

Minimal objectives:

- Capture analog voice signals with the mic module.
- Sample audio from the mic using ESP32 ADC
- Transmit audio data via Bluetooth Serial (SPP) from ESP32 -> PC
- Implement a desktop application that:
 - Receives and stores the streamed audio data.
 - Performs speech-to-text transcription using an audio processing library.
 - Translate the text into a target language (first English-only) using a translation API.
- Transmit the translated text back to the ESP32 via Bluetooth serial.
- Display the received translation on the LCD screen connected to the ESP32.

Stretch objectives:

- Enable target language selection.
- Integrate Bluetooth A2DP for real-time audio streaming to the computer (replacing manual ADC sampling and SPP transmission).
- Replace PC with a portable edge processor like a mobile phone/Jetson Nano.
- Add (translated) speech output using a speaker module.
- Distinguish speakers & represent with different screen locations & text color.
- Improve end-to-end latency for practical real-time translation/display.

MVP Scope:

The project scope is limited to the **minimum** for real-time voice translation. Core functionality is wired hardware integration, Bluetooth SPP communication, and basic text display.

Uses ESP32 microcontroller and a host PC. A single-speaker's voice is captured via a MAX9814 microphone, sampled using the ESP32's ADC, and transmitted over Bluetooth Serial (SPP) to a desktop application. The PC software is responsible for receiving/transcribing the audio, and translating/transmitting the text output, using existing libraries and APIs where possible. The ESP32 then receives the translations and displays the text on an attached LCD screen.

Advanced features like A2DP streaming, mobile phone integration, speaker differentiation, voice output, or live/overlapping/bilingual conversation handling are all out of scope for the first iteration(s).

Needed components:

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|-----------------------------|---------------------|
| • ESP32 DEVKIT V1 | - on hand |
| • MAX9814 Microphone Module | - on hand |
| • (Windows) PC | - personal property |
| • USB-A to Micro-USB Cable | - on hand |
| • Jumper Cables | - on hand |
| • Breadboard | - on hand |