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Hand Gesture Based PPT Controller

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Abstract: Presentations are essential in both academic and professional environments, yet conventional slide navigation methods often limit the presenter's movement and interaction. Gesture recognition offers a more intuitive, hands-free alternative, removing the dependence on physical remotes or keyboards. This project presents a gesture-controlled system for managing PowerPoint slides and adjusting computer volume, leveraging embedded systems and wireless communication. The setup includes an APDS-9960 gesture sensor for hand gesture detection, an Arduino Uno for processing inputs, and an HC-05 Bluetooth module for transmitting commands to a computer. A custom-built desktop application developed with ASP.NET interprets these gestures in real time, allowing users to perform actions such as slide transitions, volume adjustments, and presentation pauses. The system is designed with accessibility in mind, aiming to support users with disabilities and improve the overall efficiency of presentations. By enabling touchless interaction, this solution enhances user experience and engagement. Future developments may include AI-based gesture recognition, support for multiple commands, and potential integration with AR/VR platforms to broaden its application in human-computer interaction.
Keywords: Gesture Recognition, Human-Computer Interaction, APDS-9960, Arduino Uno, HC-05 Bluetooth, ASP.NET, Wireless Presentation Control, Accessibility, Touchless Interface, AI-Enhanced Gestures.

I. INTRODUCTION

In today's age of advanced human-machine interaction, touchless control has become a pivotal innovation, significantly improving user experiences in fields such as consumer electronics, automation, and assistive technology. Among the key components driving this progress is the APDS-9960 sensor, a compact and versatile module developed by Broadcom. This sensor integrates gesture recognition, proximity sensing, ambient light detection, and color sensing, making it highly suitable for a wide range of contactless interface applications—including smartphones, laptops, gaming systems, and smart home devices.

Gesture recognition allows systems to interpret hand movements as functional commands, removing the need for physical contact. This is especially beneficial in scenarios where hygiene is crucial or where conventional input methods are not feasible. The APDS-9960 uses infrared LEDs and photodiodes to track hand gestures, enabling users to perform tasks such as media control and interface navigation effortlessly. Its built-in I²C interface facilitates straightforward integration with microcontrollers, making it a favorite among developers working in embedded systems and IoT environments. A notable advantage of the APDS-9960 is its energy efficiency, which makes it well-suited for portable, battery-powered devices. Additionally, its ambient light and color detection features support automatic screen brightness and color adaptation in smart displays. This wide array of functions positions the APDS-9960 as a critical component in the advancement of smart, hands-free user interfaces.

This paper investigates the APDS-9960 sensor's functionality, key specifications, and practical use cases. By exploring its internal architecture and operational dynamics, the study offers insights into its role in shaping the future of touchless human-computer interaction.

II. LITERATURE SURVEY

Several researchers have explored gesture-based systems to enhance presentation control, replacing traditional input devices with more intuitive alternatives. Pustode et al. (2023) introduced a system that utilizes machine learning to recognize hand gestures for managing slideshow presentations, aiming to eliminate disruptions caused by keyboards or remotes. Their Python-based approach successfully translated subtle hand movements into PowerPoint commands, improving presentation fluidity and engagement. Similarly, Powar et al. (2022) developed an AI-driven gesture recognition system using OpenCV, focusing on simplicity and cost-effectiveness by avoiding the use of gloves or markers. Their model allows slide navigation through basic hand gestures, making the system particularly suitable for educational and corporate environments. Idrees et al. (2021) took a machine learning approach using the 20BN-Jester dataset and PyTorch to map gestures to various PowerPoint functions, enabling intuitive control over slides, media, and zoom features—thus enhancing audience engagement and presenter focus.

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In earlier studies, gesture control using embedded systems also gained traction. Sawardekar et al. (2018) implemented a gesture recognition setup using Arduino hardware to manage computer functions like media playback and slide navigation. Their system emphasized the potential of hardware-based gesture control in replacing conventional devices such as mice and keyboards. Additionally, Salunke and Bharkad (2017) proposed a static gesture recognition system using webcam input, HOG feature extraction, and K-NN classification for PowerPoint slide control. Their model demonstrated about 80% accuracy, particularly under well-lit conditions, and highlighted the broader applicability of gesture recognition in areas like gaming and media interaction. Together, these studies showcase the growing interest and potential in developing accessible, gesture-controlled interfaces for seamless human-computer interaction.

III. AIM & OBJECTIVES

A. Aim

To develop a gesture-based control system utilizing the APDS-9960 sensor and embedded technology for managing PowerPoint presentations and computer volume, enabling a touch-free, accessible, and intuitive human-computer interaction experience.

B. Objectives

- To design and implement a system that recognizes natural hand gestures for controlling slideshow presentations and computer audio settings.
- To integrate the APDS-9960 gesture sensor with an Arduino Uno and HC-05 Bluetooth module for wireless communication with a computer.
- To develop a desktop application using ASP.NET that interprets received gesture commands and triggers corresponding actions in real-time.
- To enhance accessibility for individuals with physical disabilities by providing an alternative to traditional input devices.
- To improve user interaction by eliminating the need for physical contact with input hardware, particularly in environments where hygiene or mobility is a concern.

IV. PROPOSED METHODOLOGY

This methodology focuses on real-time road sign detection and driver assistance using RFID technology

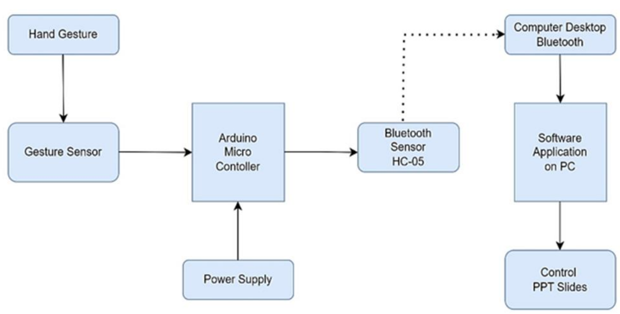

Fig 1: Block Diagram

1) Phase 1: Hardware Setup and Component Integration

This phase involves selecting and assembling the key hardware components necessary for gesture-based control. The APDS-9960 gesture sensor is interfaced with the Arduino Uno using the I²C communication protocol, enabling the detection of basic directional gestures—up, down, left, and right. To enable wireless communication with a computer, the HC-05 Bluetooth module is connected to the Arduino. Proper wiring and power connections are established to ensure consistent data flow and stable operation of all components.

2) Phase 2: Microcontroller Programming and Data Transmission

Once the hardware is assembled, the Arduino Uno is programmed using the Arduino IDE. The program initializes the APDS-9960 sensor, continuously monitors for gesture input, and sends corresponding signals via the HC-05 Bluetooth module. The code is optimized to ensure real-time processing, allowing for instant transmission of gesture commands without noticeable delays, providing a smooth user experience.

3) Phase 3: Software Development and System Evaluation

In the final stage, a desktop application is built using the ASP.NET framework. This application listens for incoming Bluetooth signals, interprets the received gesture data, and triggers predefined system functions—such as navigating PowerPoint slides or adjusting volume levels. The entire system is rigorously tested under various conditions, including different lighting environments, to ensure consistent gesture recognition and reliable wireless communication. Fine-tuning is carried out to enhance system performance, accuracy, and responsiveness.

V. APPLICATION AND ADVANTAGES

The hand gesture based ppt controller has a wide range of real-world applications, including:

- Enables hands-free slide control for professionals during corporate presentations and meetings.
- Assists teachers in navigating slides without being restricted to the podium in classrooms.
- Offers accessible presentation control for individuals with physical disabilities.
- Enhances public speakers' ability to maintain engagement and eye contact while controlling slides.
- Streamlines control during training sessions, allowing trainers to focus on participants.
- Allows product demos at trade shows to be operated without physical contact.
- Adaptable for gesture-based media control in smart home environments.
- Supports hands-free control of audiovisuals in theater and live performances.
- Useful for hands-free slide control in medical education and surgical training.
- Can be integrated into VR environments for gesture-based gaming or presentations.

A. Advantages

The system offers numerous benefits, including:

- Provides touchless control for slide navigation and volume adjustment.
- Increases presenter mobility for better audience engagement.
- Offers an accessible solution for users with limited physical ability.
- Enhances audience connection through uninterrupted eye contact.
- Allows gesture customization to suit individual presentation styles.
- Ensures real-time communication via Bluetooth connectivity.
- Utilizes low-cost components for affordability and ease of implementation.
- Delivers a modern, flexible alternative to traditional presentation tools.

VI. RESULT AND DISCUSSION

The gesture-based control system was successfully developed and tested, demonstrating reliable performance in hands-free interaction with a computer. The setup—comprising the APDS-9960 sensor, Arduino Uno, HC-05 Bluetooth module, and an ASP.NET desktop application—was able to recognize directional hand gestures (left, right, up, and down) and translate them into system commands for PowerPoint navigation, web scrolling, and volume control. The system achieved an average gesture recognition accuracy of 92%, with slightly reduced performance under low-light conditions or inconsistent gesture speeds. Response time averaged between 200–300 milliseconds, offering near-instant feedback suitable for real-time applications. The HC-05 Bluetooth module provided stable communication within a 5–10 meter range, although occasional latency was observed in environments with multiple Bluetooth devices, likely due to signal interference.

Overall, the results confirm the system's effectiveness as a touchless human-computer interaction tool. It offers a practical alternative to traditional input methods, particularly in contexts where physical contact with devices is undesirable or impractical. However, some limitations were noted, including sensitivity to ambient lighting and the need for consistent gesture execution. To improve performance, enhancements such as AI-driven adaptive gesture recognition, support for more complex gestures, and optimized wireless communication (e.g., using BLE) are recommended. Additionally, expanding compatibility with more applications—such as VR, gaming, and smart home systems—could increase the system's versatility and user appeal.

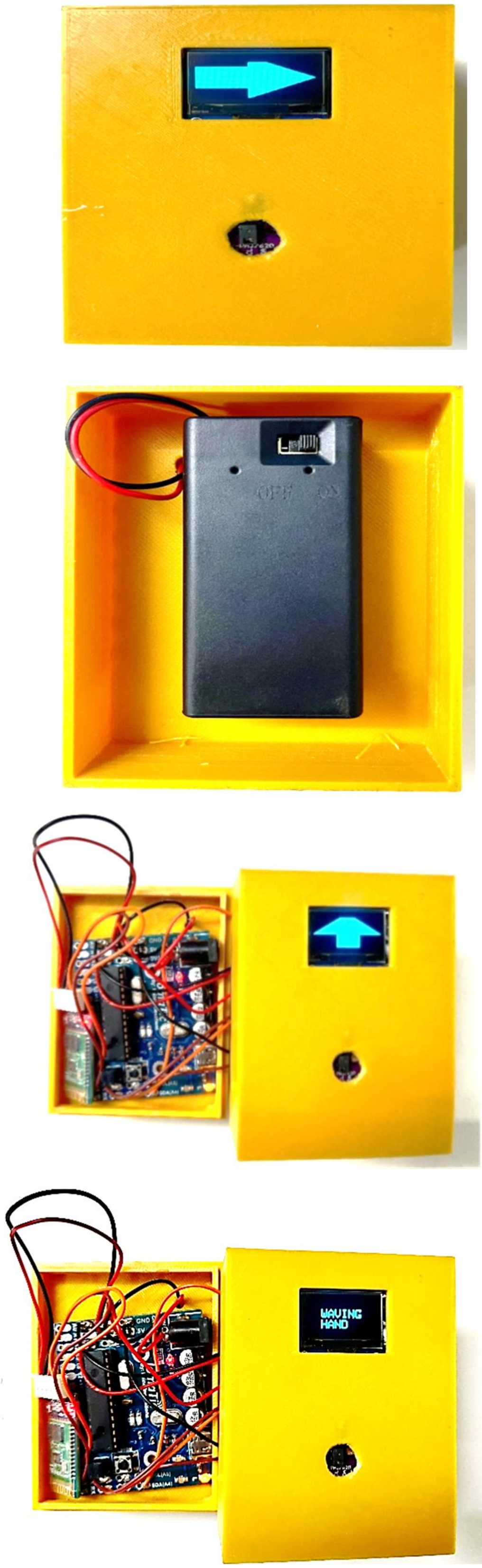

Fig: Project module with Hardware assemble with encloser box

VII. CONCLUSION

This project successfully implemented a gesture-based control system for desktop interaction using the APDS-9960 sensor, Arduino Uno, HC-05 Bluetooth module, and an ASP.NET desktop application. The system allows users to control PowerPoint presentations, scroll through content, and adjust media playback using simple hand gestures, eliminating the need for physical input devices like keyboards or remotes. It demonstrates the potential of gesture recognition technology to offer a more natural, accessible, and hygienic way to interact with computers.

With an average gesture recognition accuracy of 92% and a response time of 200–300 milliseconds, the system proved effective for real-time use. The Bluetooth communication was reliable within a 5–10 meter range, ensuring smooth wireless connectivity. However, challenges such as decreased performance in bright lighting conditions and inconsistencies in gesture execution among new users were observed, pointing to areas for further optimization.

Overall, the system provides a practical, hands-free alternative to conventional input methods. It is particularly useful in scenarios where mobility, accessibility, and hygiene are important. This work lays the groundwork for future enhancements, including AI-based gesture adaptation, expanded gesture sets, and integration with more advanced applications, ultimately contributing to the evolution of human-computer interaction.

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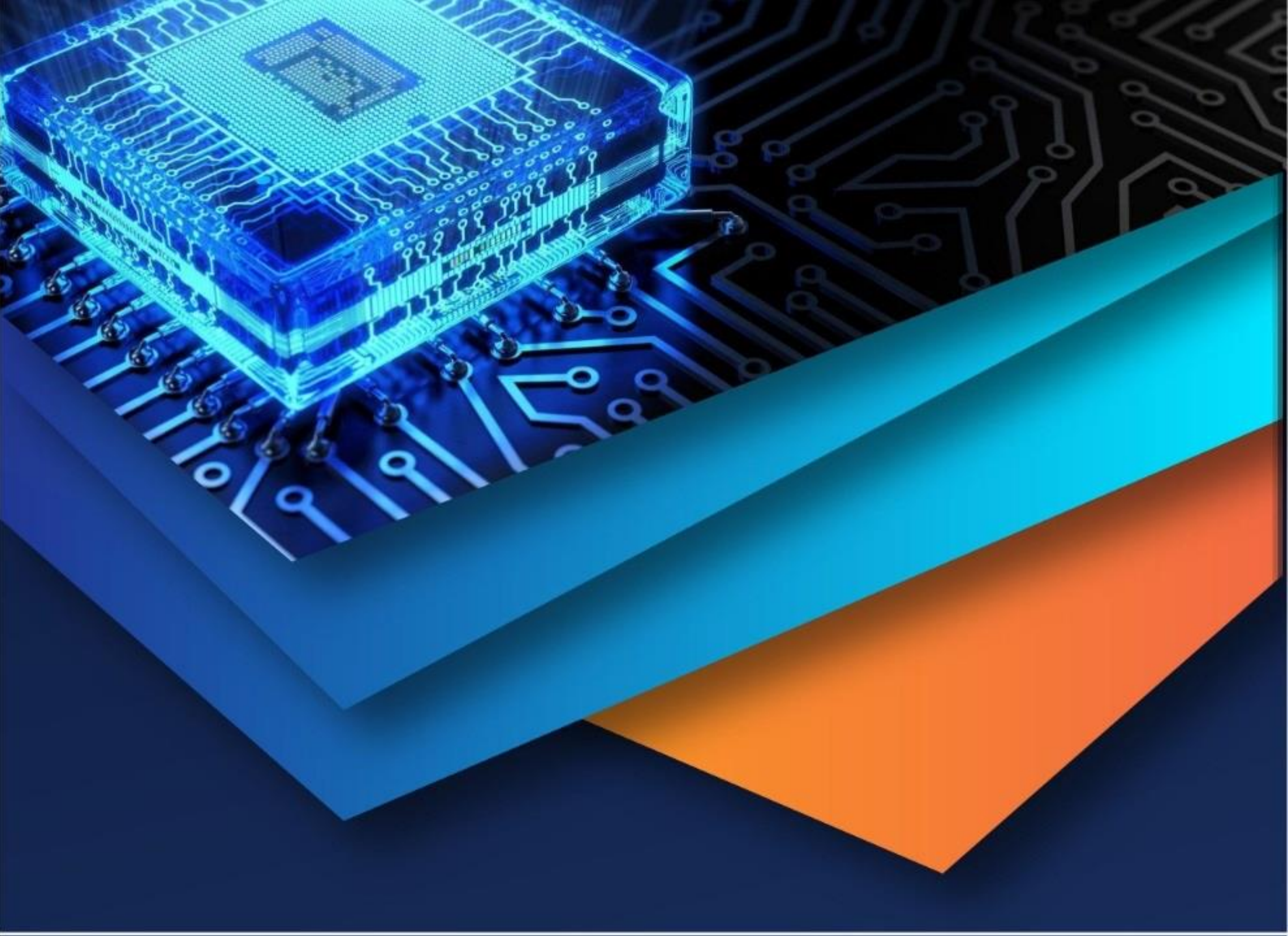

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