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Abstract:

This paper outlines the design and development of an advanced robotic system that integrates hardware implementation with theoretical simulation to address the need for versatile and user-friendly robotic solutions in various environments. Addressing the issue of limited adaptability in existing robotic systems, we propose a wireless, voice and gesture- controlled robot car with an integrated robotic arm capable of performing complex tasks such as line following, obstacle avoidance, object manipulation, and autonomous navigation over one-kilometer range. To improve operational efficiency and user involvement, this paper designs a multifunctional robotic platform that integrates user-friendly control interfaces with inexpensive, state-of-the-art sensor technologies. To achieve this, we integrate a variety of sensors, including ultrasonic sensors for precise distance measurement, infrared sensors for object detection and line following, an L298 motor driver for controlling geared motors, servo motors for controlling robotic arms, a flex sensor for claw control, and an mpu6050 accelerometer for gesture recognition. The system also uses a custom-made Bluetooth app for remote control, nRF24L01+ for long-range wireless control, and Arduino Mega and Nano for processing and control functions. The results demonstrate the robot functions well in dynamic conditions, and it can be used in hospitals to assist healthcare professionals, in restaurants for food delivery, and in industrial settings for object manipulation. The system's design proves robust in real-world scenarios, offering significant improvements in accessibility and operational efficiency. This study aligns with Sustainable Development Goals (SDGs) 3 (Good Health and Well-being), 9 (Industry, Innovation, and Infrastructure), and 17 (Partnerships for the Goals). The robotic arm's potential application in healthcare settings advances SDG 3, its contribution to industrial productivity advances SDG 9, and collaborations with tech companies to expand and improve the robot's capabilities promote SDG 17.