

Intelligent Household LED Lighting System with Autonomous Control Based On User Movement and Collective Control Using Wireless Technology

S.S. Lavhate¹, Prafull Bagul², Pritesh Gawade³, Mitesh Bhanushali⁴,

Pravara Rural Engineering College, Loni

Department of Electronics & Telecommunication, Savitribai Phule Pune University, Maharashtra, India

seema.arote@gmail.com,prafullbagul@gmail.com,gawadepritesh@gmail.com,mb.mitz92@gmail.com

Abstract— Rescuing energy has become one of the most important problems these days. The maximum waste of energy is caused by the inefficient use of the consumer appliances. Particularly, a light accounts for a huge part of the total energy consumption. There are number of light control systems introduced in today's market, because the installed lighting systems are outdated and energy-inefficient. However, due to architectural imperfections, the existing light control systems cannot be successfully applied to home and working places such as office buildings, laboratories. Therefore, this paper proposes an intelligent household LED lighting system considering energy efficiency and user satisfaction. The forth put system employees multi sensors and wireless communication technology in order to control an LED light according to the user's state and the surroundings. The intended LED lighting system can autonomously adjust the minimum light intensity value to enhance both energy efficiency and user satisfaction.

Keywords—LED lighting system, energy efficiency, wireless communication technology.

I. INTRODUCTION

As the energy conservation and environmental protection take more and more attentions, energy rescuing is becoming increasingly vital. Saving energy by operating intelligently according to user presence and demand is necessary [2][4]. More close in India, there is a lack of such lighting system which operated intelligently. We have tried to make a LED lighting system which may operate intelligently considering energy efficiency and user satisfaction. It also includes collective factors and wireless technology which discussed further.

A. Literature Review

Many researches are done on the lighting system. Y. Uhm [5] discovered lighting system that can control illumination intensity of LED light accordingly to the surrounding. Abiodun Iwayemi [3] provides complete survey of various WSN (Wireless Sensor and Actuator Networks) based schemes for lighting control for future studies. This survey also provides classification of many intelligent lighting control system based on the different schemes (centralized and decentralized schemes) used. Chunfeng FAN [2] proposed lighting system with the help of dimming process. In this process user's location is considered as a centre position and only lamps in this region

need to be lightened. Denardin *et al* [6] discovered a street light controlling and monitoring system based on a wireless data network. This system adds communication capabilities to the existing street lighting systems.

Since the existing systems are construct without considering user satisfaction, it is not suitable to the places such as house and office where user satisfaction is more crucial factor than cost benefits due to energy saving; thus a new intelligent lighting control system should be designed considering both energy efficiency and user satisfaction.

Therefore, this proposes an intelligent household LED lighting system considering energy efficiency and user satisfaction. The proposed system uses multi sensors and wireless communication technology in order to control an LED Light according to the user's state and the surroundings .The proposed LED lighting system can autonomously adjust the minimum light intensity value to enhance both energy efficiency and user satisfaction.

Objectives of System

- i. Autonomous control based on user movement: Automatic control of switches based on the user movement.

- ii. Autonomous brightness control: According to the brightness of the surrounding system brightness adjusted autonomously.
- iii. Collective control using a wireless technology: System can be operated with the help of sever PC situated at the other location using Zigbee technology.

II. CHALLENGES TO THE SYSTEM

Lighting system research over the past two decades has been driven around the need to improve energy efficiency in order to reduce energy cost. Regardless of availability of such energy efficient systems, these technologies have not widely used due to the high cost of implementing them into the working environment. However these systems are not user friendly or we may say, are not taking user satisfaction in account. In working environments such as office buildings or laboratories user satisfaction is of more importance than the reduced energy cost as the absence of an adequate light may hamper the performance of an individual. Thus we have proposed an intelligent lighting system with user satisfaction using LED's with autonomous control considering user movement and collective control over appliances such as Fan and Computer using wireless technology.

A. Need of the System

Lighting systems provide the workplace the illumination. They directly or indirectly may hamper the performance of an individual hence the productivity. As we are designing the Intelligent Lighting system considering user satisfaction, controlling the brightness of the workplace is of much importance. A variety of brightness control strategies are available, depending on the function of the room and availability of natural light. In our system by detecting the available light, Dimming, a process of minimizing the light from LED bulbs to provide pleasant working environment with an adequate light in daytime where the luminance is rectified as per user preference, is used. For autonomous control motion sensors are used.

In proposed intelligent lighting system brightness or luminance control is done by sensing the daylight of the surroundings and controlling the frequency of the power transistor. There are two types of controlling, switching

and dimming. In switching the light is either on or off depending upon daylight. An LDR is used to sense the available light. Also the appliances such as Fan and computer can be controlled using the motion sensors. And the whole system can be controlled from the single server using wireless technology such as Zigbee to save the energy further more.

B. Aim of the System

To construct a user friendly intelligent LED lighting energy saving system with brightness control using multi sensors and wireless communication technology.

C. Scope of the System

As the lighting system can provide illumination to various places, the few places are such as-

1. Home and Office buildings: - There are many peoples in home and office buildings, the luminance required should be high for the user satisfaction.
2. Laboratories:- In these workplaces user satisfaction and autonomous control by using motion detector is of most importance.
3. Parking lot and Warehouse: - In the both cases user satisfaction is of less importance. So the switching technique for controlling the brightness is preferred.

III. BLOCK DIAGRAM

A. Description

- Fig 1. Shows the detailed block diagram of our system.
- *Power supply:* It is a circuit which accepts 230V AC mains supply as its input and gives output voltage and current after converting it into proper format that can be acceptable for further circuitry.
- *Sensors:* The sensor senses different physical quantities. Two sensors are used in our system that is PIR sensor, LUX sensor.
- The function of PIR sensor is to trigger the microcontroller when user is present and the function of the LUX sensor is to control the brightness of the system according to the brightness of the surrounding.
- We use Zigbee for controlling our system through a PC. We can totally control our system using PC wirelessly.

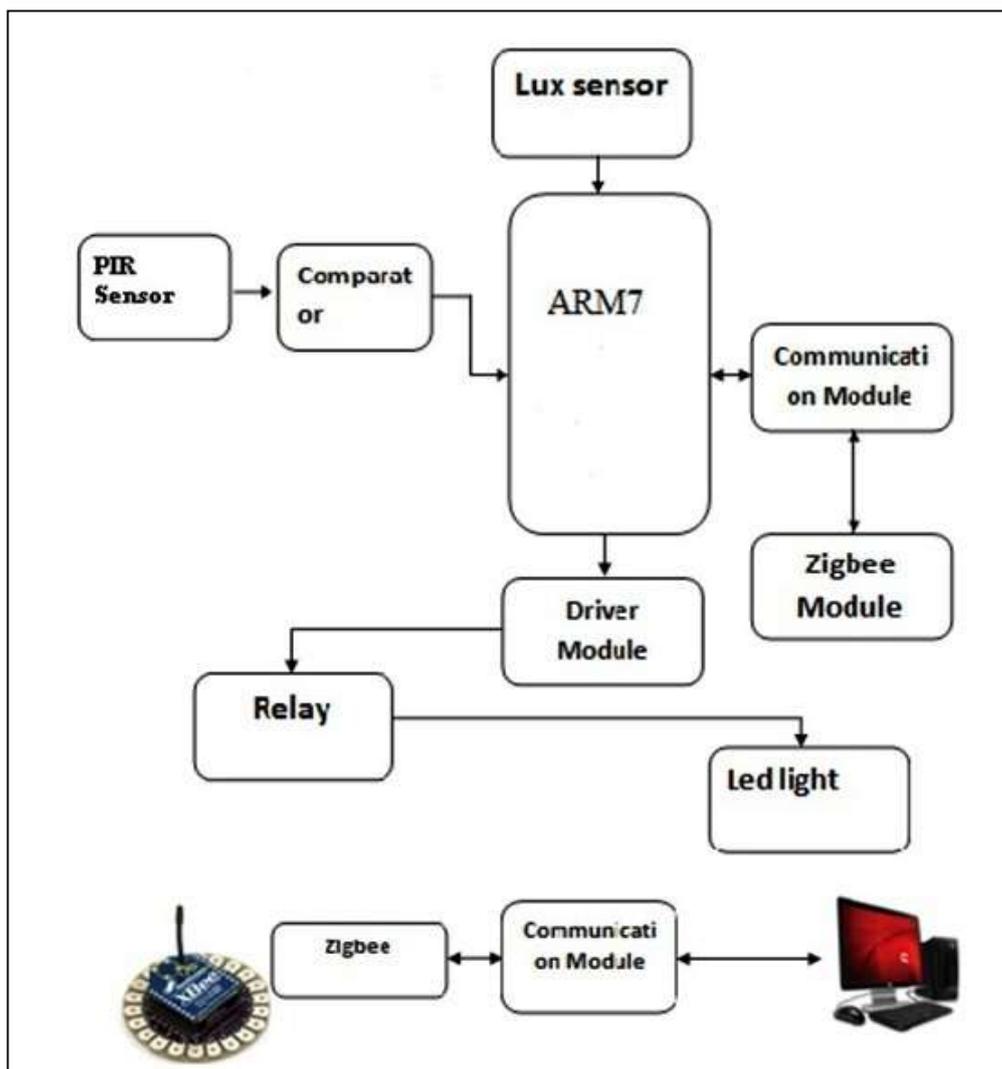


Fig.1 Detailed Block Diagram.

B. Working Procedure

We first initialize the sensors and microcontroller by applying power supply to the system. First the system is in the standby mode consuming the less amount of power. Brightness of the LEDs is control by LUX sensor autonomously by using PWM algorithm. If there is detection of human then the LEDs are turn ON with considering brightness of the surroundings. If there is no human present then the LEDs will remain OFF. If human is present in front of Fan then the Fan will turn on autonomously otherwise it will be in OFF state. System is control wirelessly with the help of Zigbee technology where transmitting range of 30m. The system is control by the server PC by using Terminal software.

IV. SYSTEM ALGORITHM & FLOWCHART

A. Algorithm

- 1) Start intelligent household LED lighting system.
- 2) If user movement detect by the PIR sensor then automatically turn on the LEDs and turn on the particular FAN.
- 3) If user movement is not detected then kept the LED brightness minimum using LUX sensor and turn off FAN.
- 4) If user be placed in front the PC then PC will turn on otherwise pc will be off.
- 5) Stop the intelligent household LED lighting system.

C. Flowchart

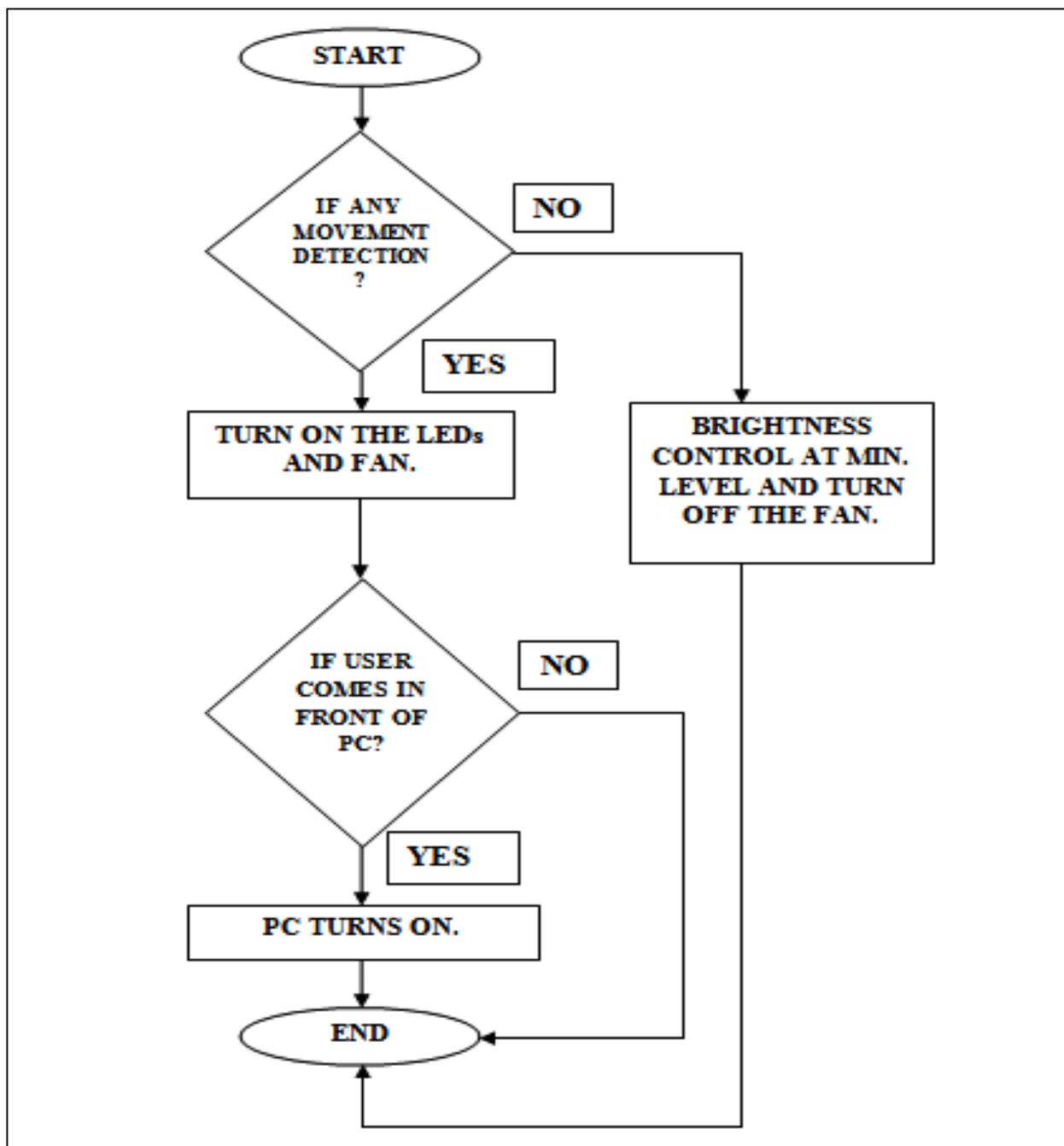


Fig.2 Flowchart

V. APPLICATIONS

- 1) Home and office building.
- 2) Warehouse.
- 3) Parking lot.
- 4) Entertainment: include high-end display and mood lighting.
- 5) Outdoor and Infrastructure: include street lighting, lighting for factories and large office buildings.

VI. CONCLUSION

We propose an intelligent household LED lighting system considering energy efficiency and user satisfaction. We have successfully control the brightness of the system autonomously according to the brightness of the surrounding. The proposed system employees multi sensors and wireless technology to enhance energy efficiency and user satisfaction by turning ON/OFF LEDs, fans and PCs as per user movement. We have also concluded that this system can be used in the applications mentioned above with more or less changes in the system.

REFERENCES

- [1] Jinsung Byun, Insung Hong, Byoungjoo Lee, and Sehyun Park, Member, IEEE "Intelligent Household LED Lighting System Considering Energy Efficiency and User Satisfaction" *IEEE Transactions on Consumer Electronics*, Vol.59, No.1, February 2013.
- [2] Chunfeng FAN, Shan JIN, Yun MENG, Weidan HONG, Qingzhang CHEN, "Design of the Lighting System for Energy Saving Based on Wireless Sensor Network" *Journal of Information & Computational Science* 8:16 (2011) 3785-3799.
- [3] Abiodun Iwayemi, Peizhong Yi, Chi Zhou, "Intelligent Wireless Lighting Control using Wireless Sensor and Actuator Networks: A Survey" *EJSE Special Issue: Wireless Sensor Networks and Practical Applications* (2010).
- [4] S. Tompros, N. Mouratidis, M. Draaijer, A. Foglar, and H. Hrasnica, "Enabling applicability of energy saving applications on the appliances of the home environment" *IEEE Network*, vol. 23, no. 6, pp. 8-16, Nov.-Dec. 2009.
- [5] Y. Uhm, I. Hong, G. Kim, B. Lee, and S. Park, "Design and implementation of power-aware LED light enabler with location-aware adaptive middleware and context-aware user pattern," *IEEE Trans. On Consumer Electron* vol. 56, no. 1, pp. 231-239, Feb. 2010.
- [6] G. W. Denardin, C. H. Barriquello, R. A. Pinto, M. F. Silva, A. Campos, and R. N. do Prado, "An Intelligent System for Street Lighting Control and Measurement," in *Proceedings of the IEEE Industry Applications Society Annual Meeting*, pp. 1-5, 2009.