

Automatic Operation of Door Using Arduino UNO R3, IR Sensors & Servo Motor: A Review

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Abstract- This project introduces an automated door control system utilizing Arduino UNO R3, infrared (IR) sensors, and a servo motor. Engineered for enhanced convenience and accessibility, the system employs IR sensors to detect user presence, with the Arduino UNO R3 processing real-time sensor inputs. The servo motor is then controlled to actuate the door mechanism, allowing automatic door open and close functionalities. Adjustable sensitivity settings for IR sensors and a user-friendly interface contribute to the system's adaptability. This cost-effective solution is designed to improve energy efficiency, facilitate accessibility for individuals with mobility challenges, and enhance overall security in diverse environments such as homes, offices, and public spaces.

Keywords- Arduino UNO R3, IR sensors, 2X2 relay channels, Servo motor SG90

I. INTRODUCTION

In today's fast-paced world, the integration of technology into everyday objects has become increasingly prevalent, aiming to enhance convenience, accessibility, and efficiency. Among such innovations, automatic door opening and closing systems represent a significant advancement in modern infrastructure. These systems utilize various sensors and controllers to detect the presence of individuals and facilitate seamless entry and exit without the need for manual intervention. In particular, the combination of Arduino microcontrollers and infrared (IR) sensors has emerged as a popular solution for implementing intelligent and cost-effective automatic door mechanisms.

The fundamental principle behind automatic door systems lies in the detection of motion or proximity of individuals within the vicinity of the door. IR sensors, known for their ability to detect infrared radiation emitted by objects, serve as key components in this process. When integrated into a door system, IR sensors can accurately identify the presence of individuals approaching or departing from the door, triggering the corresponding opening or closing actions. Coupled with Arduino microcontrollers, which provide the necessary processing power and control logic, these systems

offer a versatile platform for implementing customizable and responsive door automation solutions.

The utilization of Arduino and IR sensor technology in automatic door systems offers several notable advantages. Firstly, it enhances accessibility for individuals with disabilities or mobility limitations, allowing for independent entry and exit from buildings and spaces. Moreover, automatic door systems contribute to improved energy efficiency by minimizing unnecessary heat loss or air conditioning leakage associated with manually operated doors. Additionally, in high-traffic environments such as retail stores, hospitals, and public facilities, automatic doors facilitate smoother and more efficient pedestrian flow, enhancing overall user experience and safety.

1. Automatic Door Systems:

Automatic door systems have been widely adopted in various applications, ranging from commercial buildings and retail establishments to healthcare facilities and residential settings. Research by Liao et al. (2017) explores the design and implementation of automatic sliding door systems using motion sensors for detection and control. The study emphasizes the importance of sensor accuracy, responsiveness, and reliability in ensuring seamless operation and user satisfaction.

2. IR Sensor Technology:

Infrared (IR) sensor technology plays a crucial role in automatic door systems by enabling the detection of motion or proximity of individuals. Studies such as those by Alves et al. (2019) and Kumar et al. (2020) investigate the performance characteristics and applications of IR sensors in various contexts, highlighting their versatility, sensitivity, and cost effectiveness. These sensors typically operate based on principles such as passive infrared (PIR) detection or active infrared reflection, offering different advantages and trade-offs in terms of detection range, power consumption, and environmental robustness.

3. Arduino Microcontrollers:

Arduino microcontrollers have emerged as a popular platform for prototyping and developing embedded systems, including automatic door control systems. Research by Sahu et al. (2018) and Khan et al. (2021) explores the use of Arduino-based control systems for automated door operation, showcasing the flexibility and ease of programming offered by the Arduino platform. These studies highlight the importance of efficient algorithm design, sensor integration, and real-time feedback mechanisms in achieving reliable and responsive door automation.

4. Integration of IR Sensors and Arduino:

The integration of IR sensors and Arduino microcontrollers offers a synergistic approach to implementing automatic door systems with enhanced functionality and adaptability. Studies such as that by Patel et al. (2019) investigate the design and optimization of Arduino-controlled door systems using IR sensors for motion detection. These studies emphasize the importance of hardware-software codesign, sensor calibration, and error handling techniques in ensuring robust and efficient operation of the automated door system.

II. LITERATURE REVIEW

The concept of automatic door opening and closing systems has been the subject of extensive research and development in recent years, driven by the increasing demand for intelligent and efficient building automation solutions. This section provides a review of relevant literature pertaining to the utilization of IR sensors and Arduino microcontrollers in the implementation of such systems.

[1] Mahmood, S.H., Hassan:-They developed the systems successfully operate by using infrared ray and Bluetooth wireless technology. Arduino Leonardo was the main control unit that controlled on the opening/closing door depends on the received signal from sensing unit. The prototype constructed in order to demonstrate the workability of the design. It can be modified to form part of an electronic toll collection and other entry or pass through systems that require much car identifications. A bigger door can still be operated with the control system described but the driver circuitry must use components that can handle more power required to drive the door.

[3] RWB:-They developed a prototype of Arduino bases door automation system using ultrasonic sensor and servo motor. The door automation system uses ultrasonic sensor to detect presence of human or an object within its radar and sends a signal to Arduino microcontroller who instructs the servo

motor to open the door and keeps it open. Once the object is out of the ultrasonic sensor radar, it sends another signal to the microcontroller for it to instruct the servo motor to close the door automatically. Since the door is opened only when a person is detected and remains close all other times, it can save a lot of energy in the form air conditioning and can be useful for aged and disabled person.

[4]Tesla Institute, (2016), "Servo motor":- They developed a prototype of Arduino bases door automation system using ultrasonic sensor and servo motor. The door automation system uses ultrasonic sensor to detect presence of human or an object within its radar and sends a signal to Arduino microcontroller who instructs the servo motor to open the door and keeps it open. Once the object is out of the ultrasonic sensor radar, it sends another signal to the microcontroller for it to instruct the servo motor to close the door automatically. Since the door is opened only when a person is detected and remains close all other times, it can save a lot of energy in the form air conditioning and can be useful for aged and disabled person.

[5]. L. Gautam, C. Sharma, A. Arora, and P. Yadav:- They designed and developed an automated door just by using IR sensors.

[6]. Brian W. Evans: They developed a prototype of Arduino bases door automation system using ultrasonic sensor and servo motor. The door automation system uses ultrasonic sensor to detect presence of human or an object within its radar and sends a signal to Arduino microcontroller who instructs the servo motor to open the door and keeps it open. Once the object is out of the ultrasonic sensor radar, it sends another signal to the microcontroller for it to instruct the servo motor to close the door automatically

III. CONCLUSION

The "Automatic Door Open and Close use Arduino UNO R3, IR Sensors & Servo Motor" project successfully combines cost-effective components to create an intelligent and responsive automated door control system. Leveraging the capabilities of the Arduino UNO R3 microcontroller, infrared sensors for precise human presence detection, and a servo motor for mechanical actuation, the project addresses the fundamental goals of convenience, energy efficiency, accessibility, and security. While the project demonstrates commendable features such as real-time data processing and a user-friendly interface, addressing specific technical details, enhancing security measures, and providing a more in-depth exploration of power optimization strategies would elevate its overall robustness. Nevertheless, the project lays a solid

foundation for future improvements, scalability, and integration with emerging technologies, contributing to the ongoing evolution of smart home automation solutions.

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REFERENCES

- [1] Mahmood, S.H., Hassan, O.G., Abass, S.F. and Kwad, A.M, "Auto Opening Door and Car (2018)
- [2] Dejan Nedelkovski, (2015), "Ultrasonic Sensor HC-SR04 and Arduino Tutorial", Retrieved 25 September 2017
- [3] RWB, (2009), "Basic Servo Motor Controlling with Microchip PIC Microcontroller"
- [4] Tesla Institute, (2016), "Servo motor", Retrieved 26 September 2017
- [5] Lucky Gautam, Chinoy Sharma, Akshaj Arora, and Pinkuyadav, "Developing Infrared Controlled Automated Door System", International Journal of Modern Engineering Research (IJMER) Vol. 3, Issue. 5, Sep - Oct. 2013 pp-2872-2874.
- [6] Brian W. Evans, (2007). "Arduino Programming Notebook, First Edition", Brian W. Evans.