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Room Light Controller with Bidirectional Visitor Counter

Ankita Jadhav[1], Aleena Inamdar[2], Asmita Karale[3], Avinash Harale[4,*]

Abstract

Given the current pace of technological development, automation is essential for increasing productivity, preserving energy, and enhancing consumer ease. The concept and implementation of an automatic room light controller with a bidirectional visitor counter are presented in this study. By detecting the presence and quantity of people in a room, the device is designed to automatically adjust the lighting, reducing wasteful electricity use. Pairs of Infrared (IR) sensors are positioned thoughtfully at the entrance to track movement as people enter and exit the space. To precisely count the number of visitors, a microcontroller evaluates the sensor inputs. The system automatically turns on the lights when at least one person is present in the room and switches them off when it becomes empty. Its bidirectional feature enhances accuracy by reliably distinguishing between entry and exit events, thereby preventing counting errors and making it an effective solution for controlling energy usage in homes, offices, classrooms, and auditoriums. The design is low-cost and easy to install, making it accessible for a wide range of applications. Additionally, its scalability offers significant potential for future upgrades, such as integration with advanced sensors, automation networks, and smart building systems. Overall, the project demonstrates a simple yet powerful approach to reducing energy waste while promoting sustainable and intelligent energy management practices.

Keywords: Human presence detection, energy efficiency, bidirectional counter, relay module

INTRODUCTION

The bidirectional visitor counter provides real-time data on room occupancy by tracking arrivals and departures. This feature is especially helpful in high-traffic areas where it is important to strike a balance among comfort, security, and energy efficiency. In addition to improving operational efficiency, combining these two systems into a single device makes the environment more sustainable and user-friendly [1].

***Author for Correspondence**
Avinash Harale
E-mail: avinashharale5@gmail.com

[1-3]Student, Department of Electronics and Telecommunication Engineering, SKN Sinhgad College of Engineering, Solapur, Maharashtra, India
[4]Assistant Professor, Department of Electronics and Telecommunication Engineering, SKN Sinhgad College of Engineering, Solapur, Maharashtra, India

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This study investigates the creation, development, and execution of a system, emphasizing its possible effects in different settings such as commercial spaces, schools, and residential areas. The objective is to design a practical and flexible solution that can be expanded to address the requirements of contemporary infrastructure, all while improving energy efficiency and user satisfaction [2–5].

The design, development, and deployment of such a system are examined in this study, with an emphasis on the possible effects in a range of settings, such as residential complexes, commercial buildings, and educational institutions. The objective is to develop a practical, flexible system

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that can be expanded to accommodate the demands of contemporary infrastructure, all the while encouraging energy efficiency and improving user experience.

LITERATURE SURVEY

Research on human presence-based lighting system automation has been ongoing for energy efficiency and smart building design. Numerous methods have been investigated to effectively regulate lighting and track room occupancy. Due to human carelessness, traditional systems frequently wasted energy because they depended primarily on manual switches. In order to automate lights, later advancements included motion detectors and basic infrared sensors; nevertheless, these often failed to distinguish between individuals entering and leaving, leading to incorrect control [6].

To overcome this restriction, advanced systems introduced bidirectional counters utilizing two infrared transmitter-receiver modules. A model offering increased accuracy and energy efficiency by controlling the lighting in a space based on a visitor counter was presented in 2017 [7].

Users can now remotely monitor and control room utilities thanks to recent trends that also show a shift towards combining wireless communication and IoT-based solutions. These systems, however, are frequently more expensive and sophisticated, making them impractical for simple applications [8].

Therefore, the suggested Automatic Room Light Controller with Bidirectional Visitor Counter expands upon previous research by providing a low-cost, dependable, and simple-to-implement system that precisely counts visitors and ensures lights are managed effectively without human intervention.

METHODOLOY

System Design

Real-time occupancy monitoring is the basis for the Room Light Controller with Bidirectional Visitor Counter's ability to automate room lighting [9]. Two sets of Infrared (IR) transmitter and receiver sensors, a microcontroller (such as an Arduino or 8051), a relay module, and a display unit make up the majority of the system. In order to determine if a person is entering or leaving the room, the infrared sensor pairs are positioned strategically near the entrance. To ascertain the order of disruptions, the microcontroller continuously analyzes the signals from the sensors. The visitor counter increases when someone enters and decreases when someone leaves. The microcontroller regulates the relay module, which turns the room lights on or off based on the counter value [10]. This straightforward yet efficient design minimizes manual intervention, encourages energy efficiency, and can be scaled for integration into more complex smart building systems. A 7-segment display or LCD shows the current number of occupants in the room. The entire system runs on a regulated power supply, guaranteeing dependable performance. If the counter is greater than zero, the lights and fans stay ON; if the counter falls to zero, the lights and fans are turned OFF to save energy.

Hardware Components

1. *IR Sensors* Infrared sensors detect the presence and movement of people by sensing changes in infrared radiation. In this system, they are used to count individuals entering and exiting the room.
2. *Power Supply:* Provides stable electrical energy to all the components, ensuring the system operates smoothly and without interruptions.
3. *LCD (Liquid Crystal Display):* Displays real-time information such as the number of occupants in the room. It offers a clear, user-friendly interface for monitoring.
4. *I2C Module:* Allows efficient communication between the LCD and the Arduino using only two data lines, reducing wiring complexity.
5. *Relay:* Acts as an electrically operated switch to control high-voltage appliances like lights and fans using low-voltage Arduino signals.
6. *Bulb and Socket:* The bulb serves as the lighting load for testing, while the socket provides the connection point for safe operation.
7. *Fan and Socket:* Represents an additional electrical load, demonstrating the system’s capability

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to control multiple devices.

8. *Jumper Wire:* Used for connecting components on the breadboard or Arduino, enabling easy and flexible circuit assembly.
9. *Arduino UNO:* The central microcontroller that processes sensor inputs and controls outputs according to the programmed logic.

Data Collection and Processing

Two IR sensor pairs that are positioned at the entrance and track movements are used by the system to gather data [11]. To ascertain if a person is entering or leaving, the microcontroller analyzes the sensor signals (Figure 1).

Testing and Evaluations

The system was evaluated under various settings, including multiple individuals entering and leaving simultaneously, slow and quick movements, and situations with sensor occlusion.

Challenges and Solutions

Identify challenges, develop solutions, test and refine.

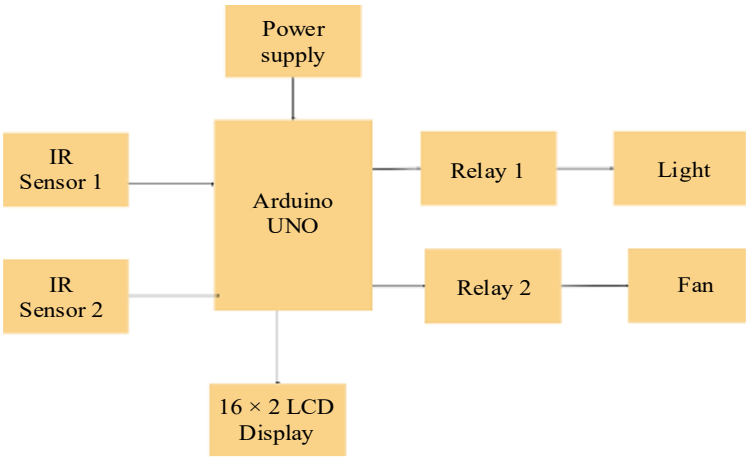

Figure 1. Block diagram of automatic room light controller.

RESULT

Figures 2 and 3 depict the automatic on/off control of the room light and fan.

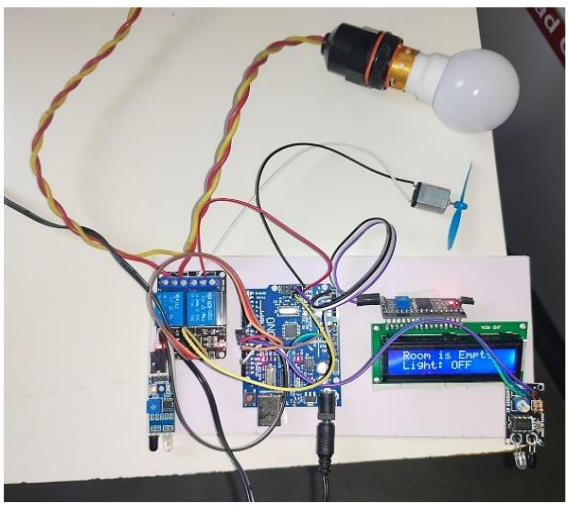

Figure 2. Room is empty Light and Fan OFF.

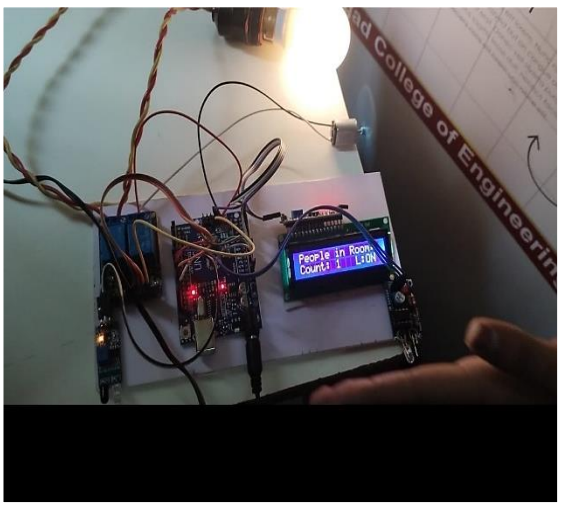

Figure 3. People in Room Light and Fan ON.

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DISCUSSIONS

Simple sensor-based automation systems can significantly reduce unnecessary energy consumption, offering both environmental and economic benefits [12]. A notable example is the development of the Room Light Controller with Bidirectional Visitor Counter, which combines automation with intelligent occupancy detection [13, 14]. This technology operates by accurately counting the number of individuals entering and exiting a room, ensuring that lights remain switched on only when the space is occupied. By automating this process, the system promotes energy efficiency, reduces electricity costs, and minimizes wastage without relying on manual control.

Testing of the prototype demonstrated reliable functionality under controlled conditions, effectively switching lights on and off in response to occupancy changes [14]. However, certain limitations were observed. The system's sensors occasionally reacted to external factors, such as surrounding ambient light, which could lead to false triggers. Additionally, the counting mechanism faced challenges when multiple individuals passed through the entryway simultaneously, sometimes resulting in miscounts and incorrect lighting control [15].

These limitations indicate opportunities for enhancement. Integrating advanced sensing technologies, such as thermal infrared sensors or ultrasonic detectors, could improve accuracy by differentiating human presence from other environmental changes [16–18]. Furthermore, incorporating machine learning algorithms would allow the system to adapt to complex scenarios, improve counting precision, and enhance responsiveness. Such advancements could make the solution more robust, scalable, and suitable for diverse real-world environments, from offices to public facilities.

CONCLUSION

The Room Light Controller with Bidirectional Visitor Counter is an innovative and efficient energy-saving solution that automates the regulation of room lighting based on real-time occupancy. By accurately detecting and counting the number of people entering and exiting a room, the system ensures that lights remain on only when the space is occupied and automatically switch off when it becomes vacant. This intelligent control minimizes unnecessary power consumption, contributing to both cost savings and environmental sustainability. The system employs infrared sensors in combination with a microcontroller to achieve reliable performance. Its design is cost-effective, scalable, and adaptable, making it suitable for diverse settings such as homes, offices, educational institutions, and public facilities. The use of simple yet effective hardware components allows for easy installation and low maintenance, further enhancing its practicality. In addition to reducing electricity bills, this project demonstrates the potential of basic automation to promote energy efficiency and advance smart building technologies. While the current model performs reliably, it also opens the door for future improvements, such as integrating advanced sensors or artificial intelligence for enhanced accuracy. Overall, the solution represents a significant step toward sustainable energy management in everyday environments.

REFERENCES

1. Kumar, A., & Singh, P. (2022) “Automatic Room Light Controller with Bidirectional Visitor Counter”. International Journal of Engineering Research and Applications (IJERA).
2. Patil, P., et al. (2018)"Smart Room Light Management System with Visitor Counter using Microcontroller". International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (IJAREEIE).
3. M. Monika, K. Ramesh, et al. (2016)"Automatic Room Light and Fan Controller with Bidirectional Visitor Counter". International Journal of Scientific & Engineering Research (IJSER).
4. S.K. Sahoo and D. N. Tibarewala (2021)"IoT Based Smart Room Automation with Visitor Counter"Proceedings of the International Conference on Smart Electronics and Communication (ICOSEC), 2021. D.D. Gajski, F. Vahid, S. Narayan and J. Gong, Specification and Design of Embedded Systems, NJ, Englewood Cliffs:PTR Prentice Hall, 1994.
5. A. Bhowmick et al. (2022)"Design and Implementation of an IoT-Based Smart Room Automation

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System with Occupancy Monitoring "Journal of Physics: Conference Series, Vol. 2158, 2022. M.-S. Hu and L.-H. Chen, "The application of embedded control and IoT technology in the automatic lightchasing vehicles," in 2019 IEEE Eurasia Conference on IOT, Communication and Engineering (ECICE), 2019: IEEE, pp. 362-365.

6. Patil, P., et al. (2018)"Smart Room Light Management System with Visitor Counter using Microcontroller". International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (IJAREEIE).
7. A. D. Harale , Amruta S. Bankar and K. J. Karande, “Gestures Controlled Home Automation using Deep Learning: A Review”, International Journal of Current Engineering and Technology, Vol.11, No.6.page no-617-621, Dec 2021.
8. A.D. Harale, Ms. Asma Hakim, Dr.K.J.Karande, “Hand gesture identification system for hearing and speech impairment”, TELEMATIQUE, Volume 23 Issue 1, 2024 page n- 497– 501,April 2024.
9. A.D. Harale, Atik N. Pathan and A. O. Mulani, “Hand Gesture Controlled Robotic System” International Journal of Aquatic Science, ISSN: 2008-8019 Vol 13, Issue 01, Jan 2022.
10. A. D. Harale, K. J. Karande, Sagar S. Bhumkar, “Wireless Hand Geture Control Robot with Object Detection”, Journal of Image Processing and Intelligent Remote Sensing, ISSN 2815-0953,Vol. 3 No. 04 (2023), July 2023.
11. A.D.Harale, Ms.Asma Hakim, Altaf Mulani, K.J.Karande, “Implementation of Human Gesture Recognition Using CNN, Journal of STM, June 2024.
12. Atik N. Pathan and A.D. Harale, “Hand Gesture Controlled Robotic System”, “International Journal of Aquatic Science (IJAS)”, ISSN: 2008-8019, Vol 13, Issue 01, pp-487-493,2022.
13. Supriya D. Kolekar and A.D. Harale, “Password Based Door Lock System”, “International Journal of Aquatic Science (IJAS)”, ISSN: 2008-8019, Vol 13, Issue 01, pp-494-501,2022.
14. A.D. Harale, Amruta S. Bankar and K. J. Karande, “Gestures Controlled Home Automation using Deep Learning: A Review”, “International Journal of Current Engineering and Technology,”, Vol.11, No.6, Nov-Dec 2021.
15. Dheeraj Muttin and Avinash Harale, “IoT Based Personal Medical Assistant System”, “International Journal of Innovative Research in Technology (IJIRT)”, Volume 8 Issue 5 | ISSN: 2349-6002, October 2021.
16. Vijay Waghmode and Avinash Harale, “Development of Alphanumeric Digital Fuel Gauge for Automotive Applications”, “International Conference on Communication and Signal Processing”, IEEE, April 4-6, 2019.
17. Gorakhnath U. Waghmode and Avinash D. Harale, “A Cloud Computing Based WSNs for Agriculture Management”, Springer International Publishing, Conference: Techno-Societal DOI 10.1007/978-3-319-53556-2_107 December 2018.
18. Sanaha S. Path and Avinash D. Harale, “Silkworm Eggs Counting System Using Image Processing Algorithm”, Springer International Publishing, Conference: Techno-Societal DOI:10.1007/978-3-319-53556-2_32_ December 2018.

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