. To overcome this problem we are designed this article for saving power and money [1] & [2]. PIR Sensor is used to detect the human being present inside the room and LDR is used to sense the ambient light. If human being is present inside the room or enters into the room fan is switched on and light is switched on based on ambient light. If ambient light is sufficient to do a work, then light is off condition or else light is on condition. When all the persons are leaving the room, light and fan is off automatically. So no need to manual controlling of electrical appliances.

This concept is also monitoring the employees working status. Because the PIR sensor senses the human being movements. If the human is sit idle condition it does not sense the human being. This produces low signal for switch off the fan and light. It indicates employees are not worked. In LDR ambient light intensity is varied with help of small variable resistor. So we are set the room light intensity for switch on the lights. Hence no need of timer for switch on the lights. This concept is not only used in office rooms, it also uses in class rooms and street lights. This article is does not need microcontroller. So cost of this implementation is very less.

2. LITERATURE SURVEY

This Section provides a brief survey on the existing energy saving system proposed in the literature by the researchers in the past. For instance Aniruddha Mukund Ghuge, Sachin R.Kale and Akash Shahade have presented An Intelligent Lightening System for Energy Saving [1].This paper explains power saving system while the human beings are not present in room and temperature based fan speed controller. It also includes smoke sensor for fire indication. R. Anandan, B. Karthik, Dr. T. V. U. Kiran Kumar have presented Wireless Home and Industrial Automation Security System using GSM [2].

This paper explains security system using PIR, gas sensor, smoke sensor and main fuse failure indicator. If anyone the sensor is sensed, then message is transmitted to the user mobile number using GSM module. Kirtika K. Lunawat, Prof. U. M. Gokhale have presented Home appliances control and energy management using PIR sensor and ARM processor [3]. This paper explains power saving up to 25% using ARM processor. M. Vishnu Chittan, Dr. Mani Kumar.C and

www.ijaceeonline.com ISSN: 2456 - 3935

International Journal of Advances in Computer and Electronics Engineering
Volume 2, Issue 9, September 2017, pp. 8–12

G. Prem Chand have presented Microcontroller based building automation system using RTD sensor is developed for saving the energy using lighting control, air-conditioning based on temperature, gas leakage detection water flow controlling for the gardens [4]. Moreover A. Elakya, D. Thenmozhi, K. A. Yasir, D. Pavithram, G. Thukkaram have presented a Smart Distribution monitoring system with security is developed to monitor the power and energy using arduino and android through Bluetooth interface [5].

Arun Radhakrishnan, Vuttaradi Anand has presented a Design of an Intelligent and efficient light control system is also suggested PIR sensor for saving power while human being is not present that room [6]. Other methodologies used for Energy saving systems are based on Zixbee and Microcontroller [7], Raspberry pi and camera [8], Matlab and Arduino Uno [9], and PIC18F4520 Microcontroller [10]. The rest of the article is organized as follows: Section 3 presents the Block representation. Section 4 focuses on the hardware implementation, while conclusion and scope for future work are given in Section 5 and 6 respectively.

3. BLOCK REPRSENTATION

The block representation of the proposed Smart Office Automation System for Energy Saving is given in Fig. 1. A PIR sensor is used to sense the human being movements. Output of the PIR sensor is given to AND gate. Another input of AND gate is coming from LDR. If both the inputs are high, AND gate gives logical high signal. This signal is given to relay driver circuit. Now Relay is switch on the light. If any one of the sensor output is zero, AND gate gives active low signal. Now the light is off condition. PIR sensor output is directly given to another relay driver circuit. If PIR sensor output is high, then relay driver is switch on the fan. Suppose the sun light intensity is more sufficient, then LDR output is Low and light is switch off.
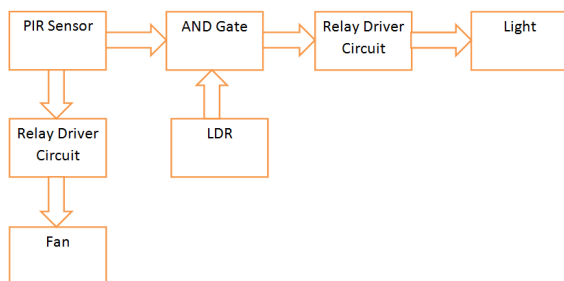

Figure 1: Block representation of the proposed system

4. HARDWARE IMPLEMENTATION

The hardware realization of the proposed Smart Office Automation system for Energy Saving is detailed below.

4.1. PIR Sensor

In this paper we are using HC-SR501 PIR sensor [3] & [4]. The PIR sensor has two slots. Each slot is sensitive IR material. When the sensor is idle, two slots detect the same amount of IR. When the human being or animals are passes by, it first intercepts first half of the PIR sensor, which causes the positive differential change between two IR. When the human beings are leaves the room, reverse action is takes place, whereby the sensor generates negative differential change. These change pulses are what is sensed. A small plastic lens is used in this PIR sensor. This is a Fresnel lens, it used to increase the sensing range. There are two adjustments in this sensor. First one is time delay and second one is sensitivity. We are change the sensitivity and output time delay with help of these adjustments. Input voltage of this sensor is DC 5V and output voltage is 3.3V, Maximum sensing distance is 7m and Maximum sensing angle is 110 degree. PIR sensor is shown in Fig 2 and Fig.3.
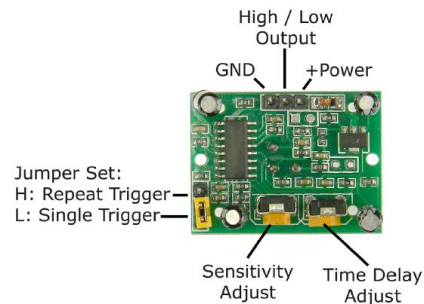

Figure 2: PIR Sensor Bottom View

Figure 3: PIR Sensor Top View

4.2. Light Dependent Resistor (LDR)

Figure 4: Light Dependent Resistor

LDR is a Passive component basically its resistance varies based on the light intensity. Another name of the LDR is Photo resistor [5]. Photo resistor is made up of high resistance semiconductor that absorbs the photon and gives it energy to bound elec-

www.ijaceeonline.com ISSN: 2456 - 3935

International Journal of Advances in Computer and Electronics Engineering
Volume 2, Issue 9, September 2017, pp. 8–12

trons for moving electron into conduction band. The number of free electrons is depending on incident frequency of light rays. LDR resistance is very high at dark condition and its resistances decreases when light falls on to the LDR based on light intensity. In this paper LDR is used to sense the room ambient light. If it is too low, then LDR gives high resistance otherwise it gives low resistance. Light Depending Resistor is shown in Fig. 4.

4.3. Flowchart

A basic flow diagram of Smart Office Automation System for Energy Saving is shown in Fig. 5.
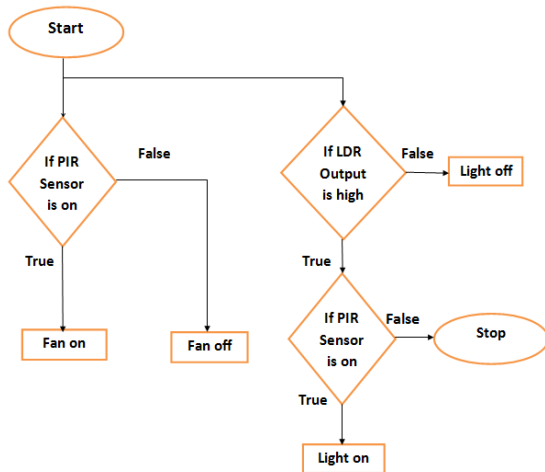

Figure 5: Flowchart for smart office automation system for energy saving

The above flowchart explains the working of this article. If the PIR sensor is senses the human being, then fan is switched on otherwise fan is off condition. LDR sensor output goes high when the sun light intensity is goes low. This time comparator checks the PIR sensor output. If the PIR sensor output and LDR output is high, then light is switched on. If any one of the output is low, then light is switched off.
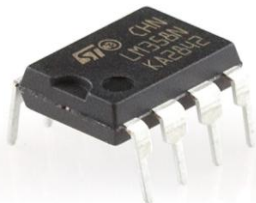
4.4. Voltage Comparator

Figure 6: LM358 Operational amplifier

In this paper a LM358 operational amplifier is used for comparing ambient light intensity [6]. It consists of two operational amplifiers with 100dB voltage gain. Important feature of this IC is no need of independent power source for each comparator. It can operate from 3V to 32V dc supply. Reference voltage is

applied to pin 3. If the input voltage of pin 2 is greater than reference voltage of pin 3, comparator gives active high signal. This concept is used for comparison of light intensity. Suppose the light intensity is greater than of reference intensity, comparator gives active high signal otherwise it gives active low signal. LM358 operational amplifier is shown in Fig.6.

4.5. AND Gate

In this paper 7408 is a logical AND gate used for comparing two sensors output levels. 7408 consists of 14 pins and 4 AND gates. Input voltage of this IC is 5V DC and also output voltage is 5V DC. In this paper we are using one gate for comparing logical levels. This gate gives logical high signal when both the inputs are high [7] & [8]. If any one of two inputs is low then it gives active low signal. This concept is used to turn on a light when both the sensor outputs are goes high level. If any one of the sensor is low then light is turn off. AND gate is shown in Fig. 7.
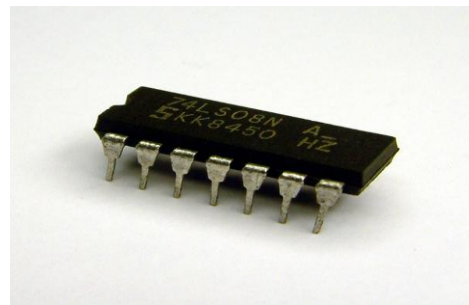

Figure 7: AND gate

4.6. Relay

In this paper we are using two 5V electromagnetic relay for switch on a light and fan. Relay consists of 5 pins namely NO (Normally Open), NC (Normally closed), C (Common) and two coil leads. One relay is used to control the light and another one is control fan [9] & [10].
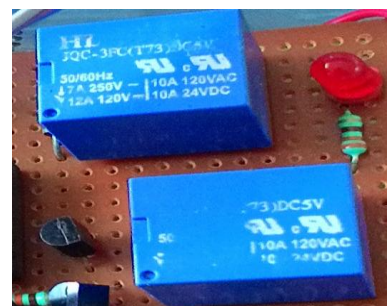

Figure 8: Relay

In this paper NPN transistor act as a relay driver. When the transistor gets high input signal from AND gate, transistor is switching the relay contacts from NC to NO. The loads fan and lights are connected to NO terminal of relay. So fan and lights are turned on condition. If the input of transistor is low signal, both the loads are turned off condition. PN junction diode

is connected parallel to relay coil. This is used to avoid back emf (electromotive force) when the relay is turned off. Electromagnetic relay is shown in Fig.8.

4.7. Hardware Model

The Final hardware model is shown in Fig.9. It consists of PIR sensor, LDR, Relays, Transistor, Voltage comparator and Slide switches etc. When the PIR sensor is senses the human being, then fan is switched on for some time interval. If the sun light intensity is too low, then LDR output becomes high and Light is turned on for some time interval. Human beings are after leaving the room, fan and lights are automatically switched off. Fan and light is continuously on when human beings motion is continuously detected.
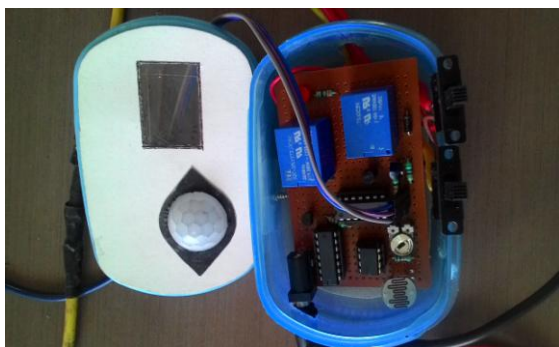

Figure 9: Hardware Model

5. CONCLUSION

This article proposes a low cost and user friendly smart office automation system for energy saving. Main advantage of this concept is no need to care about fan and light, because it is fully automated. Suppose any problem occurs in automation then we switch to manual mode. It also monitors workers movement. So no one can sit idle in office. The proposed concept is robust, reliable and requires less maintenance. The idea proposed in this article can be used in industries, class rooms and apartments.

6. FUTURE WORK

In future the proposed idea can be extended to check if the human being is present (idle) or not and also light intensity varied based on the sun light intensity.

7. ACKNOWLEDGEMENTS

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