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Cost-Effective Humanoid Robot for Service Applications: Integrating ESP32 for Motion and Raspberry Pi for AI Communication

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Abstract - The speed of developments in artificial intelligence (AI) and robotics has created the opportunity for automation in service industries, maximizing efficiency and ease of access. This paper proposes a half-automated ESP32 humanoid robot that is suitable for interactive customer services. The humanoid has remotely controlled movement based on an ESP32 Wi-Fi module that provides easy operation through a mobile app via Bluetooth or Wi-Fi to achieve greater reach and flexibility. AI-based communication is enabled through a Raspberry Pi, enabling the robot to handle user queries, respond accordingly, and offer interactive real-time support. The humanoid uses several MG995 servo motors for human-like hand gestures, supporting expressive movements like welcoming users with a wave. A 1.3-inch OLED display is also employed to mimic facial expressions, providing a touch of friendliness to interactions with users. This module and customizable platform is versatile in multiple service-based implementations. It has been utilized in different capacities, including a receptionist in business settings and an assistive companion for specially-abled persons, aiding real-time remote communication between the users and backend operators. By combining AI-driven speech processing with custom chat bot functionality, the humanoid robot provides a dynamic interaction system that may be adapted across various industries.

Keywords - Humanoid Robot, ESP32, AI Communication, Service Automation, Customizable Robotics, Semi Automation, IoT, Remote-Controlled Movement



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