Air Writing Recognition Systems for Practical Applications

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Abstract: *This paper presents a practical, multilingual air-writing recognition system and demonstrates two real world applications, including ESP32 based gesture control and a contactless public interface to mitigate pathogen transmission. Our implementation uses a standard RGB camera and MediaPipe for real time hand-landmark tracking, rendering strokes on a Pygame canvas. Segmented characters are classified by a lightweight CNN trained on the EMNIST alphanumeric dataset extended with 20 Devanagari symbols, using extensive augmentation to boost robustness. Model quantization via TensorFlow Lite yields end-to-end inference latency under 150 ms on commodity hardware. A prototype mapping O and Z gestures to LED control via ESP32 achieves reliable actuation, while a proof of concept ATM interface eliminates touchscreen contact enabling seamless user interaction and addressing critical hygiene challenges in public environments. Experimental evaluations with 20 subjects demonstrate 97.3 percentage overall recognition accuracy and user acceptance of the contactless interface.*

Keywords: air-writing, gesture recognition, MediaPipe Hands, EMNIST, Devanagari, Pygame, CNN, ESP32, TensorFlow Lite, contactless interface