# Assistive Wearable Technology to Improve Communication for Individuals with Speech Disorders

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## Project Overview

Speech represents the most instinctive form of human communication. However, many individuals can lose the ability to vocalize or produce sound due to various reasons. For example, approximately 10% of ALS patients receive life-prolonging ventilatory support through a tracheostomy, a procedure that profoundly impacts not only the patients themselves but also places considerable strain on their families. Regrettably, the overwhelming majority of ALS patients with tracheostomies find themselves incapable of vocalization. Other procedures, such as a laryngectomy, can also impact an individual's ability to vocalize.

One common solution is voice prosthesis, which entails the use of a speaking valve—a device affixed to the end of the tracheostomy tube. This valve dynamically closes during exhalation, preventing air leakage and permitting speech. However, speaking with this valve can be a challenging process, often requiring patients to seek training from speech and language therapists, imposing an additional burden on their already compromised quality of life.

To bridge this crucial gap, we introduce JawSense, an unobtrusive, lightweight wearable engineered to function as an Augmentative and Alternative Communication (AAC) modality, to improve accessibility for populations with speech related disorders, particularly those who are unable to vocalize. JawSense interprets the subtle jaw movements and facial vibrations associated with unvoiced speech, enabling a natural and intuitive means of communication. Importantly, it obviates the need for patients to undergo speech therapy or modify their articulation. JawSense empowers them to speak, just as they did before their procedure. Positioned discreetly around the patient's ear, this device detects unvoiced speech without a microphone, allowing users to articulate without vocalization and communicate in a manner that feels natural. As earables are garnering greater attention and driving the wearables market [1], this project leverages on this growing trend. In its simplest configuration, JawSense recognizes distinctive head and facial gestures corresponding to frequently used phrases. Furthermore, we are committed to expanding its capabilities to develop a continuous silent speech recognition system that extends its utility to individuals with speech disorders.

As also listed in the ALS focus survey, communication difficulties are a major concern among people with ALS as well as their caregivers. Motivated by the rising caregiver burden and challenges in communication faced by certain clinical populations, the proposed research will enable effective alternative communication. The foundational knowledge from this work will form the basis of several translational projects and grants. Successful completion of this work will also ease caregiver burden by allowing patients to easily communicate with friends and family, and improve accessibility in interacting with various devices.