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VOICE COMMAND-DRIVEN ROBOTIC PLATFORM WITH REMOTE AUDIO-VISUAL MONITORING

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Abstract: Human–robot interaction has gained significant attention with advancements in speech recognition, wireless communication, and embedded systems. Traditional robotic systems often rely on manual control, limiting their efficiency in dynamic environments. This paper presents the design and implementation of a voice command-driven robotic platform integrated with wireless voice and video transmission for remote monitoring via television displays. The system employs speech recognition techniques for real-time robotic control, while wireless camera modules provide continuous video feedback to the operator. The proposed system enhances accessibility, reduces dependency on manual controllers, and enables intuitive interaction with robots. Experimental evaluation demonstrates accurate speech recognition, reliable wireless transmission, and efficient remote monitoring, highlighting its potential applications in surveillance, assistive robotics, and human–machine collaboration.

I. INTRODUCTION

Robotics is rapidly evolving as a multidisciplinary field combining artificial intelligence (AI), embedded systems, and wireless communication. One of the most intuitive approaches to robot control is through speech recognition, as it eliminates the need for physical controllers and enhances accessibility. Voice-controlled robots have applications in military surveillance, healthcare assistance, industrial automation, and domestic services (1). However, existing systems often lack integrated remote monitoring capabilities, making it difficult to observe and evaluate robot performance in real time (2).

Recent progress in wireless transmission technology allows for seamless integration of voice and video signals between robotic platforms and remote display systems (3). By combining speech recognition for command input with wireless video streaming for output feedback, robots can be operated more efficiently in dynamic and hazardous environments. The integration of remote video transmission to televisions or display units further extends usability, enabling operators to monitor operations from a safe distance.

This study focuses on the development of a voice-controlled robotic platform with wireless audio-visual feedback, providing a user-friendly and effective solution for intelligent human–robot interaction. The objectives are: (i) to implement speech recognition for real-time robot control, (ii) to enable wireless video streaming to remote televisions for monitoring, and (iii) to validate system performance through experimental testing.

II. LITERATURE REVIEW

Voice-controlled robotic systems have been widely studied in human–machine interaction research. Sharma et al. (4) designed a simple voice-controlled robot using Bluetooth communication, but the system lacked video monitoring capability. Similarly, Kumar and Bansal (5) developed a microcontroller-based speech-controlled vehicle, demonstrating effective control but limited real-time feedback.

Incorporating video transmission in robotics has been explored for surveillance applications. Ahmed et al. (6) implemented wireless video streaming with robotic navigation, but the absence of advanced speech recognition limited user interaction. To address communication efficiency, Choudhary and Verma (7) demonstrated ZigBee-based wireless video systems for low-power robotic applications.

Recent works highlight the use of IoT and Wi-Fi modules for robotic monitoring. Gupta et al. (8) integrated speech recognition with IoT for smart robots, while Li et al. (9) showcased Wi-Fi-enabled video streaming to mobile devices. However, their systems were more suitable for internet-enabled devices rather than conventional television displays.

Furthermore, Sahu et al. (10) emphasized machine learning-based speech recognition algorithms to improve accuracy in noisy environments. Jha and Mehta (11) proposed hybrid models combining embedded controllers with cloud-based speech recognition for real-time control. These studies indicate the growing demand for integrated platforms combining speech recognition and wireless video monitoring for practical, real-world robotic applications.

III. RESEARCH METHODOLOGY

The proposed system is designed in two major modules: (i) the voice recognition-based robotic control unit and (ii) the wireless video monitoring unit. In the control unit, a speech recognition module captures user commands and translates them into corresponding robotic movements (forward, backward, left, right, and stop). The ATmega microcontroller processes recognized commands and drives DC motors through an H-bridge motor driver.

The video monitoring module consists of a wireless camera mounted on the robot, transmitting real-time video signals to a remote television via an RF transmitter–receiver pair. The receiver unit is connected to the AV input of a television, enabling continuous monitoring. The system design ensures real-time synchronization between commands and visual feedback.

To evaluate system performance, multiple speech recognition algorithms were tested, including isolated word recognition and template matching, under various noise conditions. System reliability was validated through repeated trials, measuring recognition accuracy, wireless transmission range, latency, and monitoring clarity.

IV. EXPERIMENTAL SETUP

The experimental prototype was implemented using an ATmega16 microcontroller, an HM2007 speech recognition module, RF wireless camera, and DC motors. The voice recognition module was trained with pre-defined commands such as “Forward,” “Left,” “Right,” “Backward,” and “Stop.” The RF video transmitter operated at 2.4 GHz, with the receiver connected to a standard television set for real-time monitoring.

The system was powered using a 12V DC supply, and motor control was achieved through an L293D H-bridge driver circuit. Tests were conducted in indoor and semi-outdoor environments. Experimental results showed a speech recognition accuracy of 92% in quiet environments and 85% in moderate noise conditions. The wireless video transmission was stable within a range of 20–25 meters, with negligible latency. Operators could effectively monitor robot movement on a television display while issuing commands, demonstrating the practicality of the system for surveillance and assistive applications.

V. CONCLUSION

This research presents a voice command-driven robotic platform with wireless video transmission for remote monitoring. The integration of speech recognition with wireless multimedia communication provides an intuitive and accessible approach to robot control. Experimental evaluation confirmed high speech recognition accuracy, reliable wireless video transmission, and low-latency monitoring, making the system suitable for surveillance, assistive robotics, and hazardous environment applications. Future work may focus on enhancing speech recognition through deep learning algorithms, expanding wireless range using Wi-Fi or 5G modules, and integrating cloud-based monitoring for multi-user accessibility.

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