# PID

# EchoLabs: A Wearable AI System for Analyzing and Improving Human Communication

**Authors**

Aarush Agrawal*
Isa Patel*
Uttkarsh Singh*
Vedha Pant*

*All team members are considered equal contributors.

## Abstract

EchoLabs (Team Name: EchoLabs, Team Number: 9) is an AI-powered wearable system designed to analyze real-world conversations and provide actionable feedback to improve interpersonal communication and confidence. Unlike existing wearable solutions that focus primarily on transcription, note-taking, or summarization, EchoLabs analyzes *how* speech is delivered by extracting vocal and conversational signals such as tone stability, pacing, hesitation, interruptions, fluency, and reliance on filler words (e.g., "um," "like"). These signals are processed using machine learning models to generate summaries, behavioral insights, and targeted improvement suggestions. By introducing a measurable feedback loop for human conversation, EchoLabs transforms everyday interactions into opportunities for continuous communication improvement.

## Introduction

Human conversation is one of the most important interfaces people use daily—across professional, academic, and social contexts—yet it remains largely unmeasured and unoptimized. While recent advances in AI-powered wearables have enabled passive capture of conversations through recording and transcription, these systems treat speech purely as text and ignore critical vocal and behavioral cues that shape how messages are received.

Research in communication psychology and behavioral science shows that confidence, persuasion, and clarity are strongly influenced by *how* something is said rather than *what* is said. However, individuals rarely receive objective, actionable feedback on these aspects of communication. EchoLabs addresses this gap by introducing an AI-driven system that measures conversational behavior and provides targeted insights to help users improve their communication effectiveness over time.

## Motivation / Why This Idea

Current conversational AI wearables are limited to summarization and recall, offering little to no insight into speech delivery,

confidence, or conversational dynamics. As a result, users are left without guidance on improving real-world communication skills such as speaking clearly, reducing hesitation, or maintaining conversational presence.

One of the most common and impactful issues identified through our user interviews is excessive reliance on filler words such as "um," "like," and "you know," which often signal uncertainty and reduce perceived confidence. While most speakers are unaware of these habits in real time, they have a measurable effect on how communication is perceived. Existing tools do not address this problem, as they fail to analyze speech delivery at a behavioral level. EchoLabs directly targets these patterns by identifying filler word frequency, contextual usage, and trends over time, enabling users to actively reduce verbal tics and communicate with greater clarity and confidence.

Through market research, competitor analysis, and direct user interviews, we identified strong demand for tools that go beyond transcription to analyze *how conversations happen*, a gap left unaddressed by existing products.

## Proposed Features

Key features of EchoLabs include:

- **Speech Pattern Analysis**
  Extraction of vocal metrics such as pacing, tone stability, hesitation, stuttering, and interruptions.

- **Filler Word Detection and Reduction**

  Identification and tracking of filler words (e.g., "um," "like") with contextual feedback and targeted recommendations to improve verbal clarity and confidence.

- **Conversation Summaries**
  High-level summaries of conversations for recall and context.

- **Behavioral Insights**
  AI-generated feedback highlighting strengths and areas for improvement in communication style.

- **Targeted Improvement Suggestions**
  Personalized recommendations to improve confidence, clarity, and conversational effectiveness.

- **Progress Tracking**
  Longitudinal tracking of communication metrics to show improvement over time.

## Application Functionality

EchoLabs operates as an AI-powered wearable paired with a companion application. During real-world conversations, the wearable captures audio data, which is processed to extract speech and behavioral features. These features are analyzed using machine learning models trained to identify patterns associated with confident and effective communication.

Users interact with EchoLabs through a mobile or web interface where they can view conversation summaries, receive insights, and review targeted suggestions for improvement. Over time, the system builds a personalized communication profile, allowing users to track progress and refine their conversational skills through repeated feedback loops.

# Spec

## Purpose

To clearly communicate your project idea, motivation, and planned features using a research-style format.

---

## Formatting Requirements

- Length: 1–1.5 pages
    - Single-spaced
    - Double-column
-
- Format: Research-paper style (ACM/IEEE format)
- References:
    - May be included
    - Do not count toward the page limit
-
- File type: PDF

---

## Required Structure

Your document must include the following sections:

### Title

- The title must be the name of your app, followed by a colon (:) and a short tagline
- Example:
  CampusFlow: A Smart Course Planning Assistant

---

### Authors

- List all team members directly under the title, in research-paper style
- Names must be listed in alphabetical order
- Place an asterisk (*) next to each name
- Include a footnote stating:
  All team members are considered equal contributors.

- In special cases, like mentioned in "Authorship and Acknowledgement," the naming will follow order of contribution / ownership ratio.

---

## Abstract

- A brief summary of the idea and its purpose
- Must include:
    - Team name
    - Team number
-

---

## Introduction

- Brief context describing the problem or opportunity

---

## Motivation / Why This Idea

- What problem are you solving?
- Why is this problem important or interesting?

---

## Proposed Features

- Key features your web application will include
- Bullet points are acceptable

---

## Application Functionality

- What work will the app perform?
- How users will interact with it at a high level

---

## References (if any)

- Tools, datasets, inspirations, related work, or prior systems

## Acknowledgement & Authorship (Special Cases Only)

Include this section only if applicable.

- If the project idea originates from:
    - Prior coursework
    - An existing personal or team project
    - External sources beyond class brainstorming
- 
    you must clearly state this in an Acknowledgement section.

- If the project already has significant prior development, you must explain:
    - How concepts and skills learned in this course will be applied to meaningfully extend the project
- 
- If team members agree on unequal ownership or contribution due to prior work:
    - Add a section titled "Authorship Ratio" (before References)
    - Clearly describe:
        - Contribution ratios, or
        - Any authorship rules agreed upon by all team members
    -