

Automatic Goal Defending System using Ultrasonic Sensors and Arduino

Priyanka Kale¹, Nikhil Dhurde², Tanaya Ekre³, Vaishnavi Shete⁴, Ashwini Vasatkar⁵
Prof. Amit.S.Kakad⁶

¹²³⁴⁵ Final Year Students, Department of Computer Science and Engineering, Mauli Group of Institution College of Engineering and Technology, Shegaon, SGBAU, Amravati, India.


⁶ Assistant Professor, Department of Electronics and Telecommunication, Mauli Group of Institution College of Engineering and Technology, Shegaon, SGBAU, Amravati, India.

¹priyankakale157@gmail.com



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Abstract—

This paper presents the design and development of an Automatic Goal Defending System using Arduino and ultrasonic sensor technology. With the increasing demand for automation in various domains, including sports and robotics, the need for intelligent real-time response systems has become essential. The proposed system utilizes ultrasonic sensors to detect the presence and position of an approaching object and activates a servo-based mechanism to perform defensive actions. The system focuses on real-time distance measurement, object

I. INTRODUCTION

Automation has become an essential part of modern engineering systems, enabling faster operations, improved accuracy, and reduced human intervention. In fields like robotics and sports technology, automatic response systems are widely used to enhance performance, precision, and reliability. Ultrasonic sensors are commonly used in such systems because of their low cost, simple implementation, and dependable performance. These sensors work by transmitting ultrasonic sound waves and measuring the time taken for the echo to return after reflecting from an object, allowing accurate distance detection. This project presents an Automatic Goal

tracking, and automated response with minimal human intervention. Unlike traditional systems, which rely on manual operation, this system improves reaction speed and accuracy. The implementation demonstrates efficient object detection and response within a predefined range, making it suitable for applications in sports automation, robotics, and smart defense systems.

Keywords— Arduino, Ultrasonic Sensor, Servo Motor, Automation, Object Detection, Embedded Systems.

Defending System, designed to detect an approaching object (such as a ball) and respond instantly using a servo motor. The system continuously monitors distance, and when an object is detected within a predefined range, it triggers a rapid defensive movement. This improves reaction time and demonstrates real-time sensing and actuation. The project highlights the practical application of embedded systems, sensor technology, and automation in robotics, making it useful for both educational and real-world applications.

II. LITERATURE REVIEW

Ultrasonic sensors are widely used in automation and robotics for reliable, low-cost, and precise distance measurement [1][9]. They enable real-time obstacle detection and navigation, making them essential in robotic applications. Arduino micro controllers provide a flexible platform for sensor integration and actuator control, while servo motors enable precise automated movements [2][3]. HC-SR04 ultrasonic modules integrated with Arduino have been proven effective for real-time object detection and short-range distance measurement [12][13]. Efficient real-time sensing, processing, and actuation are critical for automated defense systems [6][8]. Most existing ultrasonic-based systems focus on industrial or military applications [5][7], with limited research in sports automation. The proposed system adapts these technologies to develop an Automatic Goal Defending System, offering real-time detection and servo-based automated defense for sports applications.

III. METHODOLOGY

The system is designed using a combination of hardware components including an ultrasonic sensor (HC-SR04) for object detection, an Arduino Uno as the main controller, a servo motor for the defense mechanism, and a power supply to operate the system. The ultrasonic sensor continuously measures the distance of an incoming object by sending and receiving sound waves. When the detected distance falls below a predefined threshold value of 20 cm, the sensor signals the Arduino. The Arduino processes this input data and immediately commands the servo motor to move, thereby blocking the incoming object. This ensures quick detection and real-time response of the system.

The materials used in this project include Arduino Uno, ultrasonic sensor (HC-SR04), servo motor, and a suitable power supply. For software, Arduino IDE is used along with Embedded C programming to control the system. The methodology begins with initializing the system and setting up all components. The sensor then measures the distance continuously, and the measured value is compared with the threshold value. If an object is detected within the set range, the system identifies its presence and activates the servo motor. The final output is displayed

through the system's response, demonstrating the successful working of the automatic goal defending mechanism.

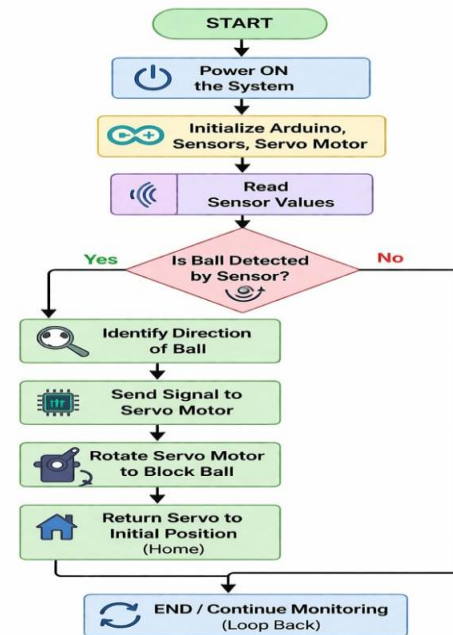


Fig.1.1 : System Flowchart

IV. IMPLEMENTATION

The proposed system is implemented using Arduino-based programming and sensor integration techniques to achieve real-time object detection and response. Two ultrasonic sensors (HC-SR04) are employed to detect incoming objects from multiple directions, enhancing the coverage area and improving detection accuracy. These sensors continuously monitor the surroundings by measuring the distance of objects using ultrasonic waves. The collected data is transmitted to the Arduino Uno, which acts as the central processing unit of the system. The Arduino processes the sensor inputs to determine the position and proximity of the detected object. Based on predefined conditions, such as threshold distance and direction of detection, the system makes a decision to activate the servo motor. The servo motor then performs the required defensive movement to block or intercept the incoming object. This real-time decision-making capability ensures a quick and efficient response, which is critical in applications such as automatic goal defending

systems. The implementation phase focuses on transforming the conceptual design into a functional prototype through proper hardware and software integration. The Arduino Uno microcontroller is interfaced with two HC-SR04 ultrasonic sensors, which are strategically placed to provide a multi-directional field of detection. This hardware setup, combined with embedded C programming in the Arduino IDE, enables seamless communication between components, ensuring accurate sensing, processing, and actuation within the system.



Figure 1.2: Automatic Goal Defending System

V. RESULT AND DISCUSSION

VI. Observed Outputs

VII. Case 1: No Object

VIII. NO OBJECT DETECTED

IX. Case 2: Sensor 1, SENSOR 1 DETECTED

X. Distance: 18 cm

XI. Case 3: Sensor 2

XII. SENSOR 2 DETECTED

XIII. Distance: 21 cm

XIV. Discussion

XV. System provides accurate detection

XVI. Real-time response achieved

XVII. Works efficiently within short range

VI. CONCLUSION

The Automatic Goal Defending System was successfully designed and implemented using Arduino and ultrasonic sensors, demonstrating efficient object detection and automatic response. The system ensures real-time performance with improved accuracy and reliability, highlighting its potential for applications in robotics, automation, and smart sports technologies.

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