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Smart Proximity Activation System

[*1]Abdul Malik, [2]Onkar Sahane and [3(a, b, c)]Dr. Lenina SVB

[*1, 2]Student, Department of Electronics & Telecommunication Engineering, SGGS Institute of Engineering & Technology, Nanded, Maharashtra, India.

[3(a)]Assistant Professor & Coordinator, Centre of Excellence in Signal and Image Processing, Department of Electronics & Telecommunication Engineering, SGGS Institute of Engineering & Technology, Nanded, Maharashtra, India.

[(b)]Fellow Women Scientist-C, WOSC-07, TIFAC, DST, India & Registered Indian Patent Agent INPA 2625.

[(c)]Founder and Director of DR. LSVBS PATTSOL Multiservices, (Indian Registered Startup: DIPP24849).

Abstract

Smart proximity activation system enhances user convenience by integrating sensors and microcontrollers for seamless operation. In this paper, an intelligent switching system is presented using an ultrasonic sensor, an Arduino Uno, and a servo motor. The system recognizes a person approaching the door, then triggers the servo motor to press the button and allow the door to be automatically unlocked. This research outlines the design, implementation, and effectiveness of the system in real-world applications.

Keywords: Ultrasonic sensor, Servo motor, Arduino Uno, Microcontroller, Switching system, Tinker cad.

1. Introduction

With developments in automation and security systems, conventional switching systems are being upgraded to smart and efficient varieties. Proximity switching systems have gained enormous popularity for home and business use, promising security as well as convenience. This paper presents an ultrasonic sensor, Arduino Uno, and servo motor-based automatic door switching system with a perspective to offering a solution for hands-free door operation.

The objective of the system is to reduce manual work by automating tasks using sensors and microcontrollers through programming. Automation can save a significant amount of time and energy, which can then be utilized for other productive activities.

2. Literature Review

Different automatic switching systems have been developed with different sensors and microcontrollers. Traditional systems use RFID, fingerprint reader, or keypad for verification [5]. These are contact-type or manual-type operations. Different recent research papers have explored the use of motion sensing, face recognition, and IoT-based control systems for smart door locking systems.

Experiments with ultrasonic sensors in systems have demonstrated their effectiveness in detecting people and objects with high accuracy. Researchers have demonstrated that ultrasonic sensors can activate events such as opening doors or alarms on their own. Ultrasonic sensors provide a cheaper option compared to other technologies for automatic doors.

The application of Arduino-based automation has increased due to its programmability and versatility. Microcontrollers and servo motors have been extensively used in robots and have been extremely reliable in actuation [1]. The system presented here is inspired from past work and uses ultrasonic sensors to provide a contactless automatic door-opener system and thus minimize hardware needs and cost.

3. Materials and Methodology

The Switching system consists of three major components: Arduino Uno microcontroller, ultrasonic sensor, and servo motor. Figure 2 shows block diagram of system. The process aims at the identification of a person approaching the door to initiate the process for automatic button pressing.

i). Components and Software Used:

- **Arduino Uno:** A basic ATmega328P-based development board used in embedded systems and IoT networks [3].
- **HC-SR04 Ultrasonic Sensor:** Measures the distance between itself and an obstacle using sound waves [2].
- **Servo Motor (SG90):** A special type of motor that rotates only between 0 to 180 degrees [4].
- **Power Supply:** Provides the required voltage and current to different components. Table 1 presents specifications

***Corresponding Author:** Abdul Malik

of components.

- **Tinker Cad:** A software tool used to design prototypes and simulate projects. It is easy to use and has a user-friendly interface.

ii). Implementation:

- Ultrasonic sensor will be mounted at the top of the door or side of the door.
- The sensing range is set according to sensors limits and our desired sensing area; in this case, it is set to 150 cm.
- Servo motor is place in such a way that it will press the button when ultrasonic sensor is triggered.
- Initialize servo motor at 0 degree.
- When sensor triggered, rotate the servo motor to 90 degree. Figure 3 shows schematic diagram of system.

Table 1: Component specification

Component	Specification
Arduino Uno	ATmega328P Microcontroller, 16 MHz Clock Speed, 5V Operating Voltage, 32KB Flash Memory, 2KB SRAM, 1KB EEPROM, 14 Digital I/O Pins (6 PWM), 6 Analog Inputs, USB & Power Jack [3].
Ultrasonic Sensor	2 cm-400 cm Sensing Range, 40 kHz Frequency, ±3mm Accuracy, 5V DC Operating Voltage, Trigger & Echo Pins for Distance Measurement [2].
Servo Motor	4.8V-6V Operating Voltage, ~180° Rotation, 1.5 kg/cm Torque, PWM Control Signal, Plastic Gears (Light-Duty Applications) [4].

iii). Working Mechanism

a) The ultrasonic sensor scans the surrounding of the front door constantly.
b) The sensor is detecting the presence of a person as he/she approaches a given proximity threshold.
c) The Arduino processes this data and sends a command to the servo motor.
d) The servo motor is used to push a button to open the door.
e) Once delayed; the servo motor reverts to its original position, keeping the door closed when not in use. This solution offers a contactless and autonomous solution for access entry, therefore enhancing convenience and security. Below Figure 1 represent tinker cad design of system.

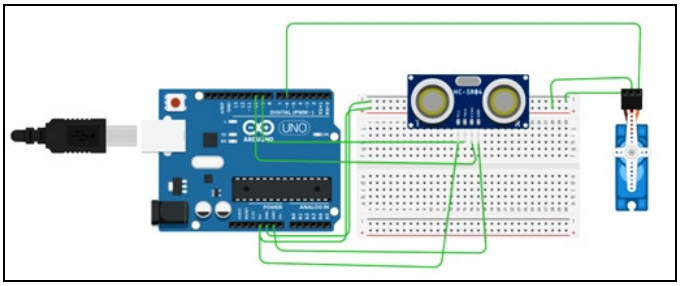

Fig 1: Tinkercad Design

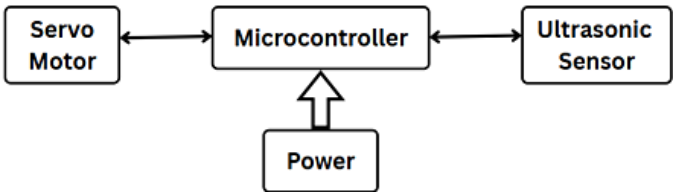

Fig 2: Block diagram

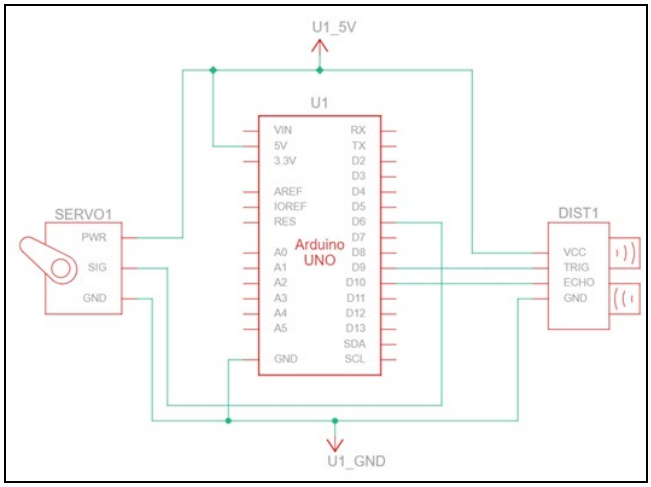

Fig 3: Schematic diagram

4. Acknowledgment

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5. Conclusion

The automatic switch system based on an ultrasonic sensor and Arduino Uno effectively automates door entry with low hardware and low cost. With the sensing of a person in front of the door and the movement of a servo motor to press the unlock button, the system is free from manual operation. In comparison to conventional locking systems, the system provides higher accessibility and hygiene with no physical contact. It can be applied in residential, commercial, and industrial sectors, particularly in hand-free environments. Future improvements can involve the integration of IoT connectivity to provide remote access control and biometric identification to enhance security. In summary, this project demonstrates that an automatic switching system is simple to implement and cost-effective. Its design and functional features make it an ideal choice for modern smart home and automation systems.

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