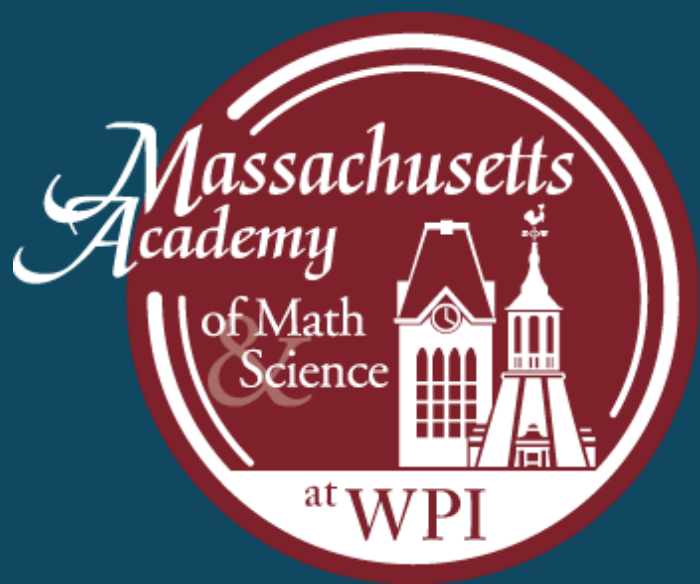




VIBRABELL

An Assistive Doorbell for the Hard of Hearing

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Problem Statement

Individuals with **hearing impairments** are often **unable** to **react** to when a doorbell is **rung** due to these systems often relying on **auditory** cues. This **prevents** the individual from being able to **respond quickly** if someone is there (The Bellman Team, 2026).

Current Market

- SafeGuard Wireless Doorbell with Flashing Strobe
 - The doorbell **flashes** a **strobe** and plays unique **chimes**
 - Range of up to **600** feet
- Ring Doorbell
 - Heavily relies on **notification** system on smartphone

Engineering Goal

The goal of this project is to develop an **assistive doorbell** for the **hard of hearing** that gives a **vibration** through the form of a **wearable watch** when the doorbell is rung, notifying the user without **relying** on **auditory** cues.

Methodology



Identify the Issue(s)

Fully identify and understand the issues at hand; make note of limitations of current designs/products

Initial Sketches

Create 3 different possible design sketches for ideas



CAD Design

Model the designs using OnShape

Prototyping

Assemble CAD designs and hardware; take note of any changes or requests for future iterations



Client Communication

Meet with the client caretaker for further requests on future iterations



CAD Designs

Doorbell Design

- CAD design with OnShape
- Easy-to-press** design for accessible use
- Small** and **compact** shape
- Sends a **signal** to the wrist device once pressed

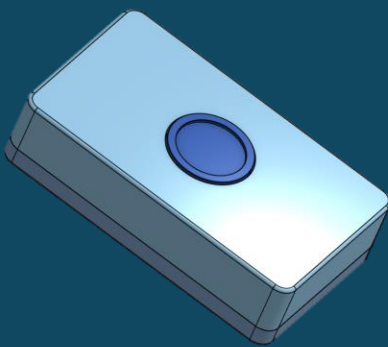


Figure 1: Doorbell CAD Design

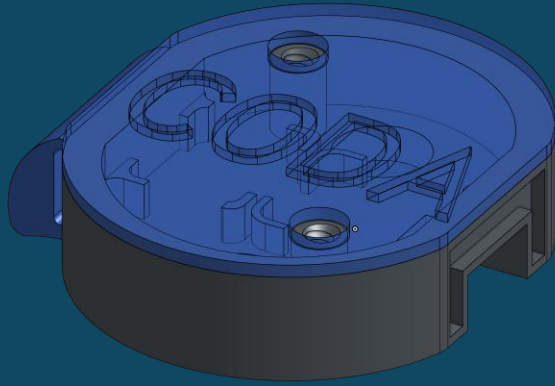


Figure 2: Wristband CAD Design; acknowledgments to Chris Xu

Wrist Device Design

- CAD design with OnShape
- Alerts the user through **vibration**, not sound
- Portable design up to **~35** feet
- Wrist-worn design for user convenience

Preliminary Prototypes

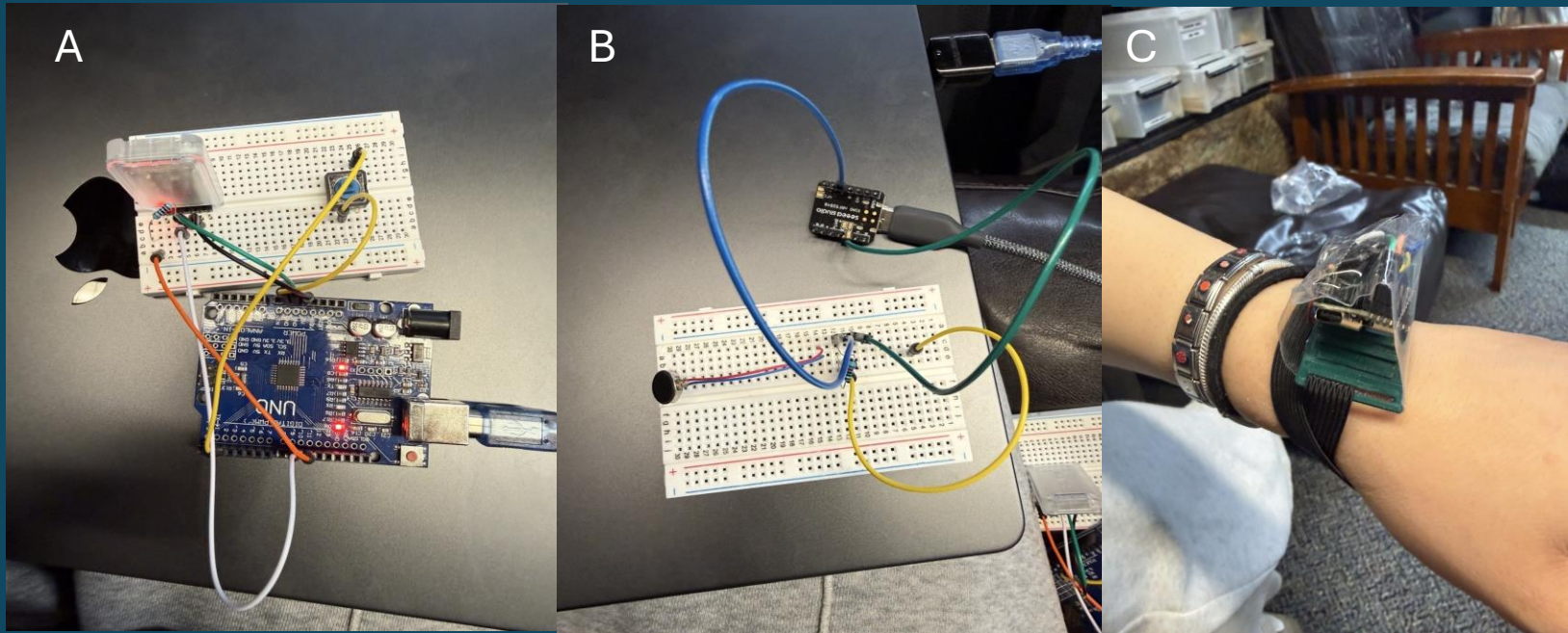


Figure 3: The preliminary designs for our model. (A) The sender with an BLE bluetooth module. (B) The receiver with an nRF52840, breadboard, and vibration motor. (C) First wrist device prototype with nRF52840, vibration motor, and initial CAD design.

Requirements

Level	Category	Requirement Statement	Vibration Watch	LED Watch	"Lamp" System
1	Functional	The device needs to be able to successfully alert someone without sound	Yes	Maybe	Maybe
1	Functional	The doorbell needs to be able to send signals wirelessly to the alert device	Yes	Yes	Yes
1	Functional	The alert device needs to be able to successfully receive the signals sent by the doorbell	Yes	Yes	Yes
1	Functional	The device is accessible and functional at all times	Yes	Yes	No
1	Functional	The device must not use an app	Yes	Yes	Yes
1	Functional	The device must not use LED as the primary notification system	Yes	No	No
1	Physical	The doorbell must stick to a door without damaging the wall	Yes	Yes	Yes
1	Physical	The doorbell must stay on the door or doorway without falling off	Yes	Yes	Yes
1	Physical	Must not obstruct the user during daily activities	Maybe	Maybe	Yes
1	Physical	If worn, device must be soft/elastic	Yes	Yes	N/A
1	Cost	The cost of the total parts list should total under \$150	Yes	Yes	Yes
1	User	The user must have a sense of feel and/or sight	Yes	Yes	Yes
1	User	The user must be able to operate basic devices (ex. on/off switch)	Yes	Yes	Yes
1	User	The user does not need to look at the alert device.	Yes	No	No
2	Functional	The device must be able to survive multiple weeks before needing to be replaced or be rechargeable	Maybe	Maybe	Yes
2	Physical	If on person, must be less than 25 mm wide	Yes	Yes	N/A
2	Physical	If worn, it must be less than 200g	Yes	Yes	N/A
2	Cost	The final device must cost less than \$50 to produce	Yes	Yes	Yes
2	Documentation	The device shall include an instruction manual	Yes	Yes	Yes
2	Documentation	The device shall include design documentation	Yes	Yes	Yes
3	Physical	The doorbell must be under 6 inches length	Yes	Yes	Yes
3	Physical	If on the person, it must stay on the user despite water, harsh conditions, etc	No	No	N/A
3	Physical	The device must align with the client's idea of appealing	Yes	Yes	No

Table 1: Requirements Matrix for Functional, Physical, Cost, and User Criteria

Design Studies

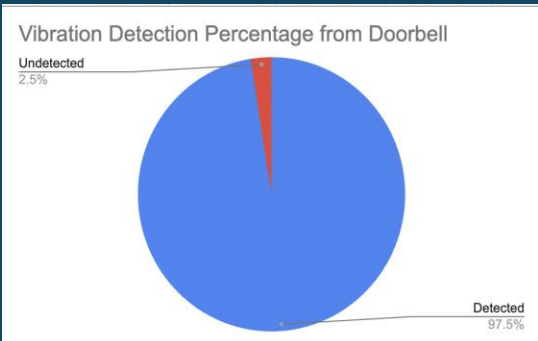


Figure 4: Vibration detection from doorbell (97.5%); participants are given the wrist device and asked to raise their hand when they feel a vibration

Comfortability Rating (Out of 10) by Activity	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5
Walking	7	6	6	7	8
Laying Down	4	5	6	5	6
Sitting	6	7	5	7	8
Average Percentage	56%	60%	56%	63%	73%

Figure 5: Comfortability of the wrist device rated by participants on a scale of 10 based on 3 categories

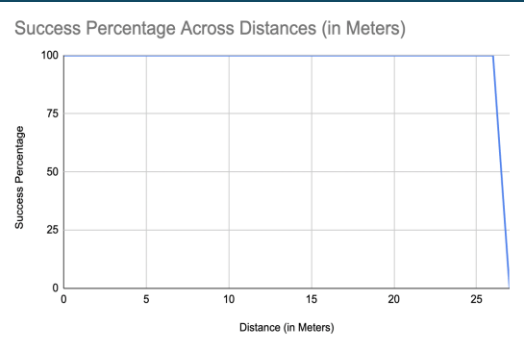


Figure 6: Range of the wrist device from the physical doorbell when compared to the distance in meters

Conclusion

We created a device that enables individuals who are hard of hearing to be notified when the doorbell is rung by sending physical vibrations through a wrist device. This allows the user to live more independently.

Future Work

- Implement an **LED notification** feature to work in combination with the **vibration** motor.
 - Increase **range** of the device
- Add **adjustable** vibration levels based on user preference