Xinyu Jiao

Idea 1

A project about housing and displacement, using VR and community mapping, staged at the neighborhood scale as an immersive narrative. The audience must act as co-designers rather than spectators, funded by community volunteers and crowdfunding, and intentionally dismantled after a short period.

Idea 2 most excited

A project about climate crisis and rising seas, using Unity game engine and narrative prototyping, staged at the room/exhibition scale as an interactive installation. Funded by nonprofits and academic networks, maintained through open-source iteration.

Idea 3 resist

A project about food supply chains and waste, using IoT sensors and visualization, staged at the kitchen/household scale as an interactive domestic object. Supported by local cooperatives and updated through community workshops.

Idea 5
A project about urban flooding and water cycles, using AR visualization and sensor networks, staged at the public square scale as an interactive performance. Funded by municipal grants and community volunteers, rebuilt after major weather events.

Idea 6
A project about labor and automation, using robotic prototyping and machine learning scripts, staged at the factory scale as a dynamic installation. Maintained by a workers' cooperative, emphasizing anti-capitalist sharing models.

Idea 7
A project about cultural memory and archives, using generative AI and data mining, staged at the library/archive scale as a constantly shifting projection. Driven by volunteer-contributed materials, and gradually overwritten with time.

Idea 8
A project about wildlife migration, using drones and GPS tracking, staged at the landscape scale as an augmented reality pathway. Funded by environmental NGOs, updated through public crowdsourced annotations.

ASSIGNMENT I

Assignment 1 - for Monday 9/8

Develop 3 ideas for the capstone based on your explorations in the summer. Specifically, address the following for each idea:

- Define the problem, condition, or questions you’d like to explore
- What is the role of computation and design for each idea? For example, will your research to explore ideas be: Data intensive? User driven? Technology driven? Survey driven? Speculative? Creative? How do computation and design help with your explorations?
- Provide one precedent for each idea and describe the following
  1. How does it work?
  2. Who is its audience? Who are the stakeholders?
  3. Summarize the methodology used to make it, in 1-2 sentences.
  4. What are some alternative ways that it could have been developed? How could they be improved or expanded? How could it produce a better world?

Due by the next desk crit. Assignment submissions should be made in your own slide deck. We will review it during desk crits.

Students will be divided into two groups for desk crits, one with each instructor. Email Adam by **Friday, Sept 5** if you have a preference. Otherwise the instructors will circulate a spreadsheet by the weekend for Monday’s desk crit.

Idea 1: Tactile Sound-Reactive Device

Problem

How can **handheld objects** offer non-visual interaction through **touch** → **sound feedback**, creating an portable interface that supports daily life and independence?

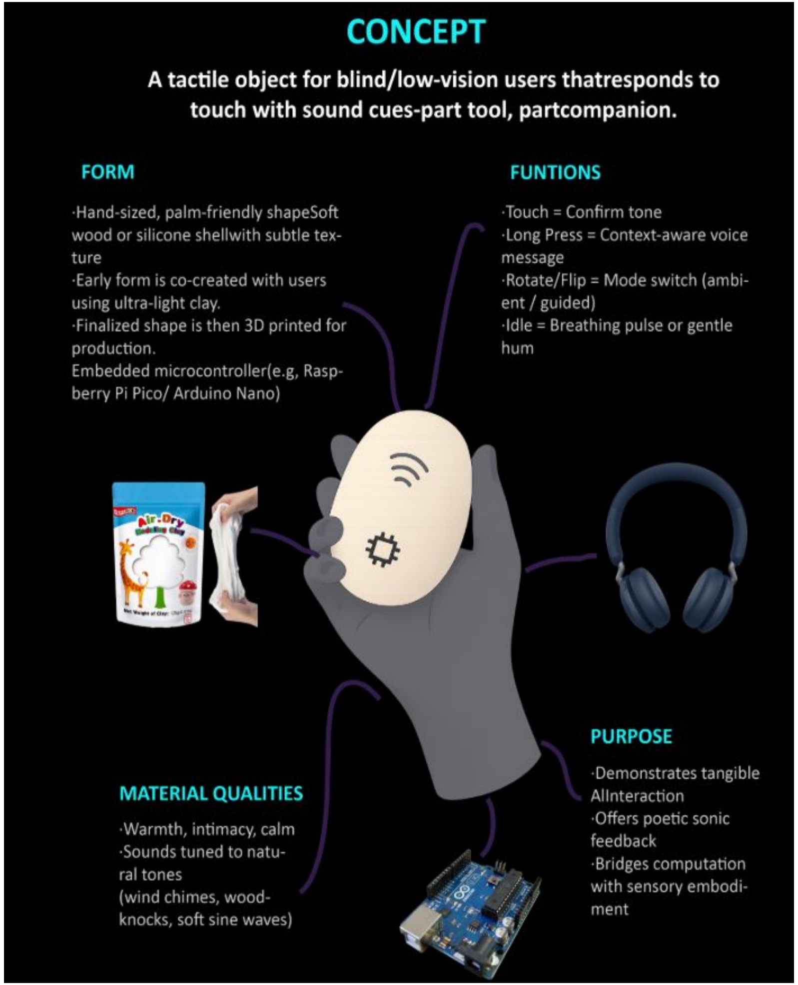
Role of Computation & Design

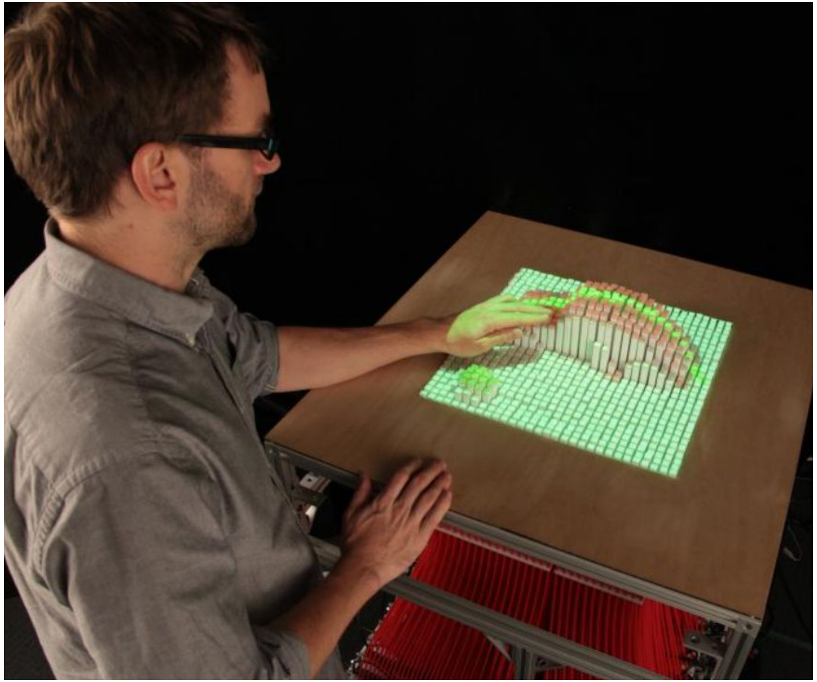
Technology-driven: Microcontrollers (Arduino/Pi Pico) link tactile gestures to sonic responses

User-driven: Co-creation of device shape with blind users using ultra-light clay.

Design: Form-finding for warmth and comfort; soundscapes mapped to touch states.

https://xinyu-jiao.github.io/colloquium-project/





https://tangible.media.mit.edu/project/inform/

Precedent: MIT's Tangible Media Group – inFORM

- **How it works**: Shape-changing table that reacts to human gestures, making data physical.
- **Audience/Stakeholders**: Designers, accessibility researchers, people needing embodied interaction.
- **Methodology**: Actuator grids + computational mapping of input to haptic output.
- **Alternatives/Expansion**: Make it into palm-sized devices, embed sound cues. Could integrate with wearables or IoT. **Better world**: turns abstract data into everyday sensory companionship.

Idea 2: Sonic-Tactile Data Interfaces

Problem

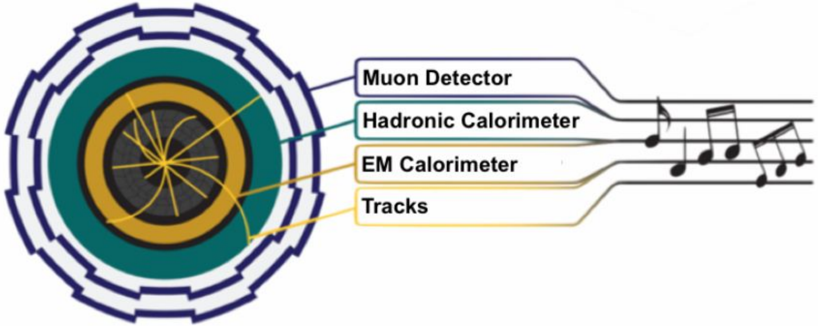
How can we make **complex data (finance, health, environment)** accessible through sound + touch, enabling blind users to perceive and analyze data without vision?

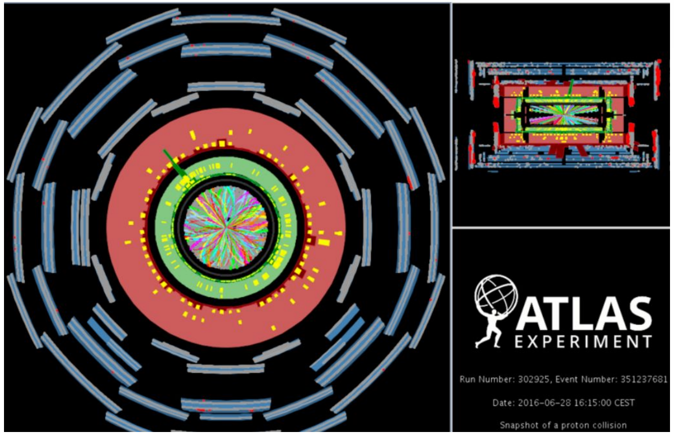
Role of Computation & Design

- **Data-intensive**: Algorithms map data streams to pitch, rhythm, and vibration patterns.
- **Creative/speculative**: Hybrid dashboards with soundscapes and tactile pads.
- **Design**: Move from visual “dashboards” to inclusive sonic-tactile sensing.

Precedent: The Shape of Data (MIT Media Lab)

- **How it works**: Sonifies and tactilizes data patterns for blind learners.
- **Audience/Stakeholders**: Educators, blind students, researchers in inclusive tech.
- **Methodology**: Data-to-sound/touch mappings tested in workshops.
- **Alternatives/Expansion**: Scale from prototypes to cloud-linked, real-time tools (e.g., stock market alerts via vibration).
  Better world: universal data literacy, removing barriers of sight.





[Overview ‹ Quantizer: Sonification Platform for High-Energy Physics Data — MIT Media Lab]

Idea 3: Ethical & Emotional AI Voice Interface

Problem

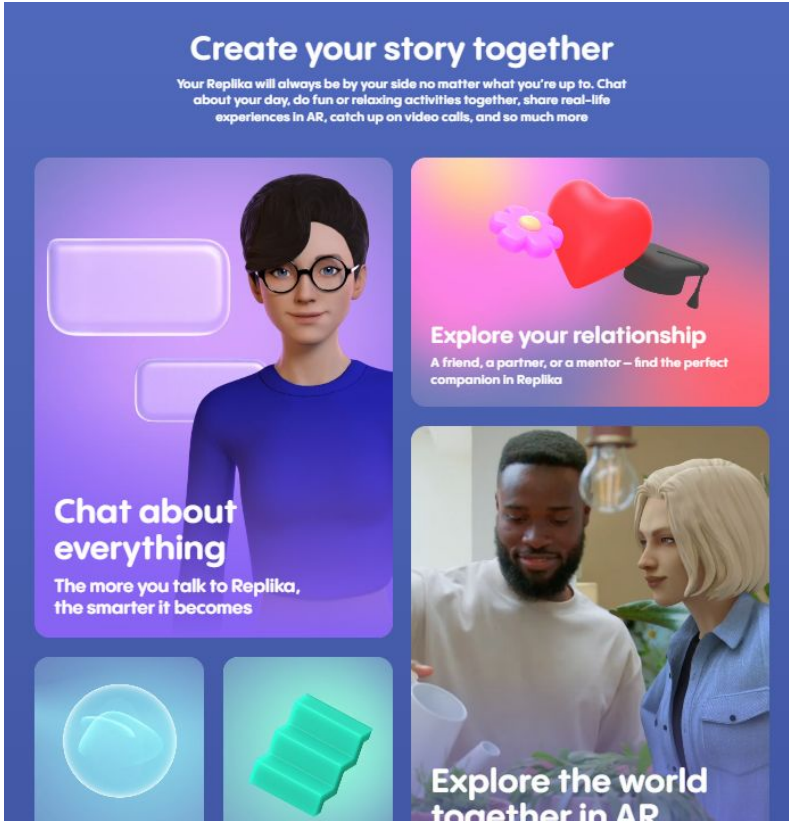
How can **AI-powered voices** move beyond “neutral assistants” to become emotionally supportive, **context-aware companions** for blind users, without being manipulative or sterile?

Role of Computation & Design

- **Technology-driven**: Real-time LLM + Web Audio API for adaptive speech
- **Speculative + user-driven**: Testing emotional cues (tone, pace, pauses) with users.
- **Design**: Rules for ethical, transparent voice responses (confidence earcons, uncertainty tones).。

Precedent: Replika (AI Companion)

- **How it works**: Chatbot app with adaptive, emotionally supportive voice/text interactions.
- **Audience/Stakeholders**: General users seeking companionship, mental health community.
- **Methodology**: Machine learning trained on dialogue, with feedback loops for tone adaptation.
- **Alternatives/Expansion**: Instead of commercial therapy-like chat, build open-source, accessible, and transparent voice UIs. **Better world**: blind users gain emotionally attuned, trustworthy digital partners.



https://replika.com/

ASSIGNMENT 2

Assignment 2:
In the summer, you explored many computational tools and methods (e.g., HCI, generative design, sensors, web development and more). Let’s think more abstractly and ask: what are the types of relationships between computation and design that emerge from these methods? In some cases, the computer can serve as an assistant (e.g. Alexa or Siri). In other uses, computation could be a co-creator (ChatGPT). In other cases computation might be an instrument, a language, a medium, a mode of thinking.
In this assignment, identify the mode(s) of computation that you want to employ for the three capstone ideas you are exploring.

- **Use precedents, sketches, and materials** from the summer to explore and define the conceptual framework around computation and its relationship to your design environment.
- What relationships are implied between the designer, the user, and the spatial?

How could you use the reverse engineering process to rethink your proposal’s approach to computation?

- Iterate on each proposal by rethinking a computational constraint, show how it changes the rest of the proposal, especially life cycle
- Are there possibilities for parallel existences of multiple implementations? Could you create a version with an alternative worldview or solution?

Feel free to come up with three brand new ideas/concepts if the three from last week are not working for you.
We are in the exploration phase of the semester.

Idea 1: Tactile Sound-Reactive Device

Mode of Computation:

- **Instrument**: Computation translates physical gestures into sonic feedback (touch = tone, long press = voice, rotation = mode).
- **Co-creator**: The object's form is co-designed with blind users using ultra-light clay, then digitized and 3D printed.
- **Medium**: The device uses touch and sound to carry out computation, replacing vision with physical sound feedback.

Designer–User–Spatial Relationship:

- Users are collaborators in shaping the object and defining interaction
- The design bridges physical affordance and sensory translation.
- Spatially, the device redefines micro-scale embodiment as interface.

[(PDF) An investigation into the effectiveness of using acoustic touch to assist people who are blind]

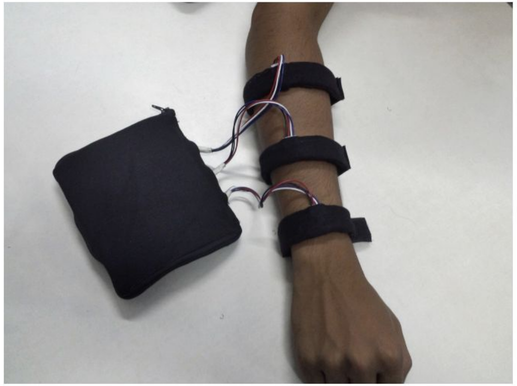


Fig. 1. The BrailleBand

[[1901.03329] Braille Band: Blind Support Haptic Wearable Band for Communication using Braille Language]

Reverse Engineering Approach:

- **Constraint**: Remove the need for buttons or sensors — what if gesture alone (e.g., squeeze, tap rhythm) triggers modes?
- **Project Lifecycle:** Funding: Self-funded / DIY → Grant-funded (future)
  Maintenance: seasonal updates
  Archiving: Preserved in archive, or adapted into new designs

Alternative Implementations:

- **Ambient wall-mounted version** for home spaces (like a voice wind chime).
- **Multi-user "companion stones"** that resonate together when held by different people — exploring social sensory networks.

Idea 2: Sonic-Tactile Data Interfaces

Mode of Computation:

- **Instrument + Language**: Data is encoded into rhythms, pitches, and vibrations — turning computation into a sensory language.
- **Data-intensive + Speculative**: Algorithms drive real-time translation of complex data (finance, weather, health) into multi-modal cues.

Designer–User–Spatial Relationship:

- Designer acts as a translator between abstract data systems and bodily sensing.
- The user becomes the interpreter of a new sonic-tactile “dashboard.”
- Spatiality shifts from screen-based layout to bodily interaction (e.g., vibrating pads, directional sound).

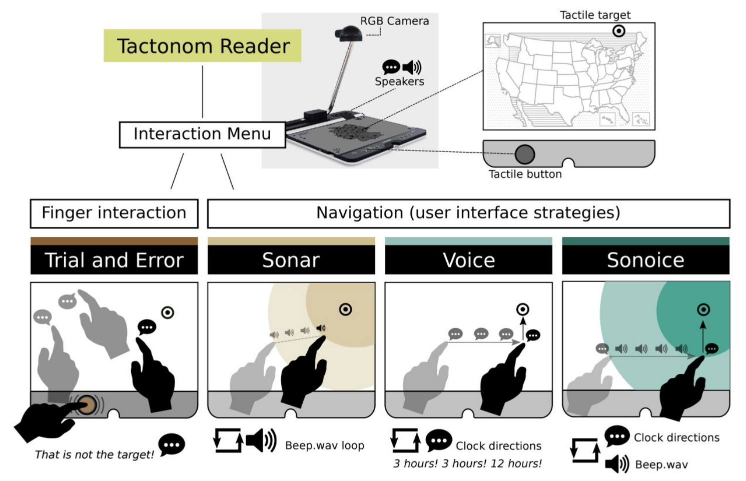


FIGURE 3
Pinpoint Navigation Strategies for Tactile Graphics (trial-and-error, Sonar, Voice, and Sonoice). The figure presents the workflow and key components of the four navigation strategies used in our study for element pinpointing in tactile graphics. Each strategy is illustrated with a diagram depicting the user's interaction and associated audio cues.

https://www.frontiersin.org/journals/rehabilitation-sciences/articles/10.3389/fresc.2024.1368983/full?utm_source=chatgpt.com

Reverse Engineering Approach:

- **Constraint**: Eliminate real-time data — what if it's a *recorded dataset* experienced slowly?
- This shifts the design toward a narrative or sculptural experience (e.g., "listen to your week's heart data").
- **Project Lifecycle**: Funding: Self-funded / DIY → Grant-funded (future)
  Maintenance: Needs dedicated updates
  Archiving: Digitally archived, may be handed to new group

Alternative Implementations:

- **Spatialized soundwalks** where environmental data is geolocated and heard via phone or AR headset.

Idea 3: Ethical & Emotional AI Voice Interface

Mode of Computation:

Assistant + Companion: Moves beyond neutral voice to adaptive, emotionally intelligent interaction.

Technology-driven: Combines LLMs with Web Audio API for real-time vocal modulation.

Speculative + User-driven: Explores ethical dimensions of voice tone, confidence indicators, and uncertainty.

Designer–User–Spatial Relationship:

- The designer codes emotional *affect* into otherwise boring systems.
- The user listens in private/intimate contexts — home, transit, bedtime — requiring trust and warmth.
- The space is shaped by **sound and relationships**, rather than visual or architectural.

Reverse Engineering Approach:

Constraint: Remove natural language — what if all feedback is *nonverbal tone only*?

Project Lifecycle:

1. Funding: Self-funded or Crowdsourced
2. Maintenance: Updated quarterly
3. Archiving: Could be deleted or evolve into new project

Alternative Implementations:

An "earcon" only interface — purely tonal signals (like musical Morse code).
Shared AI companion between blind users — trained on collective emotional preferences.

These three ideas are not separate—they work best together as a mutually supportive, multi-sensory system.

ASSIGNMENT 3

Assignment 3

Complete **A/B lists for 3 project ideas**

Dunne & Raby's *A/B of Design* sets up pairs like **Affirmative** ↔ **Critical**, **Problem-Solving** ↔ **Problem-Finding**, **Functional** ↔ **Fictional**. Contrasts help us see that design is never neutral, it either reinforces or challenges the present. Complete A/B lists for all three project ideas, generating a collection of the key terms and tensions that define your project's world. What assumptions and values are surfaced? Where does your proposal sit along these A/B axes? And where could it go? Consider the different trajectories for your projected suggested by this exercise.

Begin collecting **signals for 3 project ideas**

Signals are **observations about the present that point toward potential futures.** Speculative design uses today's signals as the starting point for imagining possible, plausible, and provocative scenarios. Drawing from examples on the Shared Signals Database, find 3-5 signals that relate to or inform each of your proposals. Which signals make your project feel more urgent or relevant? Could your project become part of this signal, accelerate it, normalize it, or resist it?

Complete **sketches for 3 project ideas**

Complete the 8 quick sketches exercises for all three project ideas. Reference the prompts and diagram examples in the Design Sprint deck.

From 8, select 2 for each idea and refine / add detail to develop them further. The detailed sketches you develop can involve research, collage, photos, diagrams, illustrations, etc. You are no longer bound to the paper-and pencil format. Instead, begin sketching with data, wireframes, prototypes, or other formats that work best with your proposal. The sketches should give an idea of how your capstone will look and work. Fast iterations are more important than fidelity at this moment.

A/B lists for Idea 1: Tactile Sound-Reactive Device

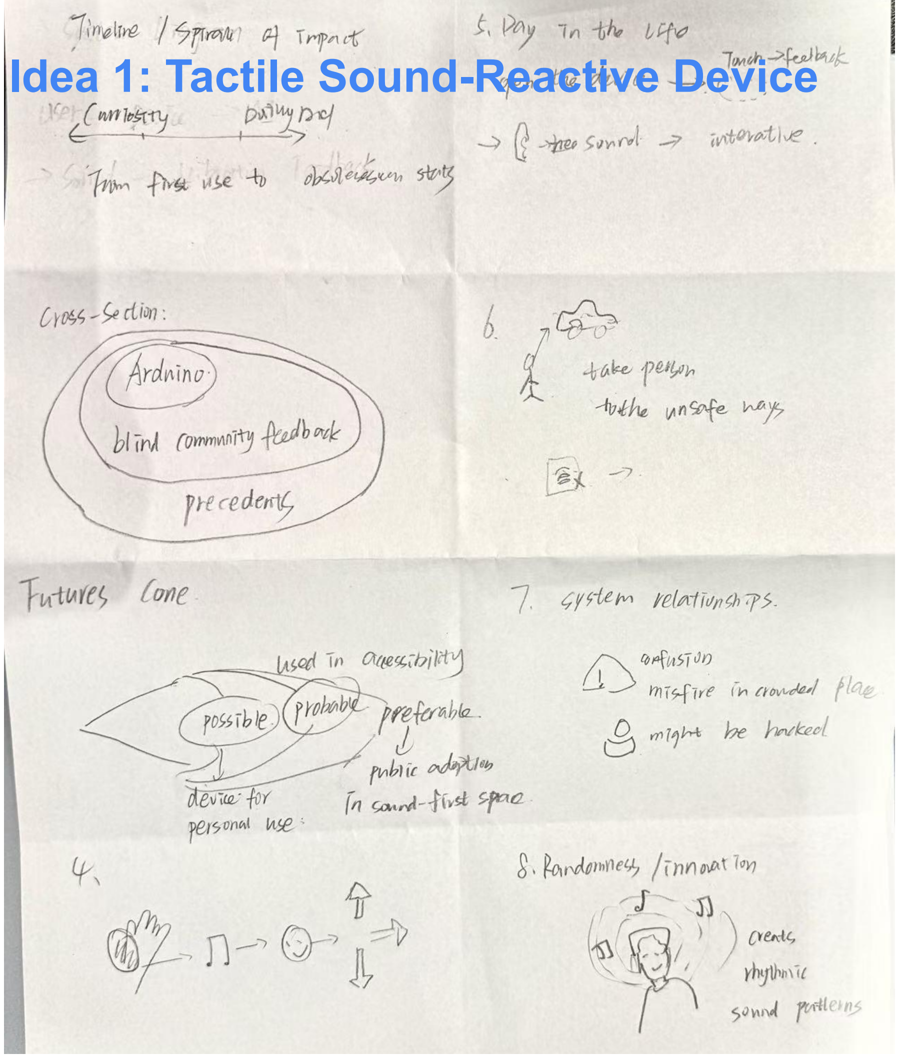
A: Affirmative Design	**B: Critical / Speculative Design**
Visual	Sonic + Tactile
Assistive Tool	Embodied Companion
Passive Sensing	Active Feedback Loop
Universal Interface	Personalized Modality
Problem-Solving	Experience-Making
Technically Functional	Emotionally Responsive
Human ↔ Device	Human ↔ Soundscape ↔ Device
External Display	Internal Perception

My project sits between **assistive** and **expressive**, starting from functional accessibility needs and evolving toward **embodied, emotional interaction**. It leans **speculative**, offering an alternative way of sensing sound for blind or multi-sensory users.

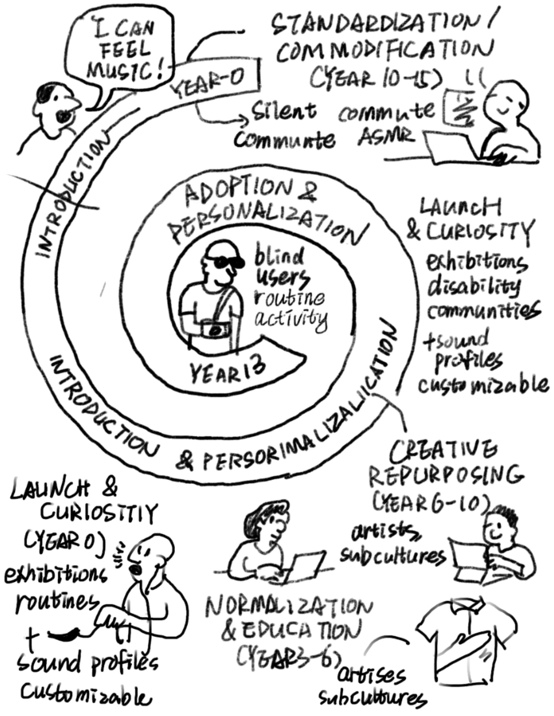
Signals for Idea 1: Tactile Sound-Reactive Device

Signal	Description	Relation to Project
Bone-conduction wearables	Sound heard via bones, not ears	Supports alternative sound interfaces
Social haptics	Devices that allow shared touch (e.g., haptic bracelets for long-distance relationships)	Suggests potential for co-experienced touch-based sound
Sound-based art therapy	Emerging field using sound and vibration in healing	Positions your device within emotional care

Sketches for Idea 1: Tactile Sound-Reactive Device

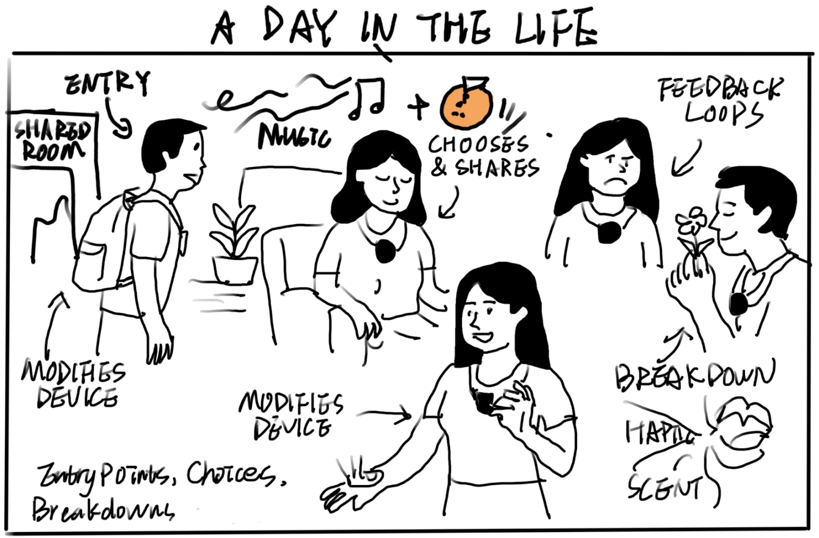


Sketches for Idea 1: Tactile Sound-Reactive Device



Draw a timeline or spiral showing how your project idea might change human behavior over time, from first use to obsolescence.

Diagram a day in the life of a user interacting with your project. Show entry points, choices, breakdowns, and feedback loops.



A/B List for Idea2: Sonic-Tactile Data Interfaces

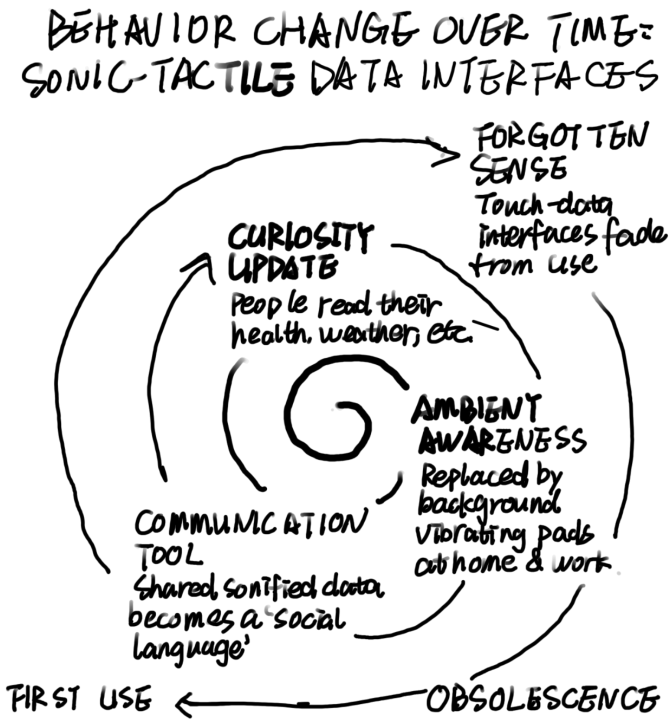
A: Affirmative Design	B: Critical / Speculative Design
Data visualization (graph/chart)	Data embodiment (sound + touch)
Accessibility aid	Sensory transformation tool
Screen-based interface	Screenless / body-first interface
Accurate data delivery	Emotional or interpretive experience
Passive listener	Interactive sensory explorer
Standardized UI	Contextual, adaptive, and personalized feedback
Designed for efficiency	Designed for reflection and slowness
Focus on usability	Focus on alternative perception and inclusion
Sighted-first design	Blind-first, body-centric design

Currently leaning toward the B side (Critical, Sensory, Speculative), emphasizing "translation" rather than "representation," and focusing on the relationship between body and sound.

Signals for Idea 2: Sonic-Tactile Data Interfaces

Signal	Description / Context	Relevance to Project
Haptic Wearables (e.g., Apple Vision Pro, HaptiTouch)	Mainstream consumer devices now include vibrotactile feedback (e.g., tapping for alerts)	Shows growing comfort with non-visual feedback systems
Sonification of Scientific Data	Projects like turning climate data or COVID-19 spread into soundscapes	Validates data-to-sound as informative and artistic
Non-Visual Music Interfaces (e.g., SubPac, Woojer)	Music tools that translate sound into body sensations (used by Deaf/hard-of-hearing users)	Reinforces the value of vibroacoustic communication
Urban Sonification Installations	Public artworks turn city data (e.g., pollution, noise) into live audio experiences	Demonstrates public engagement with data through sound

Sketches for Idea 2



Draw a **timeline** or **spiral** showing how your project idea might change human behavior over time, from first use to obsolescence.

A/B List for Idea 3: Emotional AI Voice Interface

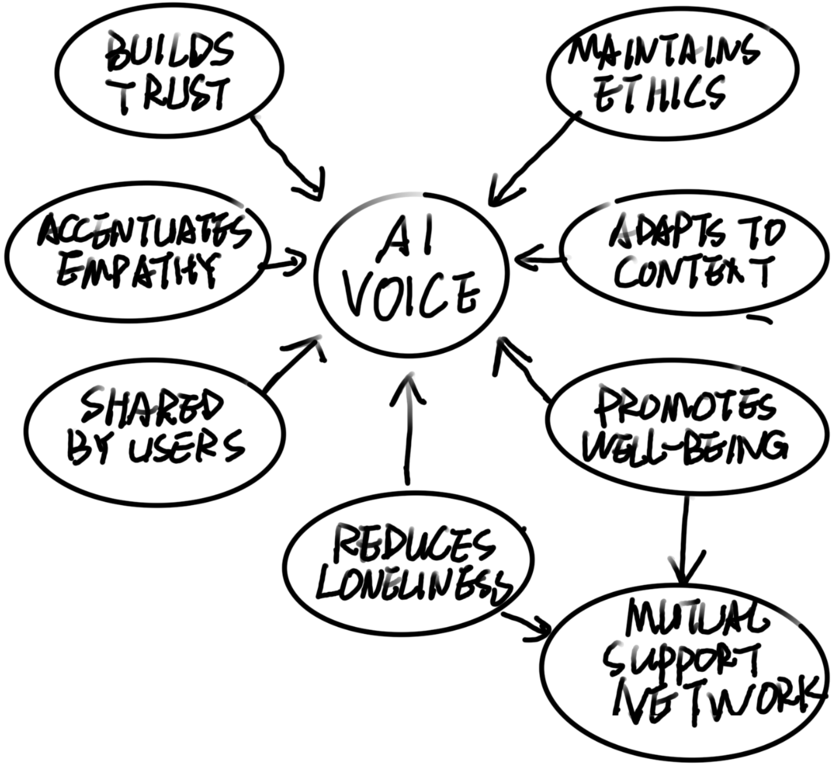
A: Affirmative Design	B: Critical / Speculative Design
Functional	Emotional / Empathic
Authoritative AI	Co-created AI
Voice as Command Tool	Voice as Companion / Caregiver
Standardized Responses	Personalized Emotional Resonance
Efficiency	Empathy / Emotional Depth
Control-Based Interaction	Relationship-Building Interaction
Neutral Tone	Expressive, Context-Sensitive Voice
Singular User Experience	Multi-User, Shared Emotional Interface
Surveillance Concern	Mutual Trust + Transparency

Current tendency: Mostly on the B side — imagining voice as a bridge for emotional intelligence and companionship rather than productivity. The system prioritizes relational interaction and emotional transparency.

Signals for Idea 3: Ethical & Emotional AI Voice Interface

Signal	Description / Context	Relevance to Project
Generative Voice AI (e.g., OpenAI Voice)	High-fidelity, emotionally nuanced voice synthesis is now achievable with low latency and realism.	Enables emotionally expressive, human-like responses from the interface.
AI Companions & Chatbots (e.g., Replika, Character.ai)	Users are forming real emotional bonds with chatbots, including for support and intimacy.	Highlights social and emotional roles voice interfaces can play for blind users.
Affective Computing & Sentiment Analysis	Advances in recognizing user emotions through tone, language, and biosignals.	Makes it possible for the interface to adapt emotionally to users in real-time.
Accessibility-Driven Voice UI Design	Inclusive design practices are reshaping voice interfaces to better serve disabled users.	Aligns project with broader accessibility goals and blind users' needs.

Sketches for Idea 3



Sketch your project not as an object or thing but as a set of **relationships** or tendencies

ASSIGNMENT 4

Assignment 4

By now, you have settled on three viable ideas/concepts to explore. To develop a proposal, conduct **background research** on each, by answering the following questions about design:

- What is the current condition and context of the concepts, technologies and methods you are investigating?
- Is there a particular problem or question that each of the three imply?
- What kinds of change is implied by your work? By whom? And why?
- What has already been done around this idea? This could be answered by some of your precedent research from last week.
- What design methods are suitable for the 3 concepts?
- What modes of computation are suitable for the 3 concepts?

Describe your project in terms of Spatial Computing. Specifically, identify and list the datasets, equipment, hardware, and other computational resources needed for your 3 ideas. Additionally, situate your project and its computations in space and across scales. How do these ideas explore, sense, or know space? Based on the resources and methods you identified in the workshop, develop initial sketches for how you plan to use these resources to develop the ideas.

Idea 1 — Tactile Sound-Reactive Device

Current Condition & Context

Sound-reactive tactile devices are not new: vibration motors and haptic feedback have been used in smartphones, wearables, and accessibility tools (like haptic canes or vibrating wristbands). However, most devices focus on functional feedback (alerts, navigation). Few exist in **poetic, intimate, or co-designed forms** that emphasize *aesthetic experience* and *personal expression* for blind/low-vision users.

Implied Problem

- Current accessibility devices are often designed just for **basic function**.
- There is little emphasis on **emotional connection, co-creation, and sensory delight**.
- Blind users are usually treated as end users rather than co-designers.

Precedents

- **Yuri Suzuki's Ambient Machine** (multi-sound object for atmosphere)

- **Be My Eyes / Be My AI** (AI-enabled accessibility tools, but not tactile)

- **DIY haptic kits** like Hapkit (Stanford) — focus on mechanical haptics, not aesthetics.

These show possibilities, but few integrate **touch, co-design, and poetic sound** together.

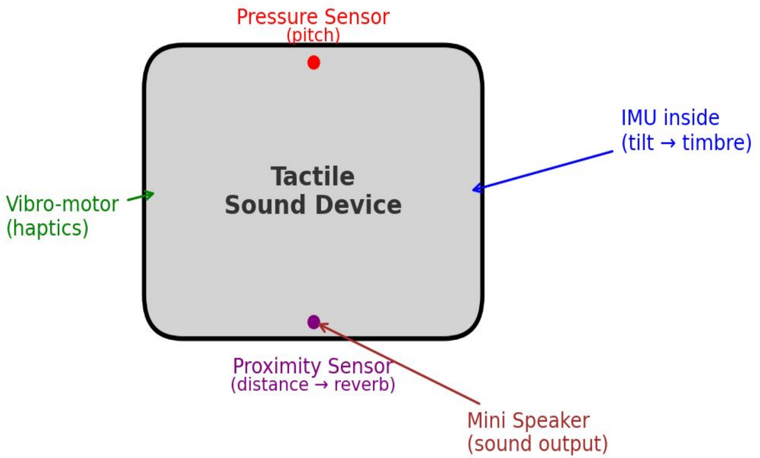
Spatial Computing Frame

Equipment & Resources

- Arduino / ESP32 + FSR sensors
- FSR sensors + IMU + vibro-motors
- Small speakers / bone-conduction headphones
- Software: Arduino IDE, Web Audio API, Python

Spatial Scales

- **Body-scale**: hand interactions (press, tilt)
- **Room-scale**: two-user collaboration, stereo sound space
- **City-scale**: portable, playful public demos



Idea 2 – Sonic-Tactile Data Interfaces

Current Condition & Context

- **Data sonification** is growing: used in scientific analysis, accessibility, and creative tools.
- Most systems are designed for **individual use**, often screen-reader-compatible but not collaborative.
- Tools like SAS Graphics Accelerator and **Highcharts sonification** offer blind-friendly audio charts, but often limited to simple 1D mappings.
- **Gap**: few interfaces support **multi-sensory**, **multi-user**, and **real-time exploration** of data (e.g. sound + vibration + spatial navigation).

Problem / Research Questions

- How can complex data (e.g. trends, peaks, correlations) be **perceived through sound and touch**?

- Can blind and sighted users **analyze data together** using shared auditory/tactile feedback?

- What mappings are most intuitive:
  - pitch = value?
  - rhythm = frequency?
  - vibration = density?

Precedents

- **The Sonification Handbook** – foundational design patterns.
- **SAS Graphics Accelerator** – screen-reader-friendly data summaries.
- **Highcharts Accessibility & Sonification** – supports keyboard + audio exploration.

But: few tools support **real-time co-analysis**, haptics, or spatial audio

Spatial Computing Frame

Datasets

- Public datasets from **NYC Open Data**
- 311 complaints (time + location)
- Air quality
- Subway headways / delays

Equipment & Resources

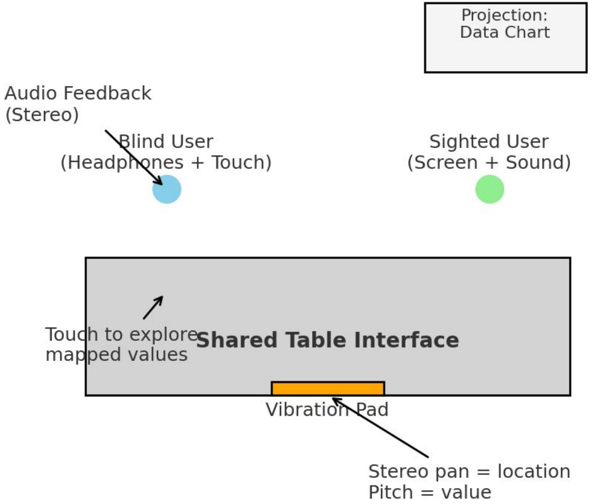
- Laptop + headphones
- Vibration pad or **surface transducer**
- Touch-sensitive interface or MIDI pad
- Software:Python (pandas, librosa)   Web Audio API /T

Spatial Scales

- **Table-scale**: shared tactile/audio interface
- **Room-scale**: projection for sighted user, sound in space

How It "Knows" Space Data mapped to space:

- Left → right = time
- Front → back = location
- Sound panning + haptics encode spatial information



Idea 3 – Ethical & Emotional AI Voice Interface

Current Condition & Context

- AI voice assistants (e.g. Alexa, Siri, ChatGPT Voice) are rapidly evolving toward **more expressive, human-like tones**.
- But most don't focus on **blind users' emotional needs**, **privacy**, or **repair** when misunderstanding the user.
- Emotion AI is being regulated (e.g. **EU AI Act** bans emotion detection in high-risk settings like schools/workplaces).
- There's a growing need for **consent-based**, **user-controllable** emotional voice systems.

Problem / Research Questions

- How can a voice interface **adapt to a user's emotional tone** without guessing or overstepping?
- What does **empathy + accountability** sound like in a voice-only interface?

Suitable Design Methods

- **Consent UX testing**: do users feel in control of what the AI knows/remembers?
- **Failure & recovery role-plays**: how does the AI respond when wrong?

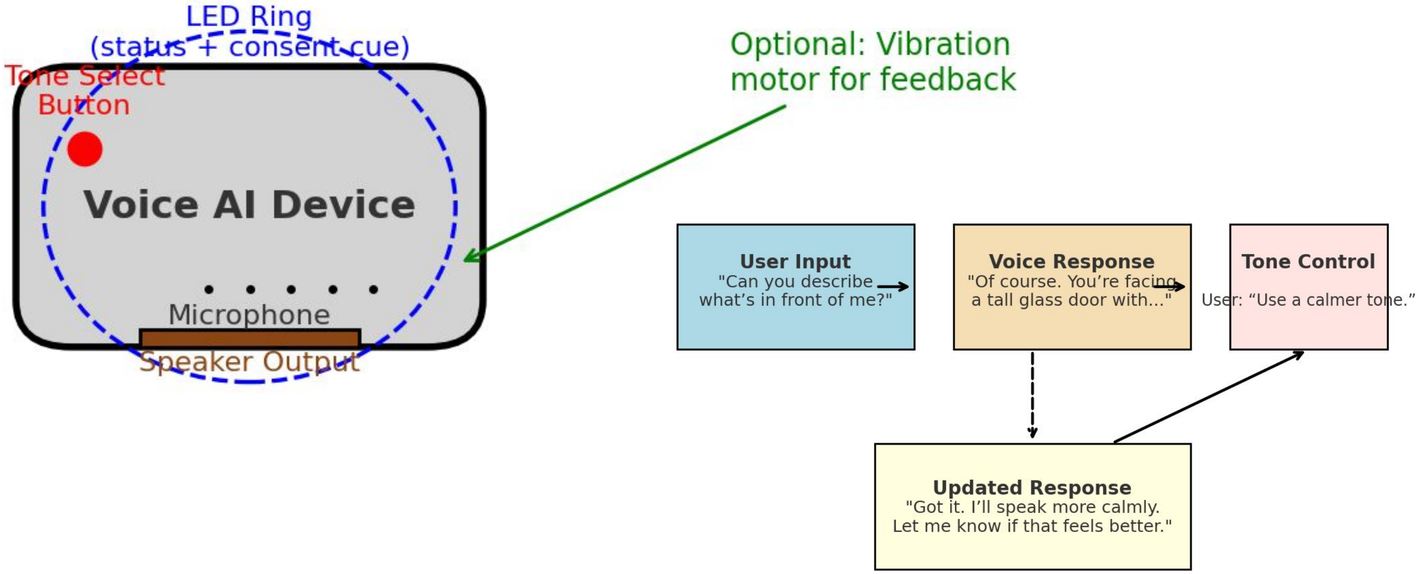
Datasets

- User-defined “tone presets” (e.g. Calm / Reassuring / Neutral).
- Opt-in interaction logs, repair history (e.g. “When I said __, you thought I meant __”).
- No emotion detection from facial/biometric signals.

Equipment & Resources

- Microphone array or headset
- Embedded device (e.g. Raspberry Pi, ESP32 with mic)
- Speaker or bone-conduction audio
- Software: python

Ethical Voice Assistant Device Sketch



Tone-Aware Voice Interaction

Review 1 EXPLORE

Over the last three weeks, I explored three connected directions for my capstone, all focused on non-visual access.

First, a tactile sound-reactive device that turns ambient audio into gentle vibrations for orientation.

Second, sonic-tactile data tools that let people “hear and feel” complex information.

Third, an ethical, emotionally aware voice companion that supports blind users while protecting privacy.

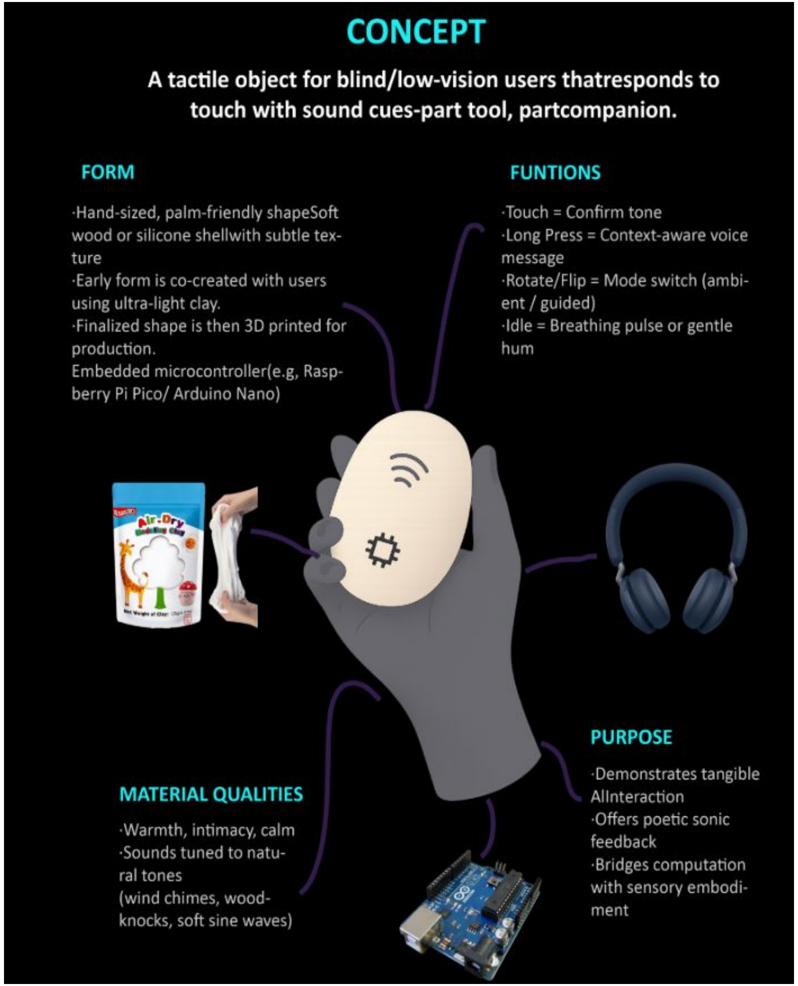
I am also interested in merging them into one integrated system, instead of treating them as separate projects.

Together, these ideas test how computation and the built environment can use touch and sound to improve navigation, learning, and care.

Idea 1: Tactile Sound-Reactive Device

Problem

How can objects or wearable interfaces provide non-visual interaction through **touch → sound feedback,** creating portable tools that support daily life and independence?



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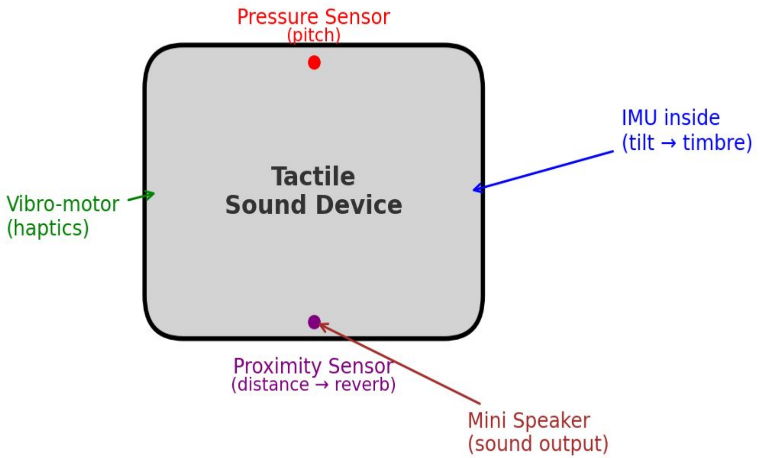
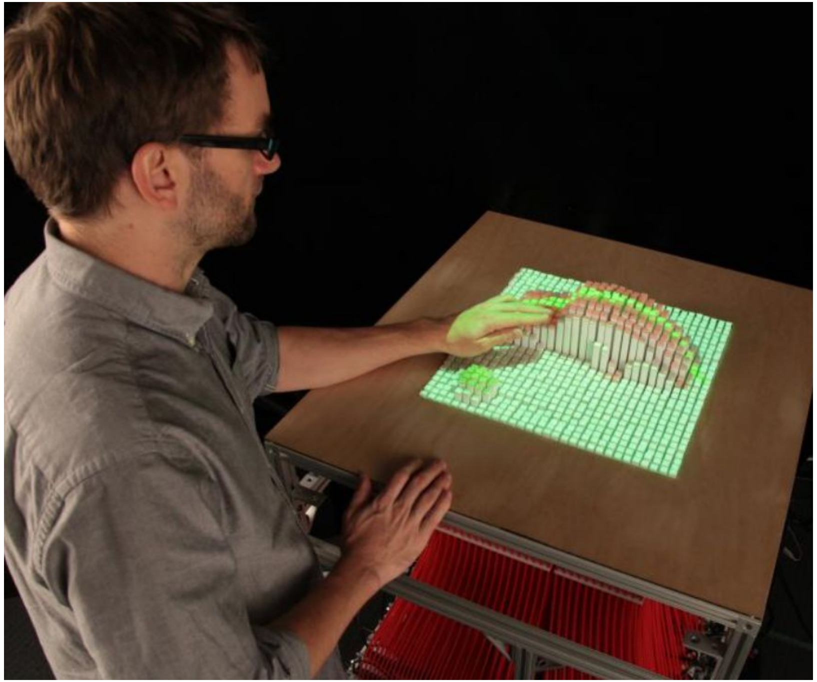
- **Room-scale**: two-user collaboration, stereo sound ii
- **City-scale**: portable, playful public demos

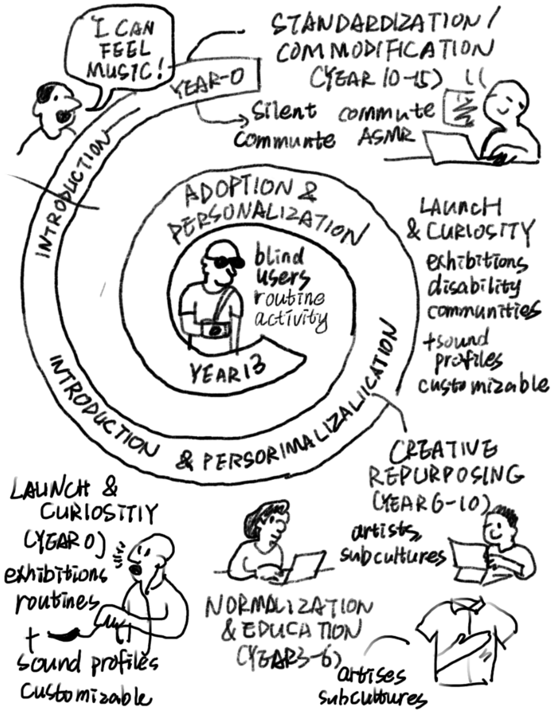


Precedent: MIT's Tangible Media Group – inFORM

- **How it works**: Shape-changing table that reacts to human gestures, making data physical.
- **Audience/Stakeholders**: Designers, accessibility researchers, people needing embodied interaction.

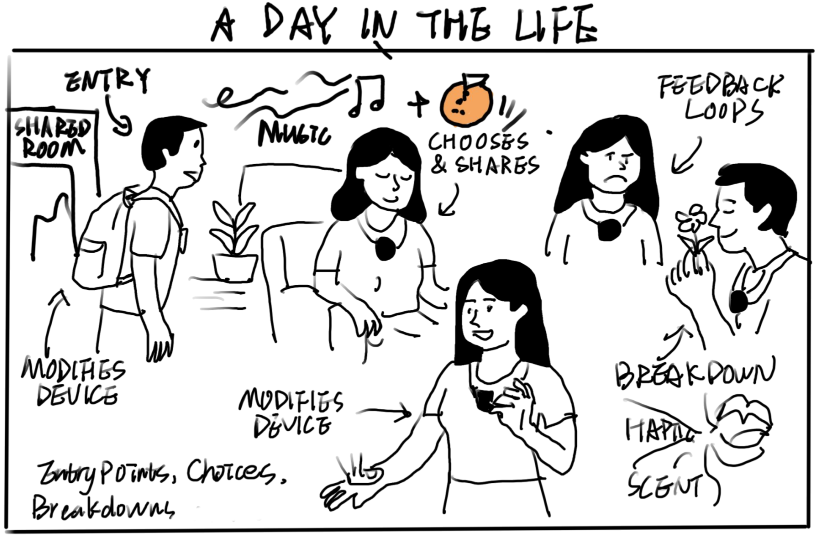


inFORM



Draw a timeline or spiral showing how your project idea might change human behavior over time, from first use to obsolescence.

Diagram a day in the life of a user interacting with your project. Show entry points, choices, breakdowns, and feedback loops.



Idea2: Feeling the Data

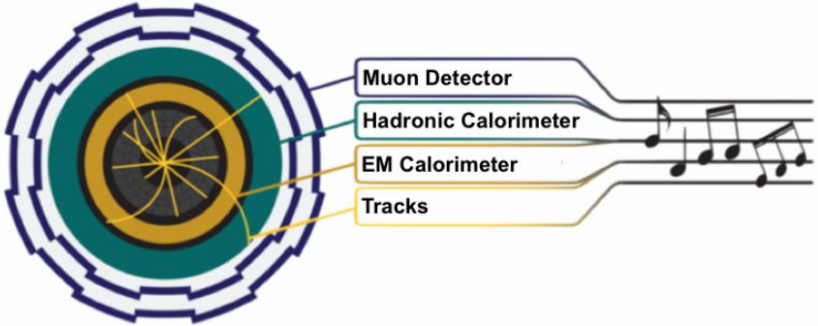
Turning complex data into sound and vibration for accessibility

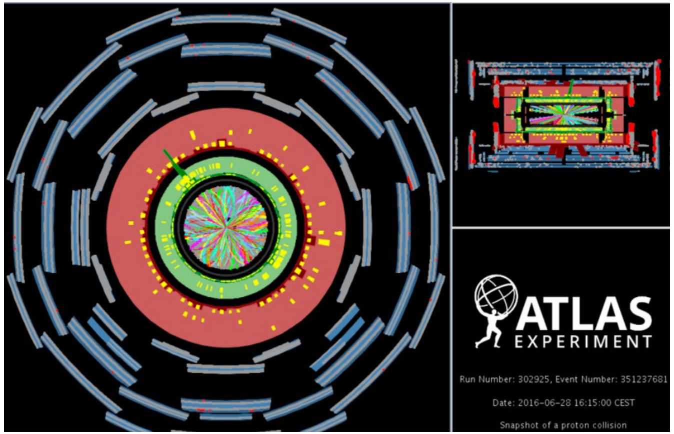
Problem

How can we make **complex data (finance, health, environment)** accessible through sound + touch, enabling blind users to perceive and analyze data without vision?

Precedent: The Shape of Data (MIT Media Lal

- **How it works**: Sonifies and tactilizes data patterns for blind learners.
- **Audience/Stakeholders**: Educators, blind students, researchers in inclusive tech.
- **Methodology**: Data-to-sound/touch mappings tested in workshops.





[Overview ‹ Quantizer: Sonification Platform for High-Energy Physics Data — MIT Media Lab]

Spatial Computing Frame

Datasets

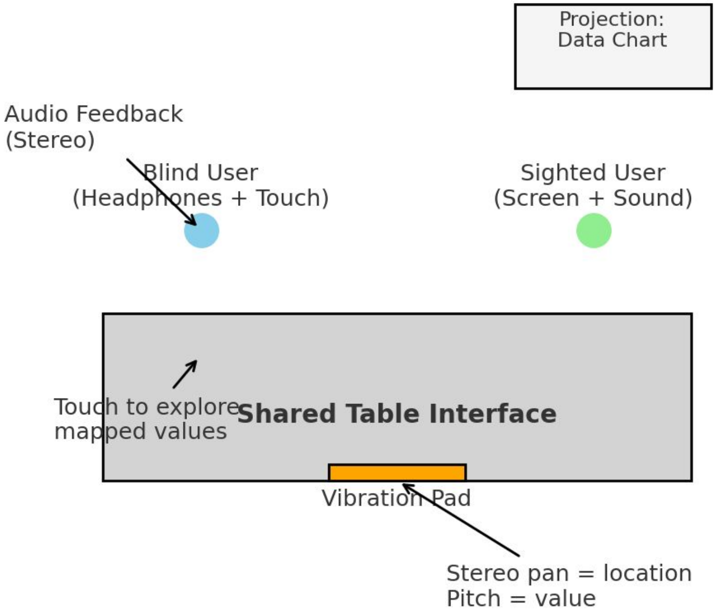
- Public datasets from **NYC Open Data**
- Air quality
- Subway headways / delays

Equipment & Resources

- Laptop + headphones
- Vibration pad or **surface transducer**
- Touch-sensitive interface or MIDI pad
- Software:Python (pandas, librosa)   Web Audio API
- **Spatial Scales**
- **Table-scale**: shared tactile/audio interface
- **Room-scale**: projection for sighted user, sound in sp

How It "Knows" Space Data mapped to space:

- Left → right = time
- Front → back = location
- Sound panning + haptics encode spatial information

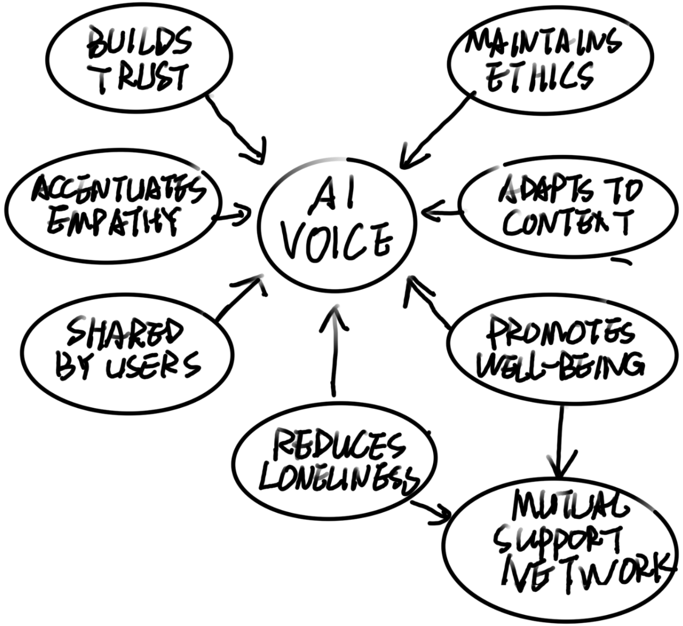


Idea 3:Voices with Care

Designing an ethical, emotionally responsive AI voice companion for blind and low-vision users

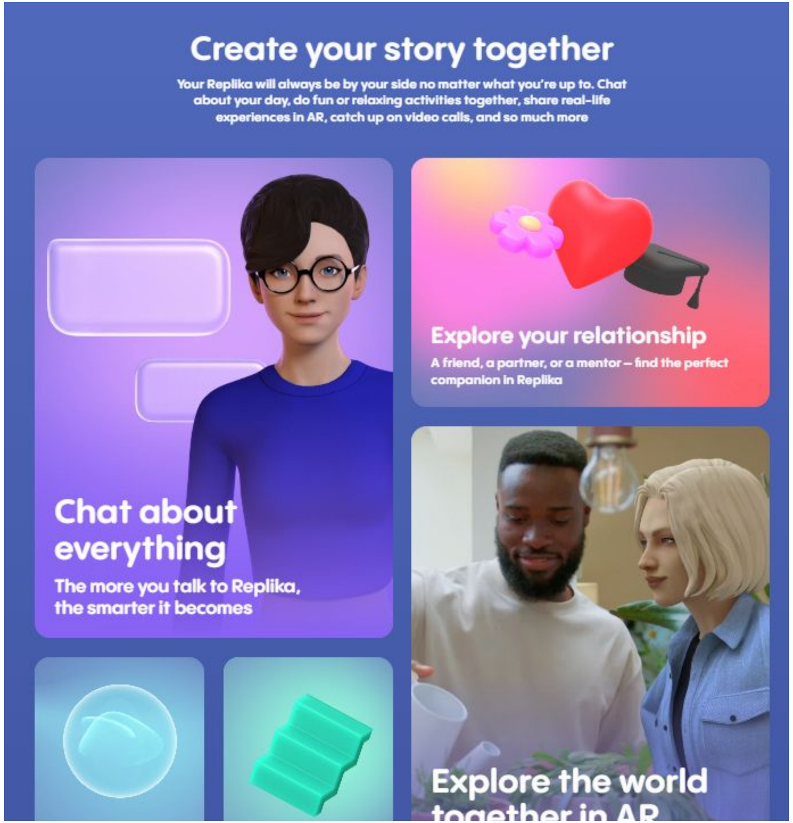
Problem

How can **AI-powered voices** move beyond “neutral assistants” to become emotionally supportive, **context-aware companions** for blind users, without being manipulative or sterile?



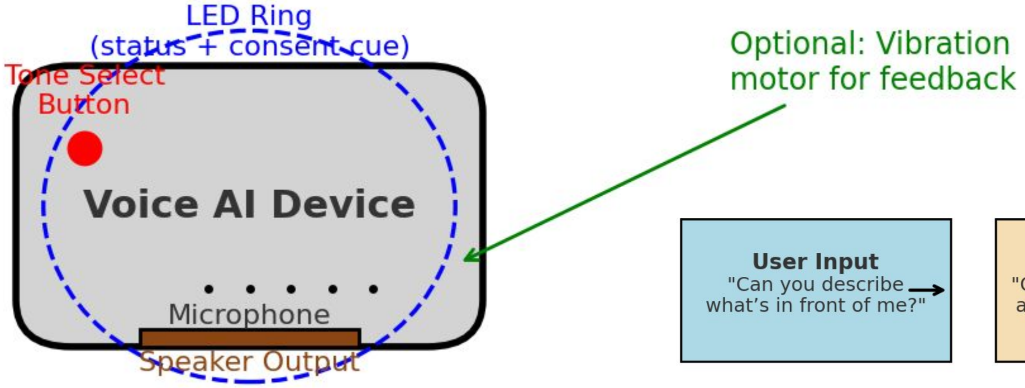
Precedent: Replika (AI Companion)

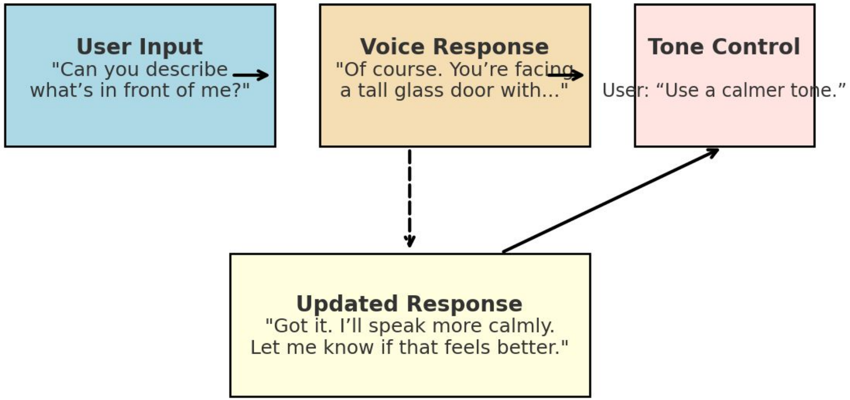
- **How it works**: Chatbot app with adaptive, emotionally supportive voice/text interactions.
- **Audience/Stakeholders**: General users seeking companionship, mental health community.
- **Methodology**: Machine learning trained on dialogue, with feedback loops for tone adaptation.



https://replika.com/

Ethical Voice Assistant Device Sketch





Tone-Aware Voice Interaction

Assignment 5

Originally developed as three design studies —

- **Tactile Sound Device** (touch-to-sound feedback)
- **Sonic–Tactile Data Interface** (data sonification and haptic mapping)
- **Emotional Voice Companion** (expressive, transparent AI voice)

—they now converge into **one device**:
a **multisensory loop** that allows users to *sense the world, understand data, and feel care* through the same system.

> **Goal:** To prototype an inclusive interaction model that connects physical, digital, and emotional layers — enabling blind and sighted users alike to experience data through embodied perception.

Forms

Voice Bloom

- **Form:**
  A soft, flower-like sensory sculpture with flexible “petals” that gently vibrate and emit sound.
- **Interaction:**
  When the user speaks, the petals respond through motion and vibration — creating a subtle tactile echo.
  When data or emotional cues change, the petals glow and pulse, turning information into a living, poetic gesture.

Haptic Ribbon

- **Form:**
  A flexible fabric band that can wrap around the arm, neck, or waist.
- **Interaction:**
  Small vibration points along the ribbon give direction, rhythm, or temperature feedback.
- **Features:**
  Easy to wear all day, good for constant orientation and feedback.

Haptic Compass

- **Form:**A small round device with vibrations all around.
- **Interaction**
  It shows direction and data through changes in vibration and sound.
- **Features:** Functions both as a **navigation tool** and a **data sensing instrument**, combining physical intuition with abstract information.

Sound Ripple Table

- **Form:**A table that feels and shows sound through small waves and vibrations.
- **Interaction**:Users can physically touch and feel the texture of sound as it spreads across the surface.
- **Purpose**:Made for group or learning use, showing how sound helps people sense space.

One Device — Three Modes

Integrating Orientation, Data Exploration, and Emotional Care

Mode A — ORIENT

Purpose: Environmental awareness and navigation.
Context: Streets, corridors, subway stations.

Interaction:
• Vibration + pitch indicate direction and distance.
• Long press = "Silent Listening" mode.
• Raise wrist and say *"Where am I?"* for a short spatial summary (non-visual cues + ear-con).

Mode B — EXPLORE

Purpose: Understanding and feeling data through sound and touch.
Context: Learning, analysis, or personal tracking.

Interaction:
• Swipe left/right to scroll through time.
• Lift upward to zoom in.
• Double-tap to mark anomalies.
• Sound ↔ vibration ↔ rhythm express data values, trends, and density in parallel.

Mode C — CARE

Purpose: Daily reflection and emotional support.
Context: Home or private setting.

Interaction: • Say *"Summarize my day"* to receive voice feedback. • System responds with tone markers + chosen voice timbre. • High confidence → clear tone; uncertainty → soft tone + gentle suggestion. *(Never fakes certainty.)*

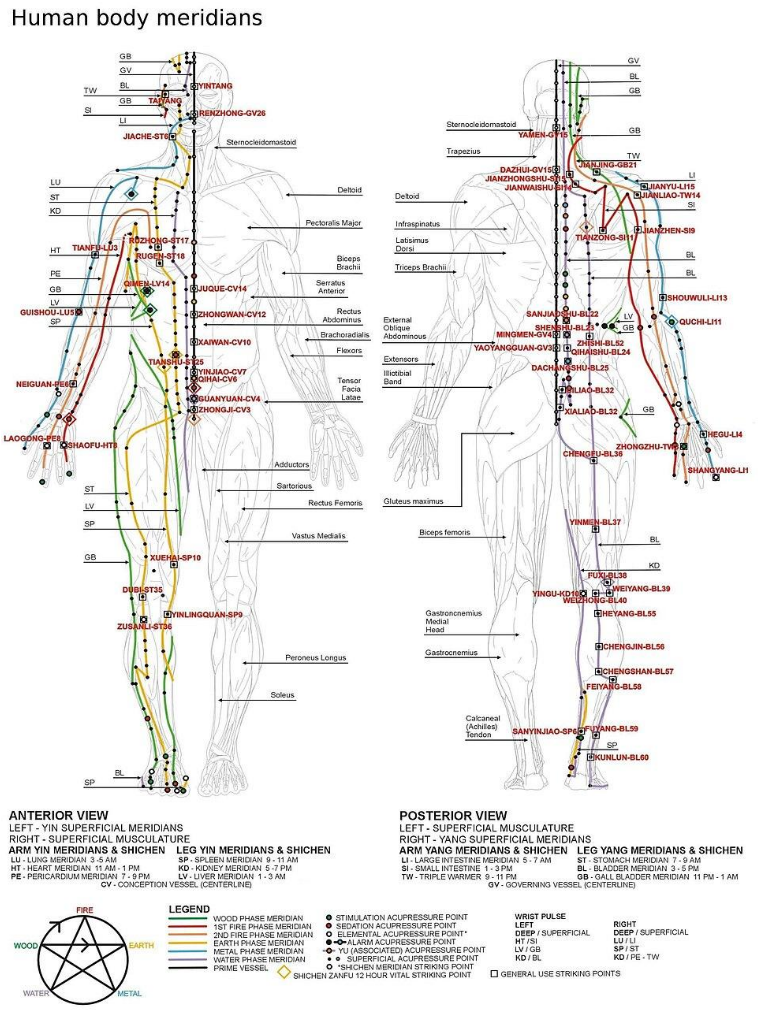
From early interviews and sound-response tests, a few key insights appeared:

1. **Voice** can show emotion and energy, but it is rarely used to give feedback to the body.

2. **Touch and vibration** are easy for people to feel and understand, even without vision.

3. In **Traditional Chinese Medicine**, the body is already seen as a network of energy points. This idea fits well with how wearable systems can connect sensors along the skin.

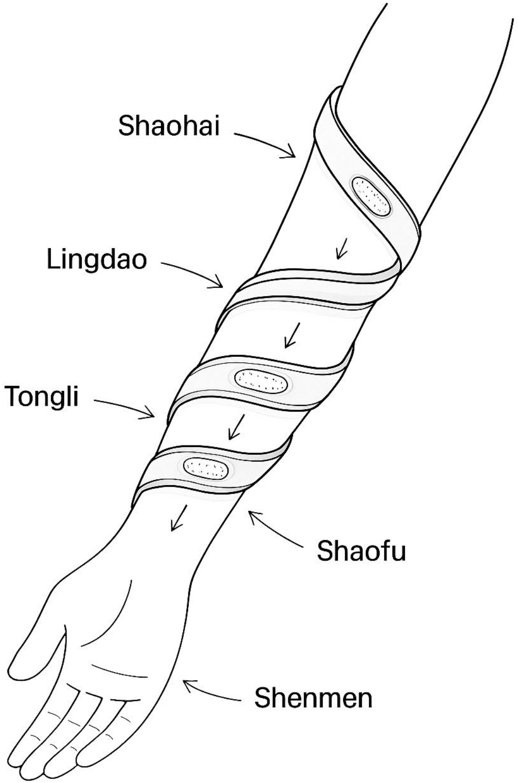
Assignment 6



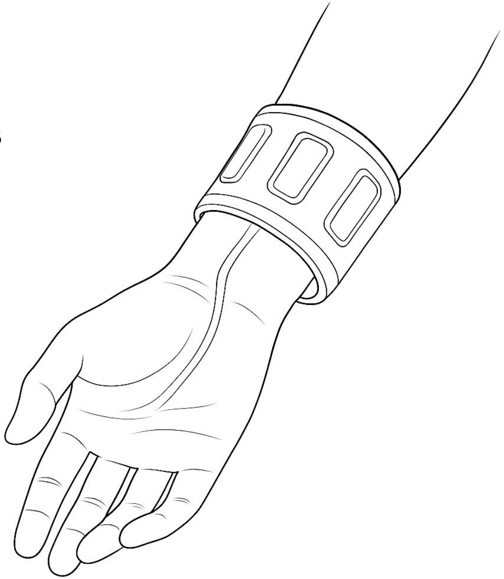
“Meridian Ribbon” — A Wearable Haptic Interface Inspired by Chinese Acupuncture

Core Idea:A wearable ribbon along the arm senses voice and emotion,creating vibration, warmth, and pressure that follow the body’s meridian flow.
connecting **ancient embodied knowledge** to **modern sensory computation**.

https://www.ranzhourobot.com/



No.	Function
Shaohai	Relaxes muscles; soothes anxiety
Lingdao	Balances emotion; connects meridian flow
Tongli	Calms the mind; improves expression
Shenmen	Key calming point; relieves stress
Shaofu	Reduces palm heat; promotes energy flow

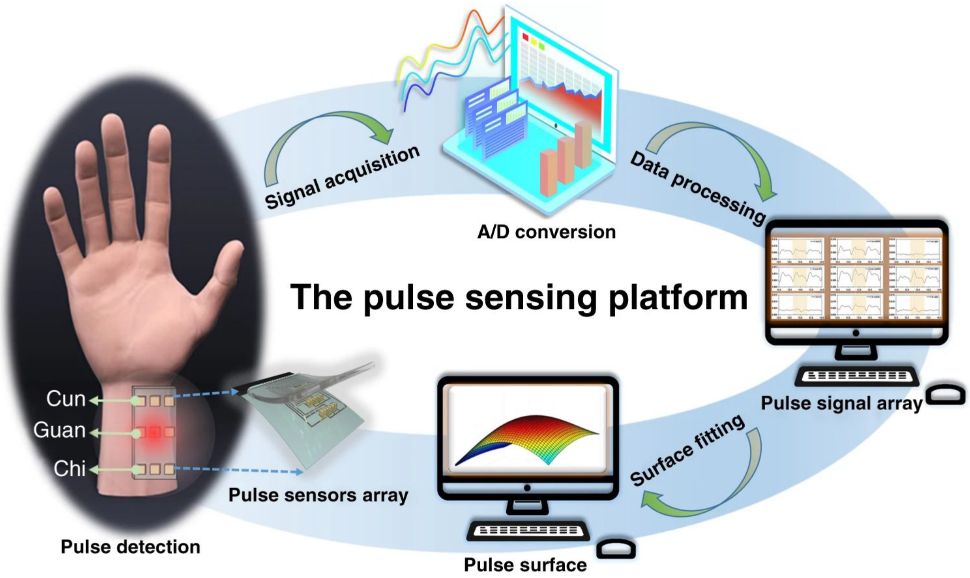


Case Study : Wearable Pulse Sensor Based on Traditional Chinese Medicine (TCM)

https://www.nature.com/articles/s41378-022-00349-3

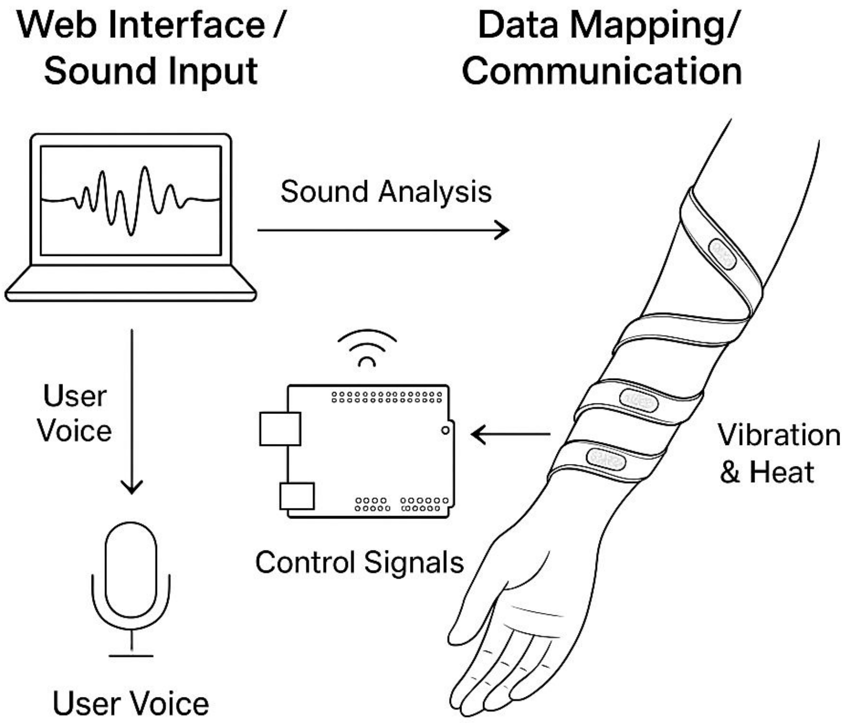
Overview:

This research created a **soft wearable wristband** that measures the pulse at three key spots on the wrist used in Traditional Chinese Medicine (*Cun, Guan, Chi*).It uses **small air cushions and pressure sensors** to feel tiny pulse changes and turn them into digital data.



The sensing platform consists of sensor arrays, signals processing, signals displaying and three-dimensional signals fitting

How the system connects



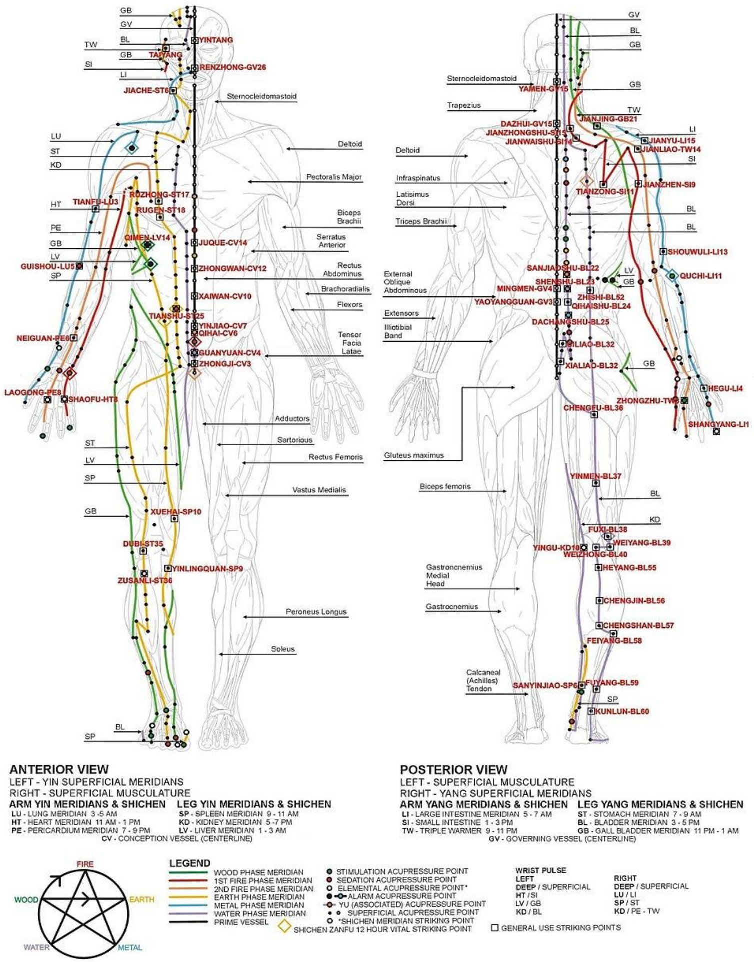
Explain Review

Originally developed as three design studies —

- **Tactile Sound Device** (touch-to-sound feedback)
- **Sonic–Tactile Data Interface** (data sonification and haptic mapping)
- **Emotional Voice Companion** (expressive, transparent AI voice)

—they now come together as a **TCM-inspired sound-to-haptic wristband** that maps sound and emotion to vibration along meridian points on the wrist. The system builds on Traditional Chinese Medicine's view of the body as an energy network, combining it with real-time sound analysis and tactile feedback.

Human body meridians



“Meridian Ribbon” — A Wearable Haptic Interface Inspired by Chinese Acupuncture

Core Idea:A wearable ribbon along the arm senses voice and emotion,creating vibration, warmth, and pressure that follow the body’s meridian flow.
connecting **ancient embodied knowledge** to **modern sensory computation**.

Writing

- Summarize your project 1 sentence. The texts you've developed in the background research workshop would be a great place to start.

My project is a sound-to-touch wristband inspired by Traditional Chinese Medicine that turns sound and emotion into small vibrations along wrist meridian points, helping blind and low-vision people feel space and energy through their body.

- Expand this to explain your idea. Write at least 100 words.

This project looks at how sound can become something we feel, not just hear. I'm building a wearable wristband with a circle of tiny vibration motors that match the energy points in Traditional Chinese Medicine. When it hears sound—like voices, city noise, or music—the system reads the tone, rhythm, and emotion, then sends patterns of vibration to the skin. The idea is that blind and low-vision users can sense where sound is coming from and what kind of mood it has, using their body as the main interface. Instead of focusing on visual information, this project creates a "sound-first" way of understanding the world through touch, energy, and rhythm.

- Which computational tools are you engaging to develop your idea?. How do these relate meaningfully with your topic/concept/research question. How will you explain the spatial concepts embedded in your work with these computational methods?Write at least 100 words

I'm using Arduino and Python to connect sound input with vibration output. Arduino controls the small motors on the wristband, while Python helps process sound features like pitch, rhythm, and emotion using audio-analysis tools. Later, I plan to try TouchDesigner to see how sound energy could move across the wrist like a map or light pattern. These tools help me turn invisible sound data into something that can be felt and understood through space. The wrist becomes a small area where sound and data travel through the body. For me, computation here is not just technical—it's a way to translate sound into a physical and emotional experience.

- What design methods will your work involve? Is your work activist, analytic, critical, decolonizing, entrepreneurial, experimental, narrative, participatory, speculative?Write at least 100 words.

My project is experimental, participatory, and a bit speculative. It's **experimental** because I'm testing new ways to map sound and touch on the body. It's **participatory** because I've talked with blind and low-vision users to understand what kinds of feedback feel natural. It's **speculative** because it imagines a future where we use our bodies, not screens, to sense technology. I also see it as slightly **decolonizing**, since I'm using Traditional Chinese Medicine as another way to think about energy and connection—not just Western tech logic. Overall, the project mixes cultural ideas, human senses, and simple electronics to explore new ways of feeling data.

Precedents

Wearable Pulse Sensor Based on Traditional Chinese Medicine (TCM)

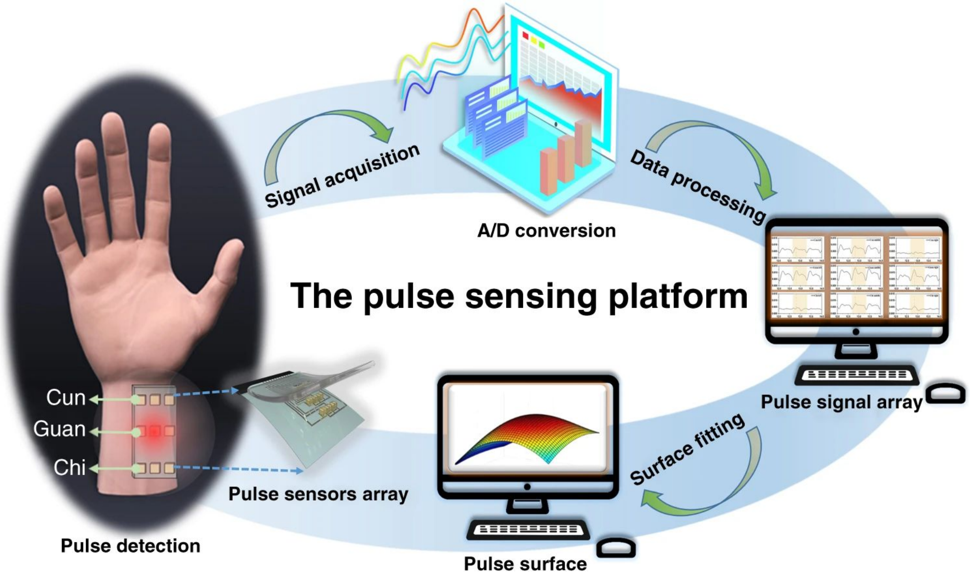
Do more research about TCM

https://www.nature.com/articles/s41378-022-00349-3

Overview:

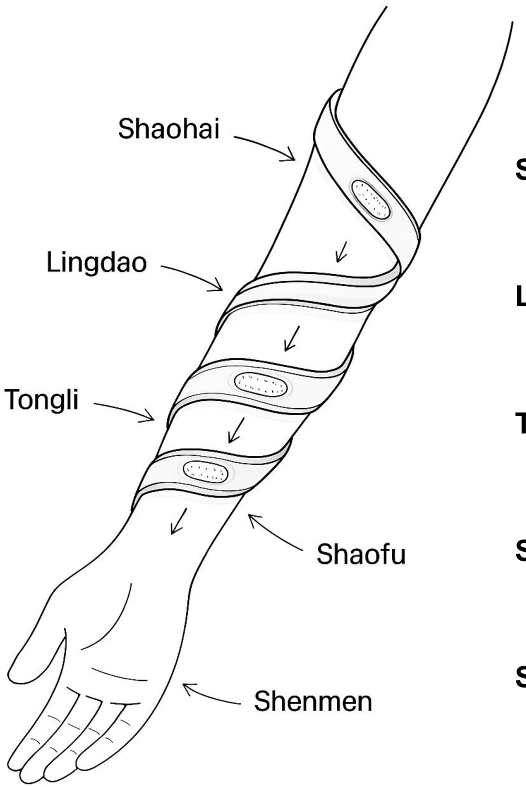
This research created a **soft wearable wristband** that measures the pulse at three key spots on the wrist used in Traditional Chinese Medicine (*Cun, Guan, Chi*).It uses **sma air cushions and pressure sensors** to feel tiny pulse changes and turn them into digital data.

My project takes this idea further but in a different direction Instead of measuring the body, I want to design a way for the body to feel the world—turning sound and emotion into vibration along the same meridian points. So while their system tracks energy flow for diagnosis, mine uses energy flow for perception and interaction, creating a new sensory language between sound, body, and space.



The sensing platform consists of sensor arrays, signals processing, signals displaying and three-dimensional signals fitting

Prototypes



No.	Function
Shaohai	Relaxes muscles; soothes anxiety
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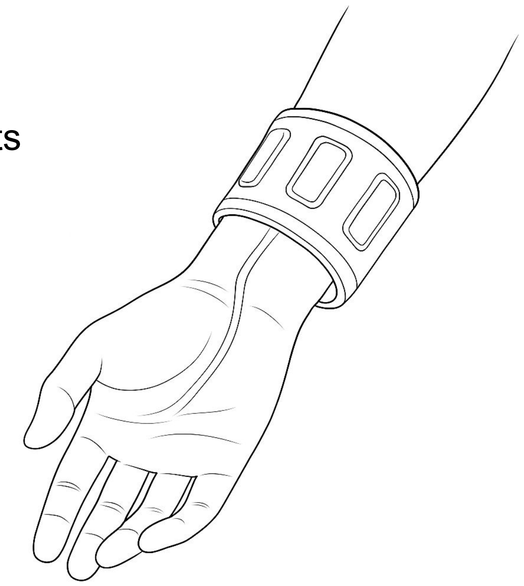
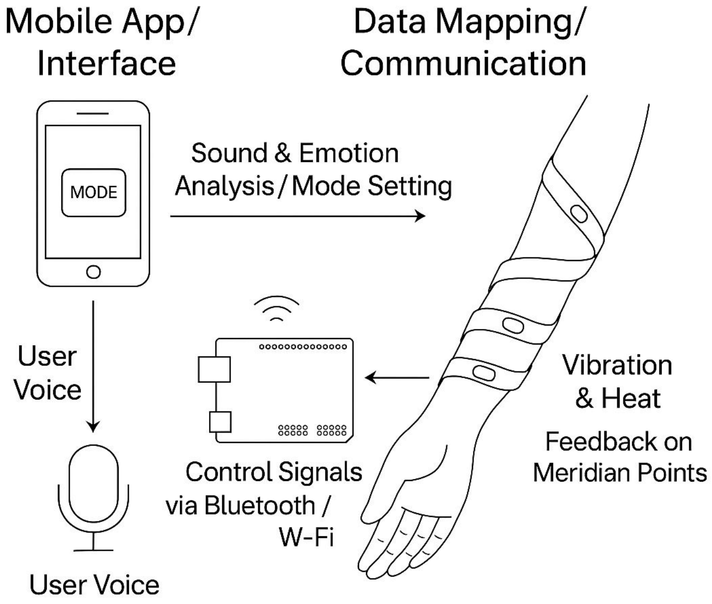


How the system connects



- Users interact through a **mobile app**, speaking or choosing a mode.
- The app performs **sound analysis, emotion recognition, and mode control**.
- It sends signals via **Bluetooth or Wi-Fi** to the **wristband device**.
- The wristband's **vibration and heat modules** respond along meridian points to give tactile feedback.

Audience & Prototype Challenges

My main audience is **blind and low-vision users**, since the design focuses on non-visual ways of sensing. But I also think the same system could work for sighted users—artists, musicians, or anyone who wants to explore sound through their body.
The project uses simple audio data (pitch, rhythm, emotion) as input, not medical data, so it's easy to collect and experiment with. The biggest challenges are making the hardware flexible enough to fit different wrists, and learning how to fine-tune vibration strength so it feels natural, not distracting.

Further Research

I still need to learn more about **sound analysis and emotion detection** in Python, and how to connect those results to vibration output. I also plan to run **user tests** with blind and low-vision participants to explore what kinds of vibrations or rhythms feel most intuitive. On the design side, I want to experiment with **flexible materials**, and maybe use **3D printing** or **handcrafted details** to give the wristband a more expressive, artistic look. I'll also study **TCM theory** further—especially how energy flow and pulse sensing could guide the placement and rhythm of sensors and motors. This research will help me merge **cultural logic, computational precision, and artistic expression**, making the prototype both technically functional and emotionally meaningful.

Core Goal:

To help blind and low-vision users **hear and feel space**,

transforming sound information into **tactile patterns the body can sense**.

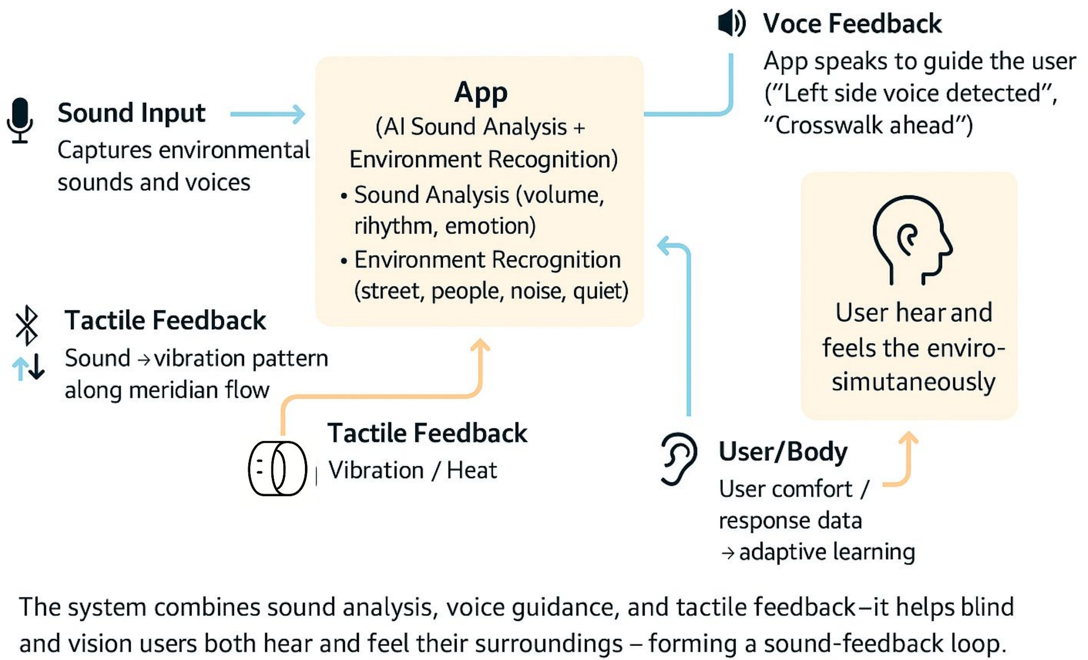
Why TCM (Traditional Chinese Medicine)?

TCM sees the body as one connected system —
energy moves through it, not just inside separate parts.

I use this idea as **inspiration**, not as medicine.
The wristband follows a few meridian points,
turning sound into small vibrations that move like energy along the body.

It’s a **cultural reference** that helps me design a more body-based, non-visual way to feel sound.

Prototype Path — From Sound to Tactile and Voice Feedback



This diagram shows how the **Meridian Raven** system connects sound, voice, and touch.
The **App** listens and analyzes sounds from the environment — detecting volume, rhythm, and emotion.
It then provides **two outputs**:
• **Voice feedback** to guide the user through spoken cues.
• **Tactile feedback** sent via Bluetooth to the wristband, turning sound into vibration or heat.
The user both **hears and feels** the surroundings, and their comfort or response is sent back to the App — forming a continuous **sound–touch–voice feedback loop**.

1. Sound Input ➡️2. Environment & Emotion Analysis ➡️3. Voice Guidance➡️4. Mapping & Bluetooth Transmission ➡️5. Vibration & Multimodal Feedback ➡️6. User Feedback & Learning

New Idea: Material Variations for the Wristband

Material Type	Physical Properties	Tactile Sensation	Possible Application
Silicone	Soft, flexible	Smooth, cushioned	Gentle pulse / calming mode
Fabric / Felt	Breathable, form-fitting	Warm, skin-friendly	Long wear / emotional mode
Aluminum / Steel Mesh	Cool, rigid, heat-conductive	Clear, instant response	Precise signal feedback / directional mode
Leather / PU	Textured, warm to touch	Natural, authentic	Everyday use / emotional expression
Thermochromic / Shape-memory Material	Temperature-responsive	Subtle tactile changes	"Energy flow" metaphor / enhanced bodily feedback
3D-Printed Flexible Material (TPU / Flex Resin)	Customizable softness	Adjustable damping and structure	Experimental vibration mapping / modular design

Research on TCM

https://www.earseeds.com/
https://www.healthline.com/health/gua-sha

https://www.feeltherapeutics.com/

https://subpac.com/x1/

https://www.earseeds.com/

Ear Seeds

Ear Seeds are a gentle, non-invasive practice from Traditional Chinese Medicine ear therapy (auriculotherapy).
Small metal or crystal beads are taped onto specific points on the ear.
They give light, steady pressure and stimulate related meridian points in the body.

Key points:

- No needles, no pain — fully non-invasive.
- The ear is seen as a “mini map” of the whole body; each point links to certain body parts and emotions.
- Often used to help with stress, sleep, mood, and pain.
- Very popular in modern wellness, and easy to include in daily self-care or wearable routines.

The website should include:

a. Your Hypothesis, research question, or provocation in one sentence.

What if blind users could ‘see’ through sound and touch instead of vision?

b. Project Description: Tell us more about your project in a minimum of 100 words. What is at stake? What practices does your project make possible for the built environment? What scales and dimensions does your project investigate?

This project develops a vision-substitution system that uses the Heart Meridian pathway on the arm as a tactile channel for sensing space. Five tactile modules are placed along key acupuncture points — Shaohai, Lingdao, Tongli, Shaofu, and Shenmen — forming a continuous line of perception from the wrist to the elbow. A mobile app listens to environmental sound, analyzes direction, distance, and movement, and converts this information into vibration patterns that travel along the meridian. The system allows blind and low-vision users to “feel” spatial structure, obstacles, and approaching motion through the body instead of sight. At stake is the possibility of transforming sound into a tactile form of vision, using the body itself as an interface across micro (skin), limb (meridian), and environmental (urban sound) scales.

c. Computational Methods: What computational methods are you using and why? Write 100 words about your methods. Do not only make a list of software and data. What affordances do your workflows display relative to the issues you are addressing.

d. <u>Design Methods</u>: What kinds of practices do your methods make possible? Is your w activist, analytic, critical, decolonizing, entrepreneurial, experimental, narrative, participatory, speculative? Write at least 100 words.

e. <u>Precedents</u>: You have also been researching projects which are precedents to your topic/concept/research question. Present projects which best show the work being done relate your concepts? Does your project move your topic, concept, or research question forward? Doe project critique a present condition, and if so, how does it propose an alternative. If you links, add an image or two to show the project. Include 50-100 words about why the precedent relevant to your work.

f. <u>Proof of concept</u>: **This should be the focus or highlight of your presentation in format.** Document your prototypes, or proof of concept for the methods you will use to undert capstone project. These should showcase examples of how the final project might be designed as operate. Your work here can be shown with wireframes, data visualization, sketches, demos or any other formats relevant to your idea. Some of you have built models – if so, please ph them or make videos if it makes sense to show these working/in action. Some of you have star designing websites, show them. Some of you are proposing things you don't know how to progra simulate them.

g. <u>Audience</u>: Describe your audience/s. Consider whether your project might change fo different audience. Or to put it another way, is anyone/anything excluded? What are some alt ways your project should be designed for a different audience, or to be more inclusive? Thes sketches, or a few sentences.

h. <u>Data</u>: What kinds of data have you worked with and will you need to explain and su the project. Show snippets of the data and initial analyses to demonstrate that the data are accessible, or possible to make/collect/gather.