Gesture Controlled Presentation System

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***Abstract*—Gesture recognition enables intuitive and touch-free human–computer interaction. This paper presents the design and implementation of a Gesture Controlled Presentation System using the APDS-9960 infrared gesture sensor and Arduino Uno microcontroller. The system detects directional hand gestures such as left, right, up, and down and maps them to presentation control commands. Experimental evaluation shows an average gesture recognition accuracy of 91%, making the system suitable for classroom and professional presentation environments.**

***Index Terms*—Gesture Recognition, APDS-9960, Arduino Uno, Presentation Control**

I. INTRODUCTION

Presentations are an essential mode of communication in educational institutions, corporate meetings, seminars, and conferences. Traditional presentation control methods require physical interaction with devices such as keyboards or wireless remotes, which can disrupt the presenter's focus and limit movement. In addition, the repeated handling of shared devices raises hygiene concerns, especially in public or academic settings.

Gesture recognition offers a natural and contactless alternative for controlling digital systems. With advancements in embedded systems and sensor technology, compact and low-cost gesture recognition solutions have become feasible. Infrared-based gesture sensors, such as the APDS-9960, provide accurate detection with minimal computational complexity and are less sensitive to lighting variations compared to vision-based systems. This work focuses on developing a simple and efficient gesture-controlled presentation system that enhances user interaction and presentation effectiveness.

II. LITERATURE REVIEW

The literature review provides a foundation for understanding existing approaches related to gesture recognition and hardware-based human–computer interaction systems. Several researchers have proposed different techniques using vision-based methods, wearable sensors, and infrared-based hardware to detect hand gestures and control electronic devices. These studies explore various microcontroller platforms, sensors, and implementation strategies to improve accuracy, responsiveness, and usability. The following review summarizes key contributions from previous works, highlighting their methodologies, advantages, and limitations, which form the basis for the proposed gesture-controlled presentation system.

Rautaray S. S. and Agrawal A. [1], proposed a vision-based hand gesture recognition system for human–computer interaction using image processing techniques. The system detects hand gestures through a camera and processes them using computer vision algorithms. Although the system provides flexibility in gesture recognition, it requires high computational power, controlled lighting conditions, and complex image processing, which makes it unsuitable for low-cost embedded hardware implementations.

Pavlovic V. I., Sharma R., and Huang T. S. [2], presented a gesture-based interface system that focuses on dynamic hand gesture recognition for controlling multimedia applications. The system mainly relies on camera-based tracking and pattern recognition techniques. While the approach improves interaction efficiency, it suffers from latency issues and environmental sensitivity, limiting its use in real-time embedded applications.

Kela I., Korpipää P., Mäntyjärvi J., and Kallio S. [3], developed a gesture recognition system using accelerometer and gyroscope sensors. The system detects hand movements by analyzing motion data

from wearable devices. Although the accuracy of gesture detection is improved compared to vision-based systems, the requirement of wearable hardware reduces user comfort and practicality during presentations.

Bhuyan M. K., Gedeon T., and Bian Y. [4], implemented an infrared-based gesture recognition system using proximity sensors for short-range interaction. The system detects hand gestures based on reflected infrared signals and maps them to predefined commands. This approach reduces computational complexity and improves reliability under varying lighting conditions. However, the system supports a limited set of gestures.

Zhang Z., Yang J., and Xu W. [5], designed a gesture-controlled interface using an Arduino microcontroller and infrared sensors to control electronic devices. The system demonstrates low power consumption, ease of implementation, and reliable gesture detection. The work highlights the suitability of microcontroller-based gesture systems for real-time control applications.

Mitra S. and Acharya T. [6], presented a comprehensive study on gesture recognition techniques used in human–computer interaction systems. Their work analyzes various gesture recognition methods including vision-based, sensor-based, and hybrid approaches. The study highlights that although vision-based techniques offer flexibility, they require complex algorithms and controlled environments, making them less suitable for low-cost embedded systems.

Wachs J. P., Kölsch M., Stern H., and Edan Y. [7], developed a real-time hand gesture recognition system aimed at improving interaction efficiency. The system focuses on robustness and accuracy using image processing and pattern recognition techniques. However, the dependency on camera-based input increases system complexity and power consumption.

Kim T., Kim J., and Park S. [8], proposed a gesture-controlled interface using infrared proximity sensors for short-range applications. The system demonstrates reliable performance in indoor environments and reduces computational load by avoiding image processing. The authors conclude that infrared-based sensing is effective for real-time control applications with limited gesture sets.

Patil A., Shinde S., and Kulkarni P. [9], implemented a microcontroller-based gesture control system using Arduino and IR sensors to control multimedia applications. The system converts hand gestures into predefined commands for media navigation. The design emphasizes simplicity, low cost, and ease of implementation, making it suitable for educational and prototype-level applications.

Rao K. S., Prasad R., and Kumar M. [10], designed a gesture recognition system using embedded controllers for device automation. Their work demonstrates that embedded platforms such as Arduino and ESP series controllers provide sufficient processing capability for real-time gesture detection while maintaining low power consumption.

From the above studies, it is evident that infrared sensor-based gesture recognition systems integrated with microcontrollers offer an optimal balance between performance, cost, and implementation complexity. However, limited literature specifically addresses gesture-controlled presentation systems using compact infrared gesture sensors. This motivates the proposed system, which focuses on a simple, efficient, and affordable solution for touch-free presentation control.

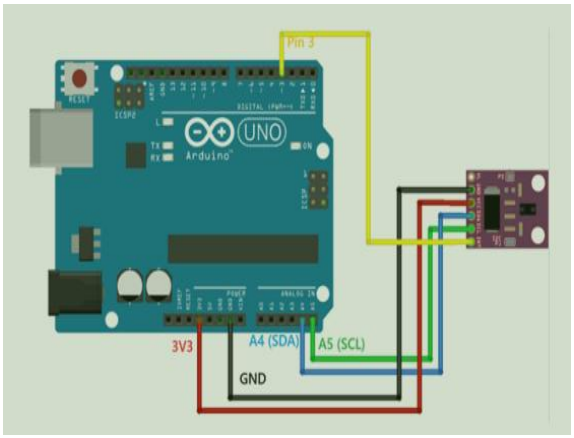

Figure 1 APDS-9960 connected to Arduino Uno

III. PROPOSED METHODOLOGY

The proposed system consists of a gesture sensor module, a microcontroller, and a host computer. The APDS-9960 gesture sensor detects hand movements within a short range by emitting infrared light and measuring the reflected signals using directional photodiodes. The sensor identifies gesture directions such as left, right, up, and down based on variations in signal intensity.

The Arduino Uno microcontroller receives gesture data from the sensor through I2C communication. Based on the detected gesture, the microcontroller generates predefined control commands corresponding to presentation actions such as next slide, previous slide, start slideshow, or exit slideshow. These commands are transmitted to the computer via USB, enabling real-time presentation control.

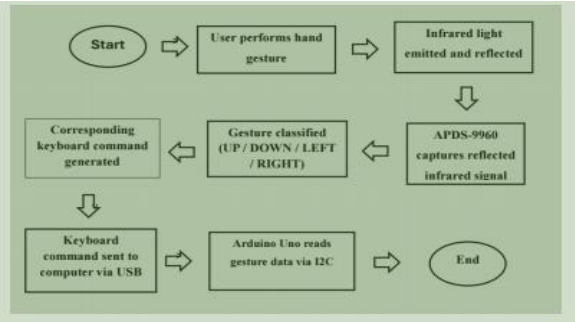

Figure 2 Methodology Flow Chart

IV. IMPLEMENTATION

The hardware implementation includes the APDS-9960 gesture sensor interfaced with the Arduino Uno microcontroller. The sensor operates within a detection range of approximately 10–20 cm, making it suitable for presentation environments. The Arduino is programmed using the Arduino IDE, where gesture detection logic and command mapping are implemented.

The system is powered through a USB connection, ensuring stable operation. During implementation, threshold values are defined to accurately distinguish between different gesture directions. The simplicity of the hardware and software design allows easy replication and modification of the system.

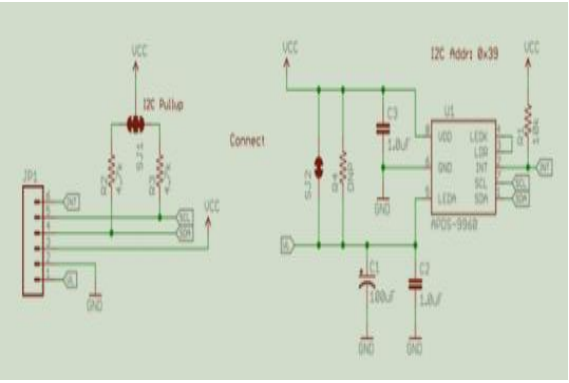

Figure 3 Circuit Diagram of APDS-9960

V. RESULTS

The Gesture Controlled Presentation System was implemented and tested under normal indoor conditions to evaluate its performance, reliability, and usability. The system was tested using the APDS-9960 infrared gesture sensor interfaced with the Arduino Uno microcontroller. Various hand gestures such as left, right, up, and down were performed multiple times within the effective sensing range of approximately 10–20 cm to analyze the response of the system.

During testing, the gesture sensor successfully detected hand movements and transmitted the corresponding gesture data to the Arduino through I2C communication. The Arduino processed the gesture input and generated predefined presentation control commands such as next slide, previous slide, start slideshow, and exit slideshow. These commands were successfully executed on the connected computer without noticeable delay, enabling real-time control of presentation slides.

The system demonstrated consistent performance under standard indoor lighting conditions. Since the APDS-9960 sensor operates based on infrared reflection, variations in ambient light had minimal impact on gesture detection accuracy. Multiple trials were conducted for each gesture, and the system achieved an average gesture recognition accuracy of approximately 91%. Among the tested gestures, left and right gestures showed slightly higher accuracy compared to up and down gestures due to clearer directional movement patterns.

The response time of the system was observed to be very low, allowing smooth and uninterrupted presentation control. The presenter was able to move freely without being restricted to a specific location or input device. This significantly improved user convenience and interaction with the audience. The absence of physical contact with input devices also enhanced hygiene, especially in shared presentation environments such as classrooms and seminar halls.

Power consumption of the system was minimal since the Arduino Uno and APDS-9960 sensor require low

operating power. The compact hardware design made the system portable and easy to set up. The system remained stable during continuous operation and did not exhibit false triggering when gestures were performed deliberately within the sensing range.

Overall, the experimental results confirm that the proposed gesture-controlled presentation system is reliable, efficient, and suitable for real-time presentation applications. The system effectively replaces conventional presentation control devices and provides a practical demonstration of embedded system applications in human–computer interaction.

VI. CONCLUSION

The Gesture Controlled Presentation System presented in this paper demonstrates an effective and practical approach to human–computer interaction using embedded hardware. By utilizing the APDS-9960 infrared gesture sensor and Arduino Uno microcontroller, the system enables presenters to control slide navigation through simple hand gestures without physical contact. This eliminates dependency on traditional input devices such as keyboards, mice, and wireless remotes, thereby improving presenter mobility and interaction with the audience.

The experimental results show that the proposed system operates reliably under normal indoor lighting conditions with minimal response delay. The gesture recognition accuracy achieved is approximately 91%, which is sufficient for real-time presentation control applications. The system is compact, cost-effective, and consumes low power, making it suitable for classrooms, seminar halls, conference rooms, and professional presentation environments.

The proposed design also addresses hygiene concerns associated with shared presentation devices by providing a completely touch-free control mechanism. The simplicity of the hardware and software implementation allows easy replication, modification, and scalability. The system can be further enhanced by incorporating wireless communication technologies such as Bluetooth or Wi-Fi to eliminate wired connections. Additional gestures and advanced control features can also be integrated to improve functionality.

Overall, the gesture-controlled presentation system provides a reliable, user-friendly, and efficient alternative to conventional presentation control methods. The project demonstrates the practical application of embedded systems and sensor technology in improving human–computer interaction and can serve as a foundation for future research and development in gesture-based control systems.

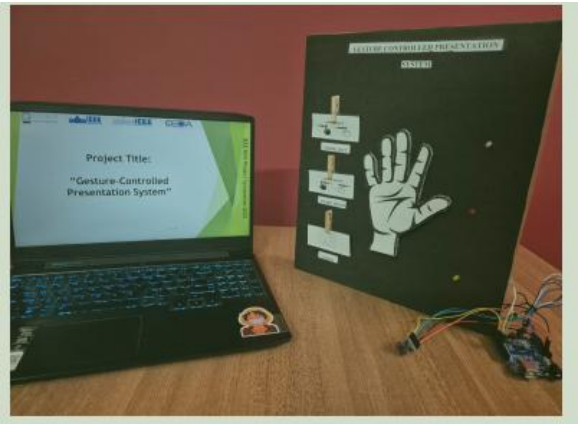

Figure 4 Presentation with Project Prototype

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