A-Z MANDIBLE

Master Provisional Patent Submission Pack

Jaw-Coupled Silent Intent Interface System
with Piezoelectric Sensing and Closed-Loop Bone Conduction Feedback

Purpose of this Pack
This document contains everything required to file a complete U.S. Provisional Patent Application for the A-Z Mandible invention under 35 U.S.C. § 111(b). It is designed for electronic filing via USPTO Patent Center as a micro-entity (or small-entity) inventor.

Contents of this Pack

CRITICAL FILING INSTRUCTIONS

1. Create a USPTO.gov account and complete identity verification for Patent Center access (do this first — it can take time).
2. Prepare clean black-and-white line drawings based on the Figure descriptions in Section 5 (or use the visual concepts already developed). Informal drawings are acceptable for provisional, but clear labeled figures strengthen the application.
3. Convert this specification into a clean PDF (this document already is one). You may edit the inventor name and residence to your legal name and current address.
4. In Patent Center: New Submission → Utility Provisional. Upload the specification PDF + drawings. Complete the cover sheet information using the data in Section 2. Claim micro entity if eligible and upload Form SB/15A.
5. Pay the fee ($65 micro / $130 small). Receive the Electronic Filing Acknowledgement with application number and filing date. That date is your priority date.
6. Keep this entire pack + the filing receipt as permanent records.

WARNING: Do not publicly disclose the invention in a way that starts the one-year grace period clock before filing if you can avoid it. Your existing laboratory documents are recent (July 2026). File as soon as practical.

2. PROVISIONAL APPLICATION COVER SHEET DATA

Use the following information when completing Form PTO/SB/16 or the equivalent fields in Patent Center. Replace bracketed items with your legal information.

Field	Value to Enter
Application Type	Provisional Application for Patent
Title of Invention	Jaw-Coupled Silent Intent Interface System with Piezoelectric Mandible Sensing and Closed-Loop Bone Conduc
Inventor Name (Legal)	[FULL LEGAL NAME — e.g., [redacted] [redacted] or Aziel Eliab as preferred for consistency with prior documents]
Inventor Residence	[City, State — e.g., Hamilton County / Indianapolis area, [redacted]
Correspondence Address	[Your mailing address for USPTO correspondence]
Attorney/Agent	None (Pro Se) — or name + registration number if using counsel
Docket Number	AZ-MANDIBLE-PROV-001 (optional internal reference)
Entity Status	Micro Entity (if eligible) or Small Entity
Government Interest	None

Suggested Short Title for Filing: A-Z Mandible Silent Intent Interface

3. MICRO ENTITY STATUS CERTIFICATION

If you qualify, file Form PTO/SB/15A (Certification of Micro Entity Status — Gross Income Basis) with the application. Requirements (gross income basis): (1) qualify as small entity; (2) not named as inventor on more than four previously filed U.S. non-provisional applications; (3) gross income for the preceding calendar year does not exceed the maximum qualifying amount (currently $251,190 — confirm current figure on USPTO site); (4) not obligated to assign the invention to an entity that exceeds the income limit. Provisional applications that were never converted do not count against the four-application limit. Self-certify honestly. False certification can invalidate the application or patent.

Download the current Form SB/15A directly from the USPTO website. Fill it, sign it, and upload it with the provisional filing.

4. WRITTEN DESCRIPTION / SPECIFICATION

(This section is the heart of the provisional application. It must enable a person skilled in the art to make and use the invention without undue experimentation.)

FIELD OF THE INVENTION

The present invention relates generally to human-machine interfaces and silent speech interfaces. More particularly, it relates to a system and method for detecting mechanical intent and articulatory movement from the mandible (jaw) using piezoelectric sensing, processing those signals into digital commands or classifications, and providing closed-loop self-hearing feedback to the user via bone conduction, without requiring audible airborne speech. The system is useful for accessibility (mute or speech-impaired users), high-operational-security (OPSEC) communication, and general silent human-computer interaction.

BACKGROUND OF THE INVENTION

Human speech begins as coordinated mechanical motion of the jaw, tongue, teeth, and vocal tract before any audible pressure waves are produced. Existing silent speech interfaces (SSIs) and related technologies include facial electromyography (EMG), camera-based lip reading, throat microphones, intraoral sensors, and various bone-conduction devices. Many of these systems are complex, power-hungry, visually conspicuous, or lack a natural closed-loop feedback mechanism that allows the user to perceive their own silent input in real time without generating airborne sound. There remains a need for a simple, robust, low-power, discrete system that captures mandibular mechanical intent early, classifies it, and returns private auditory feedback via bone conduction. The present invention addresses this need with a layered architecture centered on a passive piezoelectric sensor coupled to the mandible, an analog front-end, digital pattern classification, and a bone-conduction feedback path.

SUMMARY OF THE INVENTION

In one aspect, the invention provides a jaw-coupled silent intent interface system comprising: (a) a passive piezoelectric sensor configured for mechanical coupling to a user's mandible or teeth; (b) an analog front-end circuit that amplifies and conditions the electrical signal produced by the piezoelectric sensor; (c) a digital processing unit that performs analog-to-digital conversion and pattern classification of the conditioned signal to detect user intent or commands; (d) a bone-conduction transducer that delivers auditory feedback to the user through skeletal vibration so that the user can perceive the detected input without producing airborne sound; and (e) optional adaptive learning and security layers. The system operates in distinct developmental and operational phases, beginning with basic signal acquisition and progressing to wearable intraoral embodiments. Preferred embodiments emphasize simplicity at the hardware level, empirical validation of each layer, and failure-visible behavior.

DETAILED DESCRIPTION OF THE INVENTION

4.1 System Architecture — Layered Design

The system is deliberately structured in separable layers so that each layer can be validated before the next is added:

- **Sensor Layer:** Physical interface between the mandible and the electronics. Primary embodiment uses a passive piezoelectric disc (preferred 27 mm diameter). Alternative sensors (MEMS accelerometers, contact microphones) may be substituted in later optimization.
- **Analog Front-End Layer ("Whisper Amp"):** Low-noise amplification and signal conditioning. Converts the high-impedance, low-amplitude piezo signal into a usable voltage range for the microcontroller. Preferred configuration is a non-inverting operational-amplifier stage with gain approximately 10–16× (example: $R_f = 100\ k\Omega$, $R_g = 10\ k\Omega \rightarrow$ gain ≈ 11).
- **Digital Layer:** Microcontroller (Arduino Nano or equivalent preferred for early phases) performing ADC, basic signal processing, and pattern classification (e.g., peak timing and count for binary YES/NO or simple command sets).
- **Feedback Layer:** Bone-conduction transducer (preferred placement near the mastoid process) that provides self-hearing of the user's own input. Optional haptic output may be added.

- **Host / Intelligence Layer:** Adaptive learning, user-specific calibration, language modeling, and user interface. May run on a connected host or, in later versions, on-device.
- **Security Layer:** Air-gapped defaults, physical security switches, coercion-resistant design, and clear security-state indication. Non-negotiable for high-OPSEC use cases.

4.2 Sensor Technology — Preferred Embodiment

The preferred primary sensor is a passive 27 mm piezoelectric disc. Advantages include high sensitivity to mechanical vibration in the frequency range of jaw movement, no external power requirement for basic sensing, low cost, wide availability, and proven effectiveness in laboratory prototypes. The high output impedance of the piezo requires proper biasing (typically a 1 MΩ resistor from the signal node to ground) to establish a stable baseline. Reliable results depend on consistent mechanical coupling to the jaw or teeth (lower molars or jaw-hinge region preferred). Alternative sensors such as MEMS accelerometers or contact/throat microphones may be used once the core signal chain is proven, but add complexity and power requirements.

4.3 Analog Front-End Circuit

A non-inverting amplifier configuration is preferred. Example components: LM358 (dual) or OPA2134 (lower noise, preferred for Phase 2 and beyond). Gain is set by the feedback and ground resistors: Gain = 1 + (R_feedback / R_ground). A gain of approximately 11 has been found effective. Decoupling capacitors (0.1 µF ceramic across power pins, 10 µF electrolytic on the supply rail) reduce noise. The amplified signal is fed to an analog input of the microcontroller. Shielded cabling and careful grounding improve signal-to-noise ratio in real-world environments.

4.4 Digital Processing and Classification

In early embodiments the microcontroller samples the amplified signal, establishes a baseline when the jaw is idle, and detects deviations exceeding a threshold. A simple peak-counting classifier distinguishes patterns: for example, one peak within a timing window may be interpreted as “NO” and two peaks as “YES.” Timing windows (e.g., 800 ms of inactivity after the last peak) allow classification to complete. More advanced embodiments incorporate adaptive thresholds, multi-class pattern recognition, and user-specific calibration. Working laboratory code examples for baseline establishment, amplified monitoring, and basic YES/NO classification have been developed and validated.

4.5 Bone Conduction Feedback Path

A bone-conduction transducer converts the processed digital or analog representation of the user’s input into mechanical vibration that is delivered to the skull (preferred location: mastoid process behind the ear). This allows the user to “hear” their own silent input privately without generating airborne sound. A small Class-D audio amplifier module (e.g., PAM8403 or equivalent) may drive the transducer. The feedback path closes the loop, enabling real-time confirmation of detection and supporting natural use by mute or speech-impaired individuals.

4.6 Phase 4 — Intraoral / Wearable Embodiment

Later embodiments integrate the sensor into a retainer-style or dental-aligner-like housing fabricated from medical-grade biocompatible silicone or dental resin. Target thickness in critical areas is approximately 4–6 mm. The sensor is embedded for consistent, comfortable contact pressure along the lower molars or jaw-hinge region. Moisture protection (conformal coating, medical-grade epoxy) is applied. An optional small behind-the-ear or integrated module houses the electronics, battery (e.g., 100–300 mAh LiPo with protection), and bone-conduction transducer. Success criteria include comfort for 30–60+ minutes of continuous wear, consistent sensor coupling during normal head movement, clear bone-conducted self-hearing, and absence of moisture-related failures.

4.7 Adaptive Learning and Accessibility Features

The host/intelligence layer supports user-specific calibration and adaptive learning so that performance is optimized for an individual user’s jaw dynamics and any speech impediments. This makes the system particularly suitable as an accessibility tool for mute users or those with severe speech production difficulties, while remaining useful for high-OPSEC silent command entry.

4.8 Security and OPSEC Considerations

Preferred embodiments default to air-gapped operation. Wireless capability, if present, is deliberately enabled by the user and clearly indicated. Physical security switches and visible failure modes are employed so that a failed or coerced detection state is obvious to the user rather than silently incorrect.

4.9 Best Mode / Preferred Implementation

The currently preferred laboratory implementation uses a 27 mm passive piezoelectric disc biased with a 1 MΩ resistor, a non-inverting amplifier stage with approximately 11× gain (OPA2134 or LM358), an Arduino Nano microcontroller running peak-timing classification software, and a bone-conduction transducer driven by a small audio amplifier and placed against the mastoid. Mechanical coupling is achieved with temporary dental wax or a custom 3D-printed retainer-style housing. This configuration has demonstrated clear signal acquisition, improved signal-to-noise ratio after amplification, and basic binary classification accuracy on the order of 80 % in controlled trials.

4.10 Alternative Embodiments

Alternative sensors (MEMS accelerometers, multi-channel arrays, contact microphones), higher-gain or instrument-grade amplification, more sophisticated machine-learning classifiers, multi-command vocabularies, fully wireless miniaturized packages, and dual-use tactical packaging are contemplated and fall within the scope of the invention as long as they retain the core combination of mandible-coupled sensing, digital intent classification, and closed-loop bone-conduction feedback.

5. LIST OF FIGURES AND DETAILED DESCRIPTIONS

Attach the actual drawings (black-and-white line drawings preferred) as separate pages or a multi-page PDF when filing. The following descriptions define the content that should appear in each figure. Use consistent reference numerals across all figures.

FIG. 1 — System block diagram showing the layered architecture: Sensor Layer (piezoelectric element) → Analog Front-End (amplifier) → Digital Layer (microcontroller + classification) → Feedback Layer (bone-conduction transducer) → optional Host/Intelligence and Security layers. Arrows indicate signal and feedback flow.

FIG. 2 — Mechanical coupling of the piezoelectric sensor to the mandible. Side and frontal views illustrating preferred contact locations (lower molar region and/or jaw hinge / temporomandibular area). Sensor shown in both temporary external mounting and embedded intraoral retainer configurations.

FIG. 3 — Schematic of the preferred analog front-end circuit: piezoelectric disc, 1 MΩ bias resistor to ground, non-inverting op-amp stage with feedback and ground resistors setting gain ≈ 11, decoupling capacitors, and connection to microcontroller analog input.

FIG. 4 — Representative signal waveforms: (a) idle baseline, (b) single jaw movement / clench producing one peak, (c) double peak pattern corresponding to a YES classification. Time and amplitude axes labeled.

FIG. 5 — Bone-conduction feedback path. Illustration of transducer placement on the mastoid process and the vibration path through the skull to the inner ear, providing private self-hearing.

FIG. 6 — Phase 4 intraoral / wearable embodiment. Exploded or cross-sectional view of a retainer-style housing showing embedded piezoelectric sensor, electronics module, battery, and optional integrated or remote bone-conduction transducer. Approximate thickness call-outs (4–6 mm critical areas).

FIG. 7 — High-level operational flowchart: acquire signal → establish/update baseline → detect peak(s) → classify pattern → generate feedback via bone conduction → optional adaptive update.

Reference numeral examples (use consistently): 10 – piezoelectric sensor; 12 – mandible / jaw; 14 – bias resistor; 16 – operational amplifier; 18 – microcontroller; 20 – bone-conduction transducer; 22 – retainer-style housing; 24 – battery / power module.

6. FINAL FILING CHECKLIST

- ■ USPTO.gov account created and identity verified for Patent Center
- ■ Legal name and current residence confirmed for inventor and correspondence address
- ■ Micro entity eligibility verified; Form SB/15A prepared and signed (if claiming)
- ■ This specification reviewed and any personal details updated
- ■ Clean drawings prepared corresponding to FIGS. 1–7 (or a subset sufficient for understanding)
- ■ All files converted to PDF and ready for upload
- ■ Patent Center → New Submission → Utility Provisional selected
- ■ Cover sheet / ADS fields completed with data from Section 2
- ■ Specification + drawings uploaded
- ■ Micro entity certification uploaded (if applicable)
- ■ Filing fee paid ($65 micro / $130 small)
- ■ Electronic Filing Acknowledgement (receipt with application number and date) downloaded and saved
- ■ Complete package (this document + drawings + receipt) archived securely

7. AFTER FILING — RECOMMENDED NEXT STEPS

1. Mark all subsequent materials, demos, and communications "Patent Pending."
2. Continue laboratory development of Phase 4 (intraoral comfort, coupling consistency, multi-command accuracy).
3. Within 12 months of the provisional filing date, file a non-provisional (utility) application claiming priority to this provisional, or file a PCT application if international protection is desired. Professional claim drafting is strongly recommended for the non-provisional because of existing prior art in silent speech and bone-conduction interfaces.
4. Maintain detailed, dated laboratory notebooks of improvements; these support inventorship and can strengthen later claims.
5. Consider a preliminary prior-art search (Google Patents, USPTO) focused on mandible/jaw vibration + bone-conduction feedback combinations to inform claim strategy.
6. [redacted] resources: PatentConnect (IU Maurer), IU Maurer IP Clinic, Notre Dame IP Clinic, and local Patent & Trademark Resource Centers can provide further guidance or pro-bono matching if needed.

END OF PROVISIONAL PATENT SUBMISSION PACK

This pack is intended to be a complete, enabling disclosure suitable for establishing a priority date. It is not legal advice. For the non-provisional stage, consultation with a registered patent attorney or agent is recommended.