



Thebes Institute
for Engineering

Graduation project

Head and Gaze Controlled Communication System

EyeTalk

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ABSTRACT

EyeTalk is an AI-based assistive communication system developed to support individuals with severe motor impairments who are unable to use conventional input devices. The system enables hands-free interaction through head orientation and gaze-based control, allowing users to operate a computer and communicate effectively.

Using standard camera and computer vision techniques, facial landmarks are detected via Mediapipe Face Mesh. Head orientation vectors are computed and mapped to screen coordinates through a configurable control core supporting both absolute and relative cursor modes. To ensure smooth and stable operation, the system integrates Kalman filtering and Exponential Moving Average (EMA) smoothing. A calibration module enhances accuracy by statistically aligning the system to each user's neutral head position.

EyeTalk includes a bilingual (Arabic/English) virtual keyboard interface with integrated Text-to-Speech functionality, enabling real-time spoken communication. Predefined emergency phrases allow rapid expression of urgent medical needs. The system is designed for low-cost deployment on embedded platforms such as Raspberry Pi, making it portable and accessible.

By combining artificial intelligence, computer vision, and assistive interface design, EyeTalk provides an affordable and scalable solution to improve independence and quality of life for motor-impaired individuals.

Keywords

Assistive Technology; Human-Computer Interaction; Head Tracking; Gaze Interaction; Computer Vision; Kalman Filter; Embedded Systems; Virtual Keyboard; Text-to-Speech; Medical Assistive Systems.