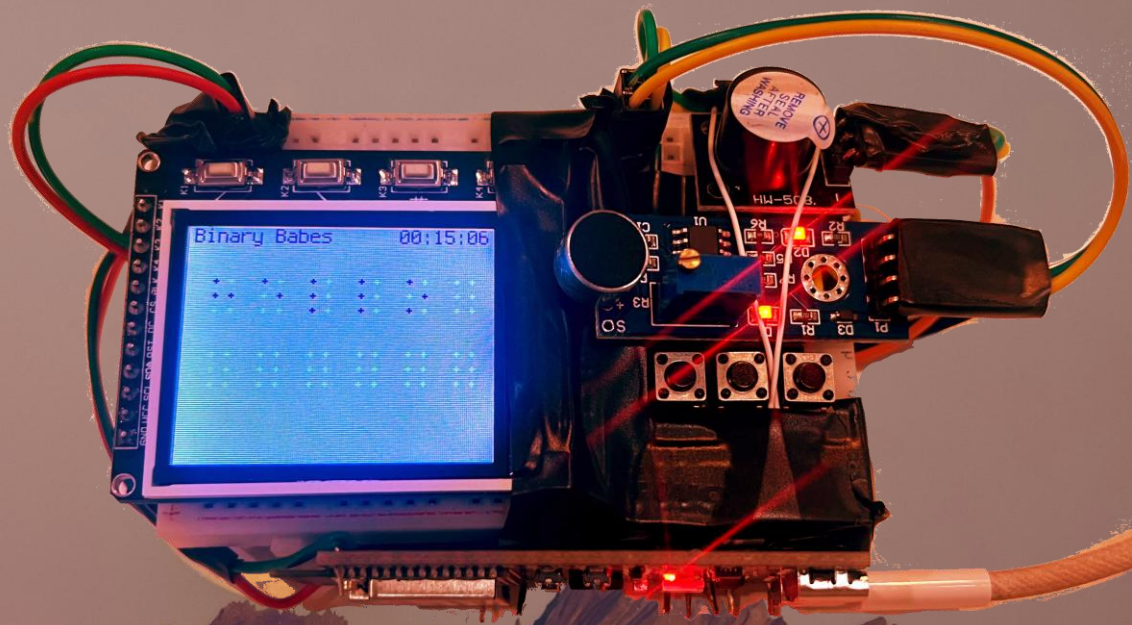
Binary Braille

Bridging the Silence with Every Touch

By The Binary Babes



Shoko

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Women in tech

Renaissance Engineering Programme

Problem Statement #1.

People with **Deafblindness** face major barriers in **Communication** and **Daily Independence** because most assistive technologies do not provide real-time, portable, multi-modal support.

Despite making up an sizeable proportion of society, the deafblind remain underserved by assistive technology.

Currently, close to

of the world's population suffer from some form of **deafblindness**

As few as

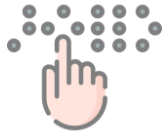
of deafblind have access to **assistive technology**

World Federation of the Deafblind, 2023
World Health Organisation, 2022

While the deafblind have methods for communication, they remain overlooked by most channels of communication and information.

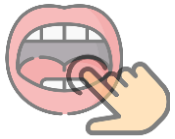
Common methods of communication

1. Braille



2. Tactile Signing

3. Tadoma



Struggles in communication

- Excluded from verbal conversations
- Miss out on critical audio cues (e.g. fire alarms)

⌄

- Feel isolated and excluded

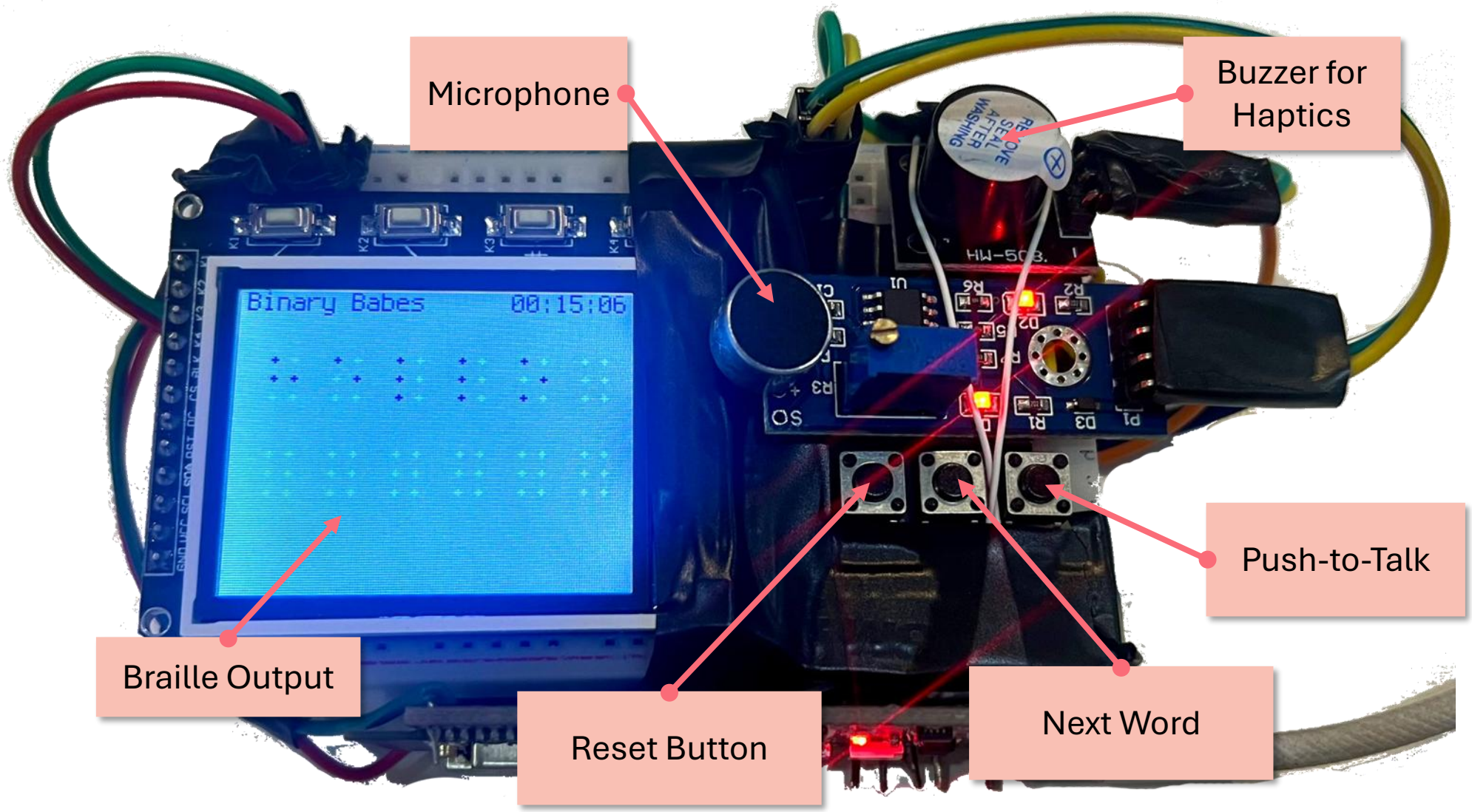
Out of the alternatives we considered, a wearable device would be the best across user-friendliness, cost, and feasibility.

	Ease of Usage	Cost of Implementation	Feasibility
 Computer Website			
 Mobile App			
 Wearable Device			

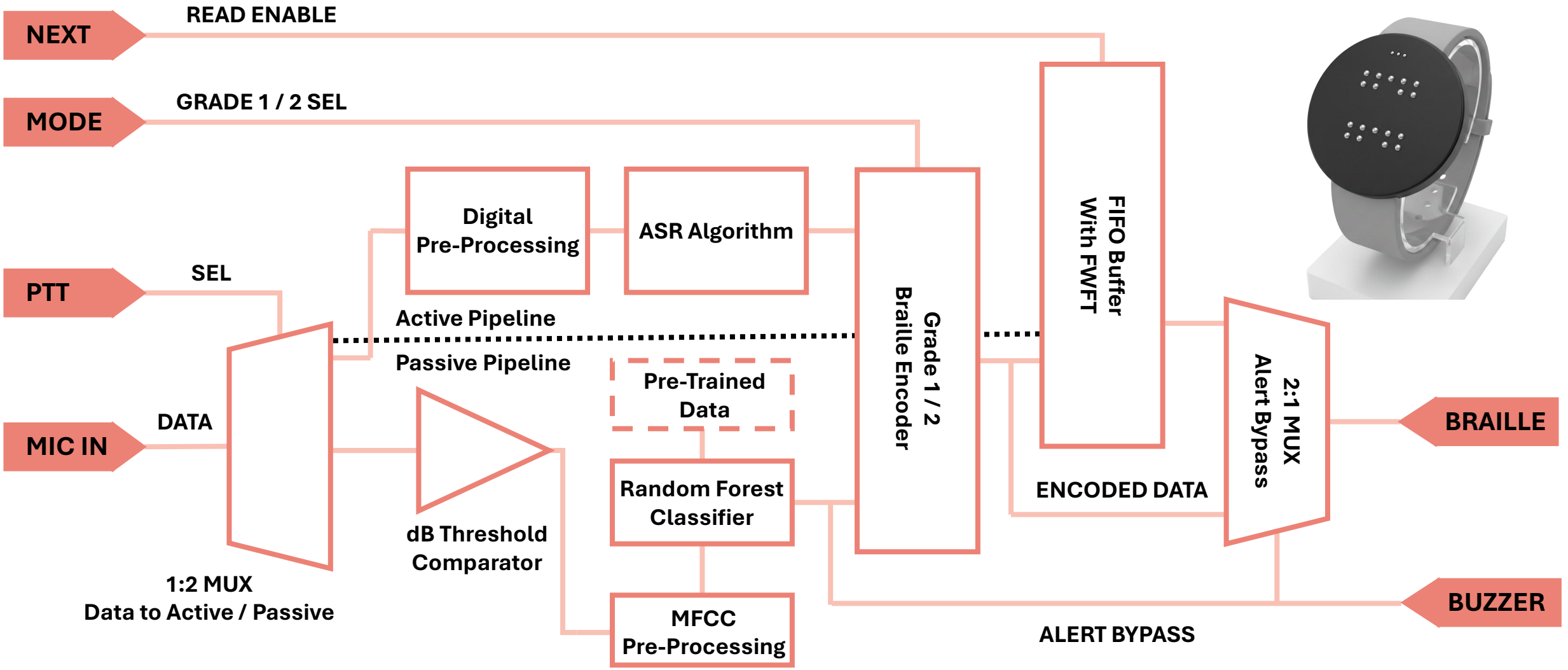
Presenting Binary Braille.

A Wearable Watch that empowers the deafblind community by converting sounds to Braille in real-time.

Binary Braille Prototype on ESP-32.



Oversimplified Binary Braille System Diagram.



Binary Braille has 2 modes.

ACTIVE

Audio-to-braille translator when user is engaged in conversations

PASSIVE

Real-time haptic-alert system which conveys critical audio cues

Binary Braille has an audio-to-braille converter for easier communication.

Audio Input 

Transcription

Braille Output

Goal

Capture speech clearly enough that your transcription step does not fall apart

Prototype

- MEMS Microphone
- MCU/processor
- Audio settings
- Pre-Processing
- Auto Gain Control
- Noise suppression
- Voice Activity Detection

Binary Braille has an audio-to-braille converter for easier communication.

Audio Input

Transcription

Braille Output

Design Architecture / Transcription Pipeline / Post Processing

Model	Whisper-small/ VOST	→	ESP32
Process	VAD splits	→ Local inference	→ Post-processing
Output	Punctuation restoration	Number formatting	Language selection

Binary Braille has an audio-to-braille converter for easier communication.

Audio Input 

Transcription 

Braille Output 

Translation Layer – Convert Text

Grade 1 — Braille (direct character mapping, easiest)

Grade 2 — Braille (contractions, more complex but “real Braille” for fluent users)

Braille encoding → device commands

Refreshable Braille display

- Each cell has 6 pins
- Control board drives actuators
- A line of cells (12 characters per frame)

Binary Braille has 2 modes.

ACTIVE

Audio-to-braille translator when user is engaged in conversations

PASSIVE

Real-time haptic-alert system which conveys critical audio cues

Binary Braille will also alert users of sounds.

1 Sound Identification

Only sounds over a certain **decibel** will be identified

ML pipeline using **FFT** and **MFCC**

ML model **pre-trained** on external computer

Offloads computational power

2 Alert System

Warns user of critical, high-risk sounds with high confidence level through **haptics**

❖ **Examples** include
- Sirens
- Car horns
- Gun shots
- Dog barks

3 Personalised Sounds

Enables **independence** and reduces need for **physical contact**

❖ **Examples** include
- Calling user's name
- Baby crying
- Doorbells

Our solution has 3 key features.

1

Portability

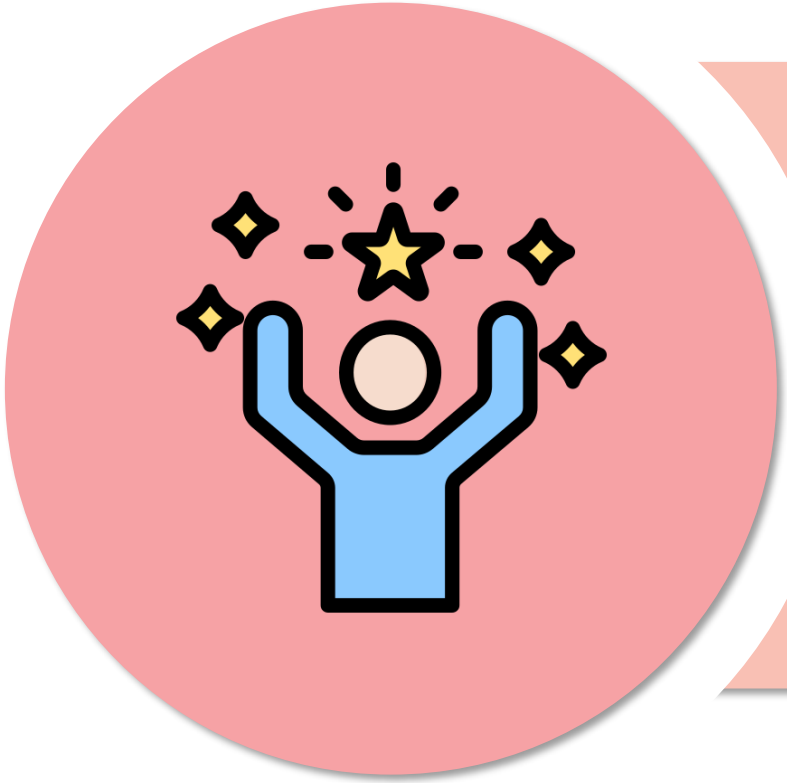
2

Ease of Use

3

Personalisation

Our solution is impactful to improve the lives of those who are deaf and blind.



Improves **Social** and **Environmental Awareness**

Improves **User Confidence**

Improves **Practicality** of Tech Products

Feasibility and future considerations of Binary Braille.

PROTOTYPE	CHANGE	PRODUCT
~120mW	**Pipeline Optimization** 	~60mW
~$10/unit	**Economy of Scale** 	~$60/unit
Text to Braille latency of ~300ms	**Transition from Dev Board to ASIC with dedicated DSP Slice** 	~100ms overall latency