MA Communication Design | Final Project 2026

BATsense

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A Different Way of Sensing Space

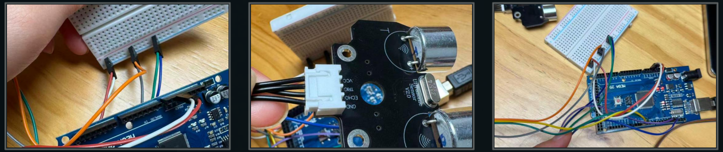
A speculative multisensory interface
inspired by bat echolocation.

BatSense translates distance and direction into sound, vibration and real-time visual feedback. Rather than reproducing bat perception, it uses echolocation as a speculative lens to question why human interfaces remain so visually dominated.

MORE-THAN-HUMAN · MULTISENSORY · SPECULATIVE INTERFACE

WEARABLE DEVICE / HORIZONTAL APP INTERFACE / AI CAMERA TEST MODULE

Design Challenge — Regenerative Systems / More-than-human Communication



real prototype evidence

AI-assisted visualisation of BatSense in use

THE VISUAL DEFAULT

What if vision were not our default interface with the world?

Human environments and interfaces are largely organised around vision. Maps, screens and signs make sight feel like the natural way to understand space. Yet this is only one sensory model. Bats construct spatial knowledge through sound, echo and time. BatSense begins from this difference, asking what communication design can learn from a non-human way of sensing.

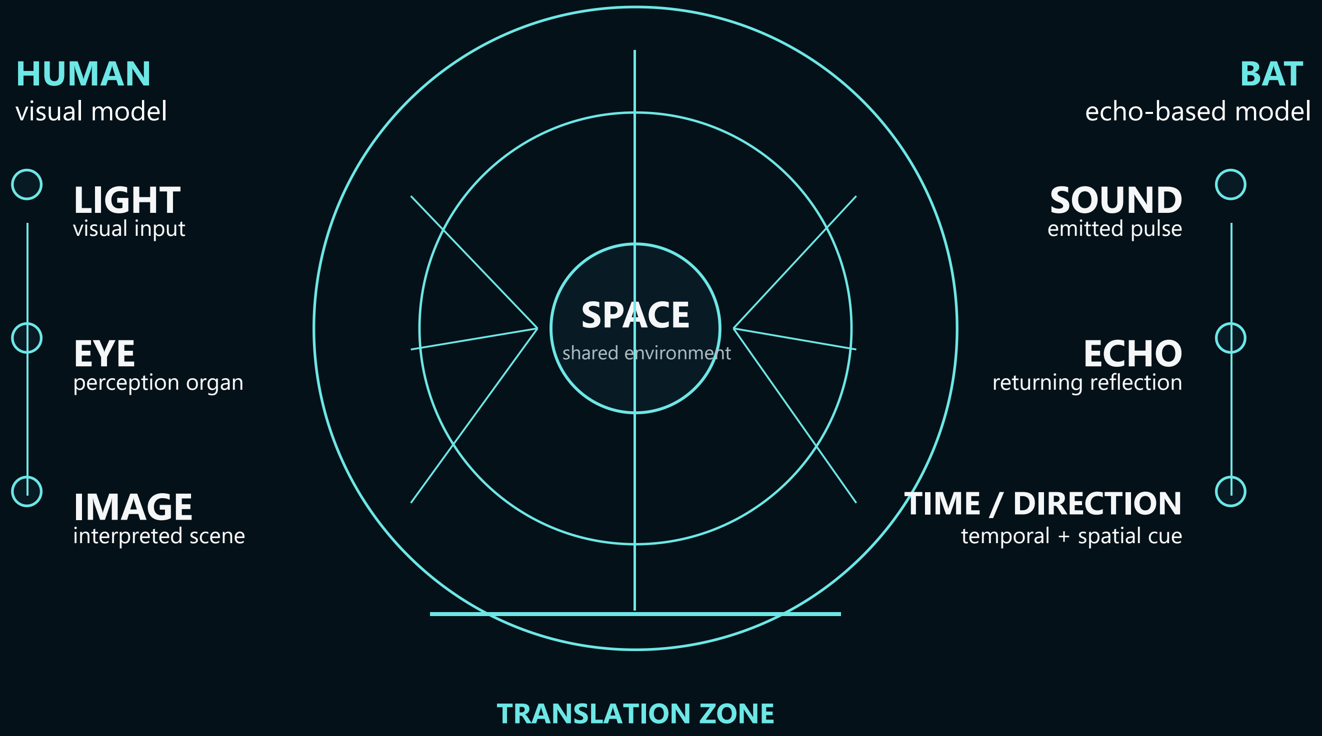
QUESTION

Vision is a default, not a universal condition.

DESIGN CHALLENGE	LENS
Regenerative Systems	More-than-human Communication

SAME SPACE. DIFFERENT WAYS OF KNOWING.

Communication design does not copy bat perception. It translates the logic of echolocation into a human multisensory language.



The page reframes echolocation as a critical design lens: not a fantasy of becoming a bat, but a way to question why human interfaces remain visually dominated.

LEARNING FROM ECHOLOCATION

Echolocation as an information system, not an image.

Bat echolocation transforms reflected sound into spatial knowledge. Rather than treating it as a form of “seeing”, this project focuses on the information carried through emission, reflection and return: time, direction and proximity. This informational logic became the basis for BatSense — a design translation from biological sensing into human-readable sound, touch and visual feedback.

RESEARCH SHIFT

From “How do bats see?”

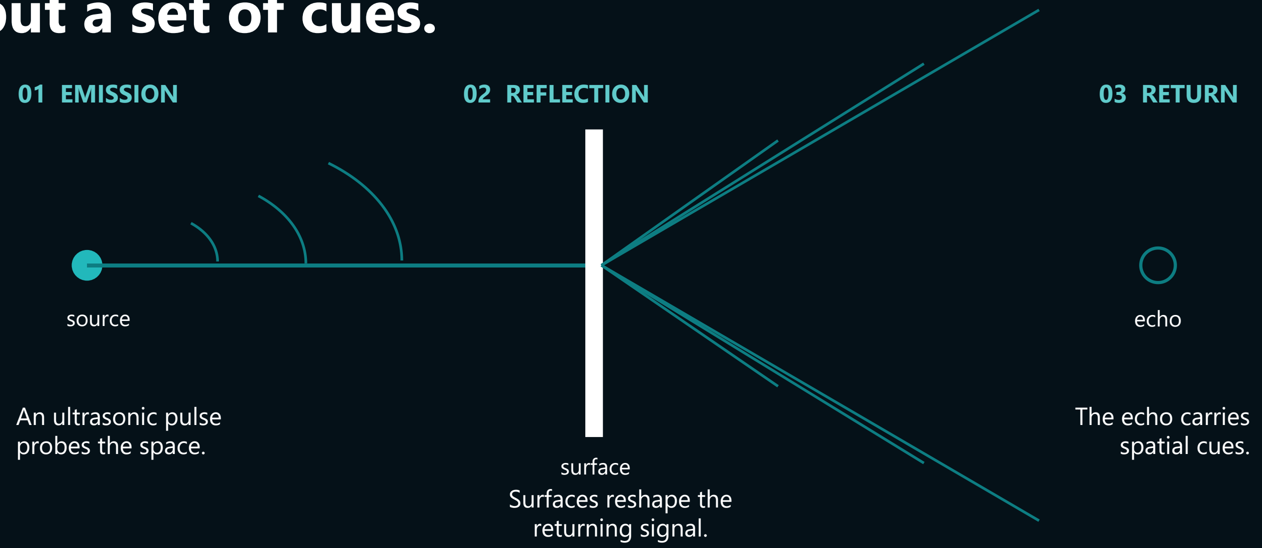
to “How does an echo become spatial information?”

TECHNOLOGICAL APPROXIMATION

Ultrasonic sensing provided a practical way to test how proximity and direction could be converted into other sensory outputs.

ECHO → INFORMATION

What returns is not an image, but a set of cues.



01	02	03	OUTPUT
TIME	**DIRECTION**	**DIFFERENCE**	**SPATIAL KNOWLEDGE**
How long does the echo take to return?	Where does the echo return from?	How has the signal changed?	an interpreted understanding of space
→ proximity	→ orientation	→ environmental cue	

DESIGN TRANSLATION **Biological sensing logic → sound / vibration / visual feedback**

BatSense does not recreate bat perception; it translates selected principles.

SELECTED REFERENCES

Griffin, 1958 · Grinnell & Griffin, 1958
Nagel, 1974 · von Uexküll, 1934/2010
Bach-y-Rita et al., 1969

TRANSLATION IS NEVER NEUTRAL

What is gained, lost, and constructed when one sensory system becomes another?

Interfaces frame how perception becomes experience.

Sensor data is not the same as meaning.

CRITICAL SHIFT

From imitating echolocation to translating its logic into a human interface.

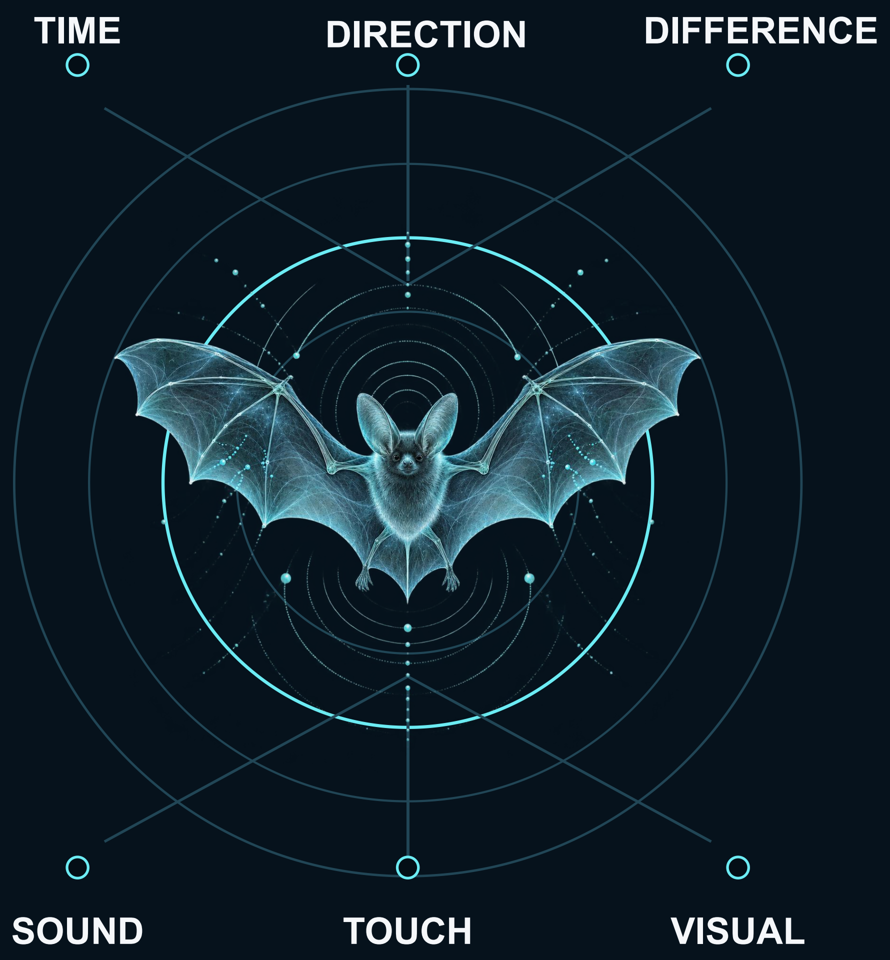
REGENERATIVE LENS

The bat is not a decorative motif. It is a non-human model for thinking about sensing differently.

Prototype insight

Raw sensing becomes useful only after design decisions map it into legible forms of feedback.

TRANSLATION FIELD



Echolocation is not copied as a bat image; its cues are translated into sound, touch, and visual feedback.

1 Space comes before image.

Spatial knowledge can be constructed without relying on vision as the default.

2 Translation is interpretive.

Design choices decide what gets preserved, amplified, or simplified in the interface.

3 Meaning is learned.

Users understand the system through repeated relations between signal and space.

SELECTED REFERENCES

- Nagel, T. (1974) What Is It Like to Be a Bat?
- Bach-y-Rita, P. & Kercel, S. (2003) Sensory substitution.
- Dunne, A. & Raby, F. (2013) Speculative Everything.

From research to proposition

MAKING THE INVISIBLE PERCEIVABLE

HOW MIGHT WE

How might we translate selected principles of bat echolocation into a human multisensory interface that makes space perceivable beyond vision — without claiming to reproduce bat perception?

THEME

More-than-human communication

INSIGHT

Space is not inherently visual. Echolocation reveals space as information before it becomes an image.

POV

Alternative sensory languages reveal how interfaces shape perception rather than simply display it.

DESIGN GOAL

Develop a wearable multisensory communication system translating distance and direction into sound, vibration and real-time visual feedback.

DESIGN PRINCIPLES

TRANSLATE, NOT SIMULATE

BatSense does not claim to reproduce bat perception.

MULTISENSORY, NOT SCREEN-FIRST

Spatial information is distributed across sound, vibration and visual feedback.

LEARNABLE, NOT INSTANT

Consistent feedback relationships allow users to recognise patterns over time.

DESIGN PROPOSITION

BatSense is a speculative sensory translation system combining wearable sensing, sound, haptic feedback and digital visualisation to explore how humans might encounter space through a sensory logic inspired by echolocation.

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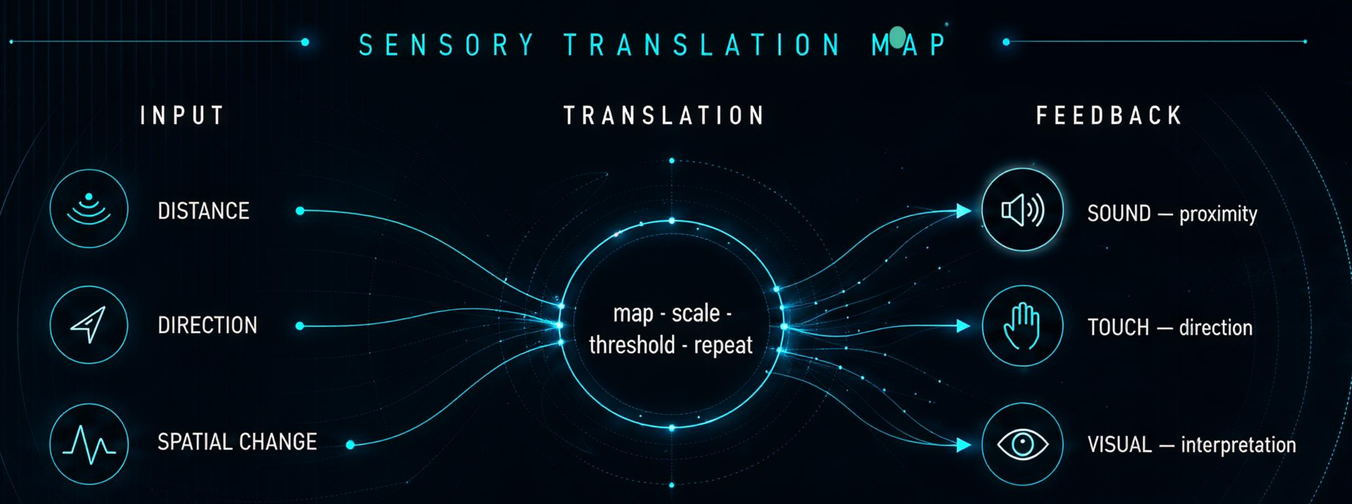
DESIGNING A SENSORY LANGUAGE

From spatial data to perceivable feedback

BatSense does not present sensor values as raw information. Spatial readings are interpreted and redistributed across sound, touch and visual feedback, allowing each sensory channel to take a different communicative role. The aim is not to replicate echolocation, but to build a learnable multisensory language for perceiving space.

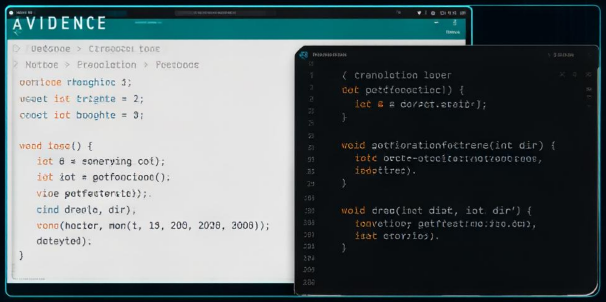
DESIGN SHIFT

From displaying numeric data to distributing meaning across sound, touch and vision.

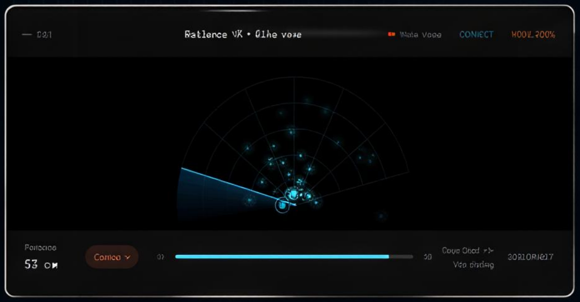


A number becomes a sensory condition.

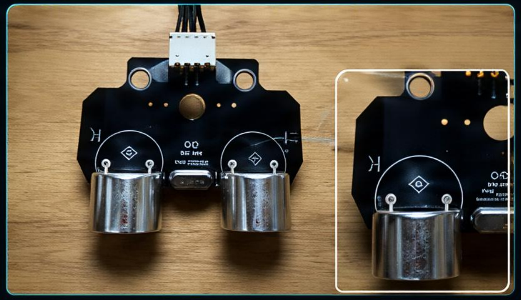
```
// wap distance to beep frequency
int freq = mwp(distance, 10, 200, 2000, 5000);
tone(buzzer, free, 40);

// direction = vibration pattern
int dir = getDirection();
setVicrationPattern(dir);

// special change = visual intensity
float delta = abs(current - previous);
updateVisual(delta);

noid leep; (
voint d = readDistance();
  int dir = getDirection();
  flost delta = calcDeltaDistance();
  communicate(d, dir, delta);

void communicate(int d, int dir, float change) (
  tone(bazzer, wap(d, 10, 208, 2000, 5000));
  setVibratioPattren(dir);
  updateVisual(change);

void class="hud">
  <div class="distance"></dia>
  <div class="direction"></di>
  <canvas id="visual">>/canvas>
</d()>:
)
```



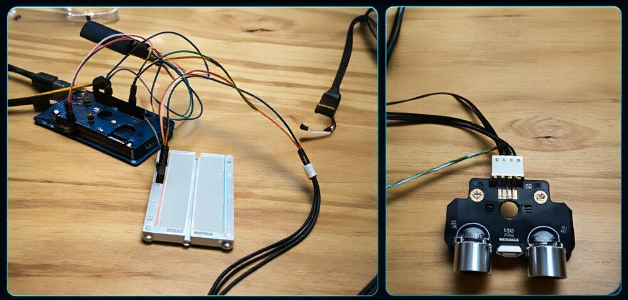
Arduino logic / sensor mapping
Ultrasonic readings mapped to frequency, vibration patterns and visual intensity.



Android + web interface development
Real-time visualization of distance, direction and spatial change across platforms.



Ultrasonic sensing prototype
Custom sensor module designed for reliable distance and direction capture.



Hardware testing
End-to-end testing with Arduino, breadboard and live serial monitoring.

SENSORY LANGUAGE IN ACTION

Distance becomes pitch.
Direction becomes vibration.
Change becomes light.
Together, they form a learnable language of space.

SOUND
Closer → higher pitch

TOUCH
Left / Center / Right

VISUAL
Change → intensity

BUILDING THE BODY OF BATSENSE

From sourced components to a working multisensory prototype

Physical prototyping turned the research proposition into a working feedback loop: sensing, computation, sound, vibration and live visualisation began responding together.

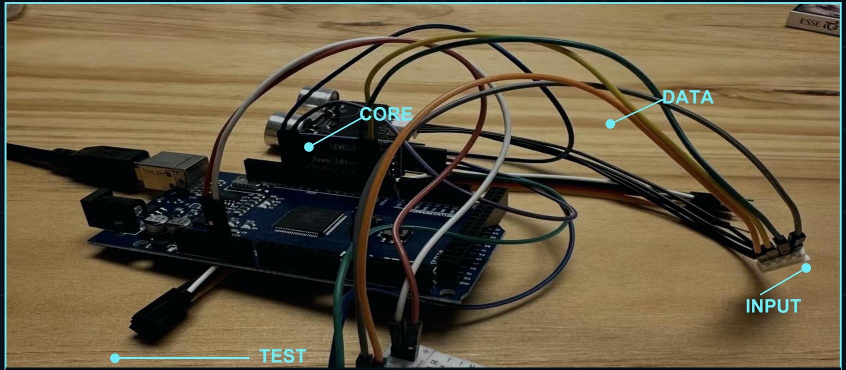
CRITICAL DEVELOPMENT

Detecting distance → coordinating sound, vibration and live view.

MATERIAL SOURCING

Procurement records are kept as process evidence: components were independently sourced, tested and recombined.

PHYSICAL SIGNAL CHAIN



Ultrasonic sensor, Arduino, HC-05 and feedback outputs combined on the bench.

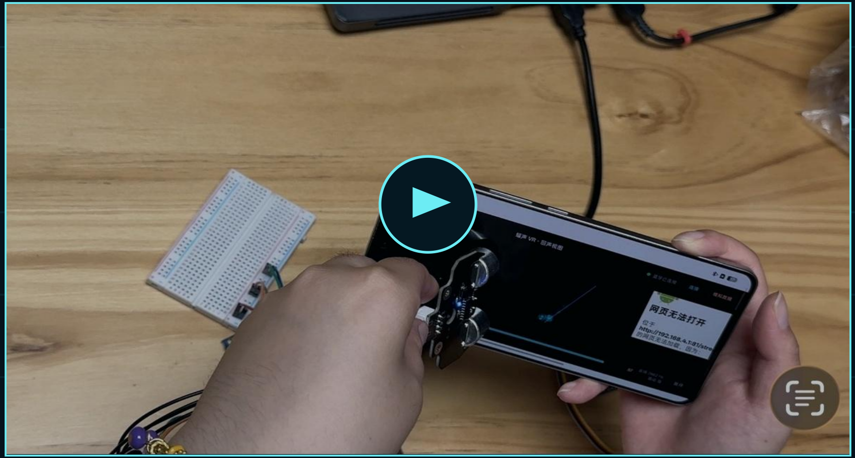
WORKING LOOP

SENSOR — ARDUINO — BUZZ/VIB — HC-05 — MOBILE

Sensing, computation and feedback began operating as one continuous loop.

TECHNICAL DECISIONS BECAME EXPERIENCE DECISIONS.

LIVE VALIDATION



WATCH LIVE TEST

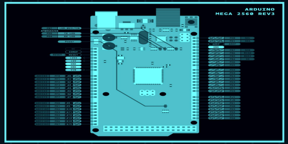
sensor + buzzer + vibration

https://youtu.be/g8xByH84TNY?si=AtnV1q7hmyDay6HL

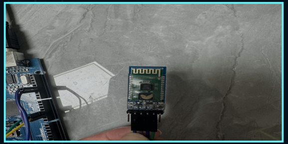
Real-time Echo View visualises connected sensor readings as spatial feedback.

PROTOTYPE ANATOMY

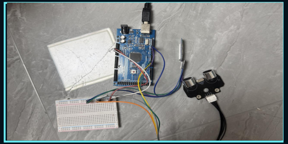
01 **SENSING**
Ultrasonic ranging



02 **PROCESSING**
Arduino Mega



03 **CONNECTION**
HC-05 Bluetooth



04 **FEEDBACK**
Buzzer + vibration

05 **ASSEMBLY**
Hand wiring process

Speculative scenario visualisation — AI-assisted image

THE BODY BECOMES THE INTERFACE

Wearing BatSense: sensing, receiving and interpreting space

Moving BatSense from the workbench onto the body changes the nature of the interface. Sensing becomes connected to head orientation, while auditory, tactile and visual feedback occupy different perceptual locations. Rather than concentrating interaction on a single screen, the system distributes information across the body and requires movement, attention and interpretation to become part of the experience.

SCENARIO VISUALISATION / AI-assisted images based on the developed prototype system.

DISTRIBUTED INTERFACE

THE INTERFACE IS DISTRIBUTED ACROSS THE BODY.

- **HEAD** sensing — orientation samples space
- **EAR** sound — proximity becomes audible
- **WRIST** touch — spatial change becomes bodily
- **HAND** visual — Echo View supports learning

Sensing, sound, touch and visual interpretation occupy different bodily and perceptual positions.

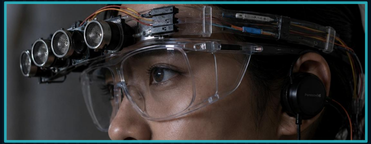
WEARABLE SENSING MAKES BODILY ORIENTATION PART OF THE INTERFACE.

A non-human sensing logic is reinterpreted as a human bodily experience.

EMBODIED TENSION

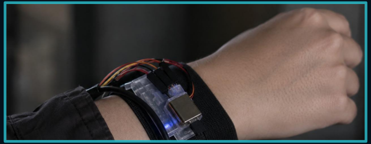
More feedback does not automatically create more understanding. When sound, vibration and visual information operate simultaneously, the user must learn which signals deserve attention.

The design challenge shifts from producing feedback to coordinating attention.



HEAD / SENSING

Forward-facing sensors move with the user's orientation.



TOUCH / HAPTIC

Vibration turns spatial change into a bodily cue.

HAND / VISUAL

Echo View supports interpretation without becoming the only feedback source.

SOUND

EAR / SOUND

Proximity becomes continuous auditory feedback while the user moves.

SOUND · TOUCH · VISUAL

Each channel takes a different communicative role.

EMBODIED INTERACTION SEQUENCE

from body → feedback → interpretation

01 — WEAR

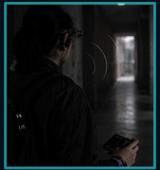
The sensing array is positioned relative to the user's head and body.

02 — ORIENT

Moving the head changes where spatial information is sampled.

03 — RECEIVE

Sensor readings become coordinated auditory, tactile and visual feedback.



04 — INTERPRET

Repeated relationships allow patterns to become recognisable.

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FROM SIGNAL TO INTERPRETATION

A digital ecosystem for sensing, learning and control

BatSense uses the screen as an interpretive layer rather than the centre of the experience. The interface connects live sensing data with spatial visualisation, system guidance and feedback control, allowing users to understand relationships between movement, distance and multisensory response.

THE SCREEN SUPPORTS PERCEPTION — IT DOES NOT DEFINE IT.

INTERFACE ROLES

01 **EXPERIENCE** — PERCEIVE
live spatial reading

02 **LEARNING** — UNDERSTAND
guide + mental model

03 **CONTROL** — ADJUST
connect + configure

DESIGN DECISION

The visual interface was repositioned from primary output to interpretive support.

Software testing link：https://youtu.be/oF29hefgV-o?si=ZRgSnQVGqobCwj6w

01 / EXPERIENCE — ECHO VIEW

Live sensor data becomes spatial relationships in a landscape interface.

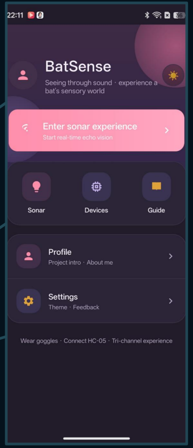
DISTANCE
proximity as spatial cue

DIRECTION
orientation and field movement

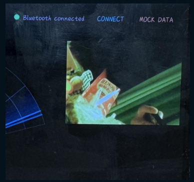
RESPONSE
sound + vibration status

ENTRY POINT

Enter sonar, learn the system, manage devices.



SECONDARY MACHINE-SENSING



Camera recognition was explored alongside ultrasonic sensing as an additional machine-perception layer.

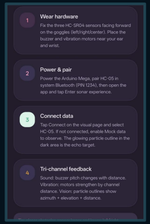
CRITICAL QUESTION

Does visual recognition expand sensory access — or recentre the visual logic BatSense questions?

App test link:https://youtube.com/shorts/ZG4_sYGHys4?si=38j0g2nhxJnhAv3S

02 / LEARNING — BUILDING A MENTAL MODEL

Guidance and sonar principles help users understand relationships between movement, echo logic and feedback.

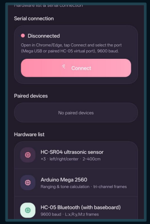


GUIDE

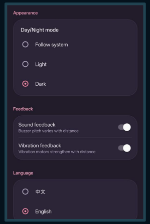
SONAR

03 / CONTROL — CONFIGURING THE SYSTEM

Connection, feedback and language settings allow the sensory experience to be configured rather than imposed.



DEVICES



SETTINGS

COMPANION WEB DEMO

Extends the encounter into a space for demonstration, explanation and project documentation.

Face detection test link:https://youtube.com/shorts/cQus3jbSC-k?si=Olftg5fbMB3S8PN7

EXPERIENCE · LEARNING · CONTROL

Different screens serve different communication roles instead of simply adding more interface surfaces.

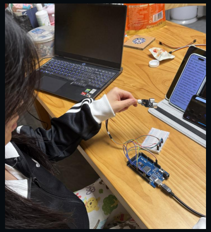
WHEN FEEDBACK BECOMES EXPERIENCE

Formative testing of clarity, attention and sensory learning

4 participants · same 5-question protocol · prototype observation + interview

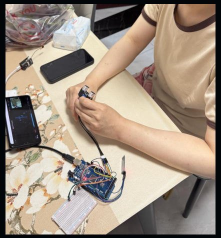
FORMATIVE PROTOTYPE TEST
live sensing + multisensory feedback

Video link: https://youtu.be/w_tdUKD5lDA?si=qO9b2l76y7Evtl26



SESSION 02
orientation

SESSION 03
confirmation



SESSION 04
interpretation

TESTING FOCUS	01 / PROXIMITY	02 / DIRECTION	03 / SENSORY LOAD	04 / LEARNING
	distance change	orientation	reinforce / compete	predictability

Small-scale formative testing examined how participants interpreted BatSense through sound, vibration and visual feedback. The aim was not statistical generalisation, but observing how unfamiliar sensory relationships became meaningful through use.

01 PROXIMITY WAS MORE IMMEDIATE THAN DIRECTION

Participants often noticed that spatial conditions had changed before confidently identifying where the change occurred.

02 DIFFERENT MODALITIES SERVED DIFFERENT ROLES

Sound suggested proximity; vibration felt immediate and bodily; visualisation provided orientation and confirmation.

03 MULTIMODAL FEEDBACK COULD COMPETE FOR ATTENTION

When sound, vibration and screen-based information were active together, participants sometimes focused on decoding signals.

04 PREDICTABILITY INCREASED THROUGH REPETITION

Repeated interaction helped participants associate feedback patterns with spatial conditions, though screen dependence varied.

MORE SIGNALS DO NOT AUTOMATICALLY MEAN MORE CLARITY.

The design challenge shifted from producing feedback to coordinating attention.

PARTICIPANT VOICES

" At first I used the screen to confirm what the sound and vibration meant. After a few tries, I stopped checking it as often.
— P01

" The vibration felt very direct, but through sound I was sometimes unsure whether the object was on the left or right.
— P02

" When all channels were active, I focused more on interpreting the signals than on the space around me.
— P04

FROM TESTING → DESIGN DECISION

BEFORE channels equal → **AFTER** distinct roles

BEFORE screen-primary → **AFTER** learning scaffold

BEFORE more output → **AFTER** clear hierarchy

REFINED SENSORY ROLES

- **SOUND** proximity
- **TOUCH** bodily cue
- **VISUAL** learning

FRICTION / LIMITATIONS Directional coding needs stronger differentiation · full multimodal output can divide attention · screen dependence varied · short-term testing cannot determine long-term intuitiveness

WHEN SPACE IS FELT, NOT ONLY SEEN

BatSense as a multisensory communication system

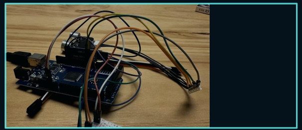
FINAL PROPOSITION

BatSense is a speculative multisensory interface translating selected principles of bat echolocation into coordinated sound, vibration and digital visualisation. Rather than reproducing bat perception, the project uses a non-human sensory logic to question the visual assumptions embedded within conventional interfaces.

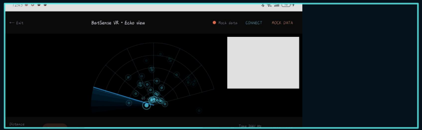
MORE-THAN-HUMAN POSITION

The bat operates not as an aesthetic motif, but as a sensory provocation through which human-centred interface conventions can be reconsidered.

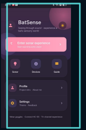
REAL DEVELOPMENT OUTPUTS



SENSE
physical prototype



INTERPRET
landscape Echo View



CONNECT
digital companion

AI-assisted scenario visualisation of the intended embodied BatSense experience.

FINAL ECOSYSTEM

SENSE

ultrasonic proximity + direction

FEEL

sound + vibration as bodily cues

INTERPRET

Echo View as a learning layer

The screen supports perception — it does not define it.

THE PROJECT DOES NOT ASK HOW HUMANS CAN BECOME BATS.

IT ASKS WHAT HUMAN INTERFACES CAN LEARN FROM THEM.

ENVIRONMENT → SENSE → TRANSLATE → FEEL → INTERPRET

Explore project: liunan.site

Project Position

BatSense began with a simple question: what might change if vision were no longer treated as the default way of knowing space?

Inspired by bat echolocation, the project translates selected principles of non-human sensing into a human multisensory language through sound, vibration and digital visualisation.

Rather than attempting to reproduce bat perception, BatSense uses echolocation as a critical lens through which conventional interface assumptions can be questioned. The project suggests that perception is not simply received through technology, but learned through relationships between bodies, signals and environments.

In this sense, BatSense proposes not another way of seeing, but another way of attending to space.

A speculative enquiry into what human interfaces might learn from non-human ways of sensing.

Core Findings

SEEING IS NOT THE ONLY WAY TO KNOW SPACE.

01	TRANSLATE, NOT SIMULATE	Non-human sensing cannot simply be copied into a human interface; it must be selectively translated.
02	DISTRIBUTE, NOT SCREEN-FIRST	Spatial meaning can exist across sound, touch and vision rather than within a single display.
03	LEARNABLE, NOT INSTANT	Unfamiliar sensory relationships become meaningful through repetition, interpretation and bodily adaptation.
04	COORDINATE, NOT MULTIPLY	More feedback does not automatically create more understanding; multisensory design requires hierarchy.

Position: Regeneration is approached as perceptual reconsideration — revisiting non-human sensory knowledge to rethink human-centred interface conventions.

References & Documentation

Theoretical Framework

Dunne & Raby — Speculative Everything

Haraway — When Species Meet

Ihde — Technology and the Lifeworld

Merleau-Ponty — Phenomenology of Perception

Echolocation & Sensory Research

Griffin — Listening in the Dark

Schnitzler & Kalko — Echolocation by insect-eating bats

Moss & Surlykke — Probing the natural scene by echolocation

Research & Development Evidence

Echolocation research and sensory translation mapping

Arduino / HC-05 / ultrasonic sensing experiments

Android, web and Echo View interface development

Formative prototype testing and process documentation

BatSense

More-than-human Communication
Speculative Multisensory Interface

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AI-assisted scenario visualisations communicate intended embodied experience; physical prototyping, interface development and testing evidence are presented separately.