IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 8, April 2025
Impact Factor: 7.67

Hand Gesture-Based Servo Motor Control Using Edge Computing.

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Abstract: *Controlling and operating objects effortlessly with just a wave or gesture of our hand, no touch requirement, is revolutionizing the way we interact with technology in today's world, shaping future right before our eyes. We can even see smart home objects controlled by just our hand that to by gestures only. Through enabling touchless control via simple hand movements, this work presents a real-time hand gesture-controlled servo motor system that revolutionizes human-machine interaction. The system employed an ESP32 microcontroller and computer vision technologies (MediaPipe and OpenCV) to interpret hand landmarks, capture live video from a standard camera, and apply vector geometry in computing the angle between the index and thumb finger. The ESP32 receives the computed angle wirelessly via serial communication, and under various lighting conditions, it safely controls the servo motor within a 0–180° range. High signal parsing and accurate PWM-based servo control are guaranteed by the Arduino firmware, which also features low latency and fast actuation.The project proves that off-the-shelf hardware can be used to develop gesture-based, accessible solutions and provides avenues for future extensions such as multi-gesture recognition and wireless communication. The sensor-less solution is an association of computer vision and embedded systems without needing any extra hardware, and it proves to be an excellent choice for assistive robotics, smart home automation, and interactive control systems applications.*

Keywords: Hand Geture Recognition, Servo Motor Control, ESP32, OpenCV, MediaPipe, Human-Computer Interaction, Edge Computing

DOI: 10.48175/IJARSCT-25576