

Haptic Guidance for Persons with Visual Impairment during Crisis Evacuations



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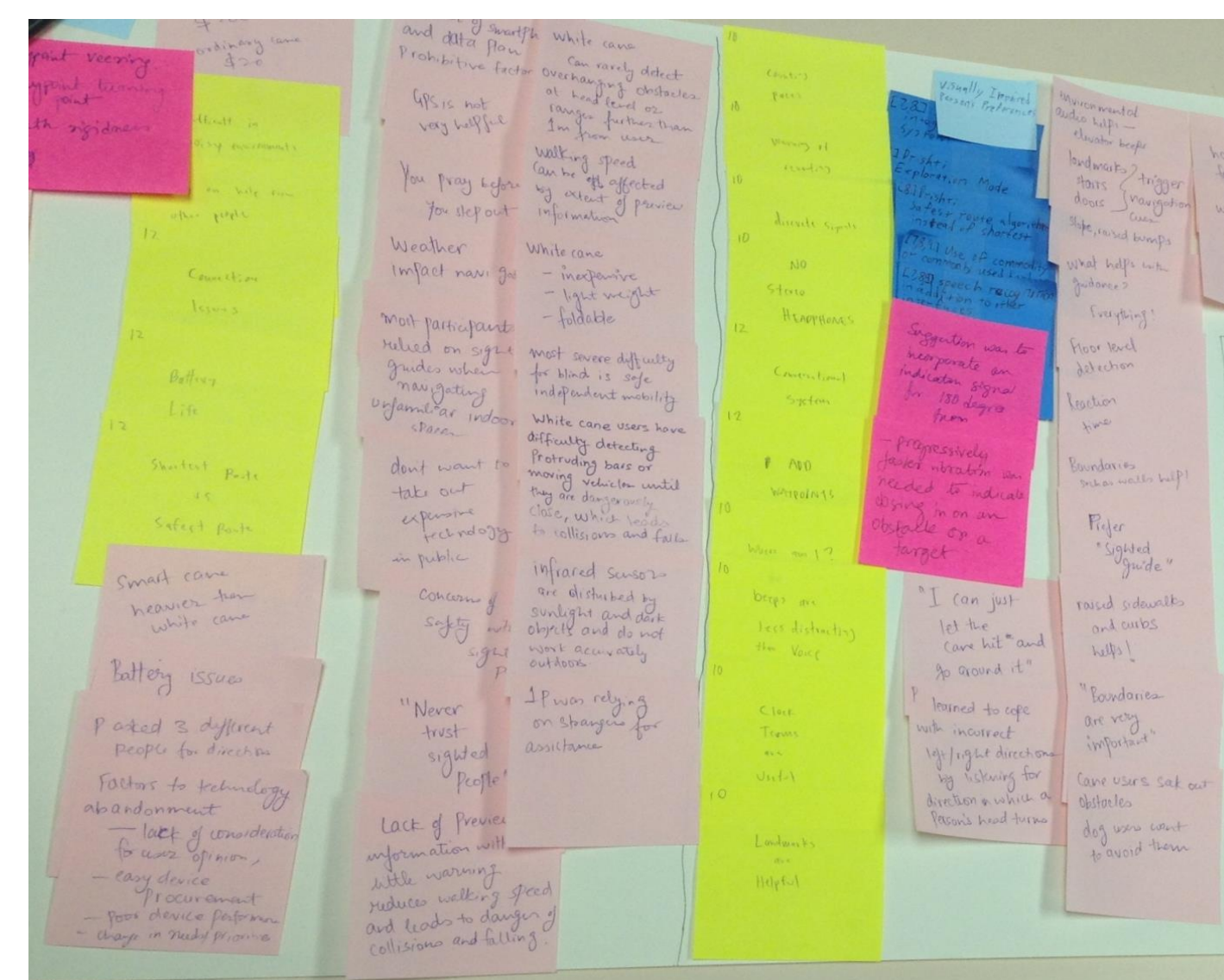
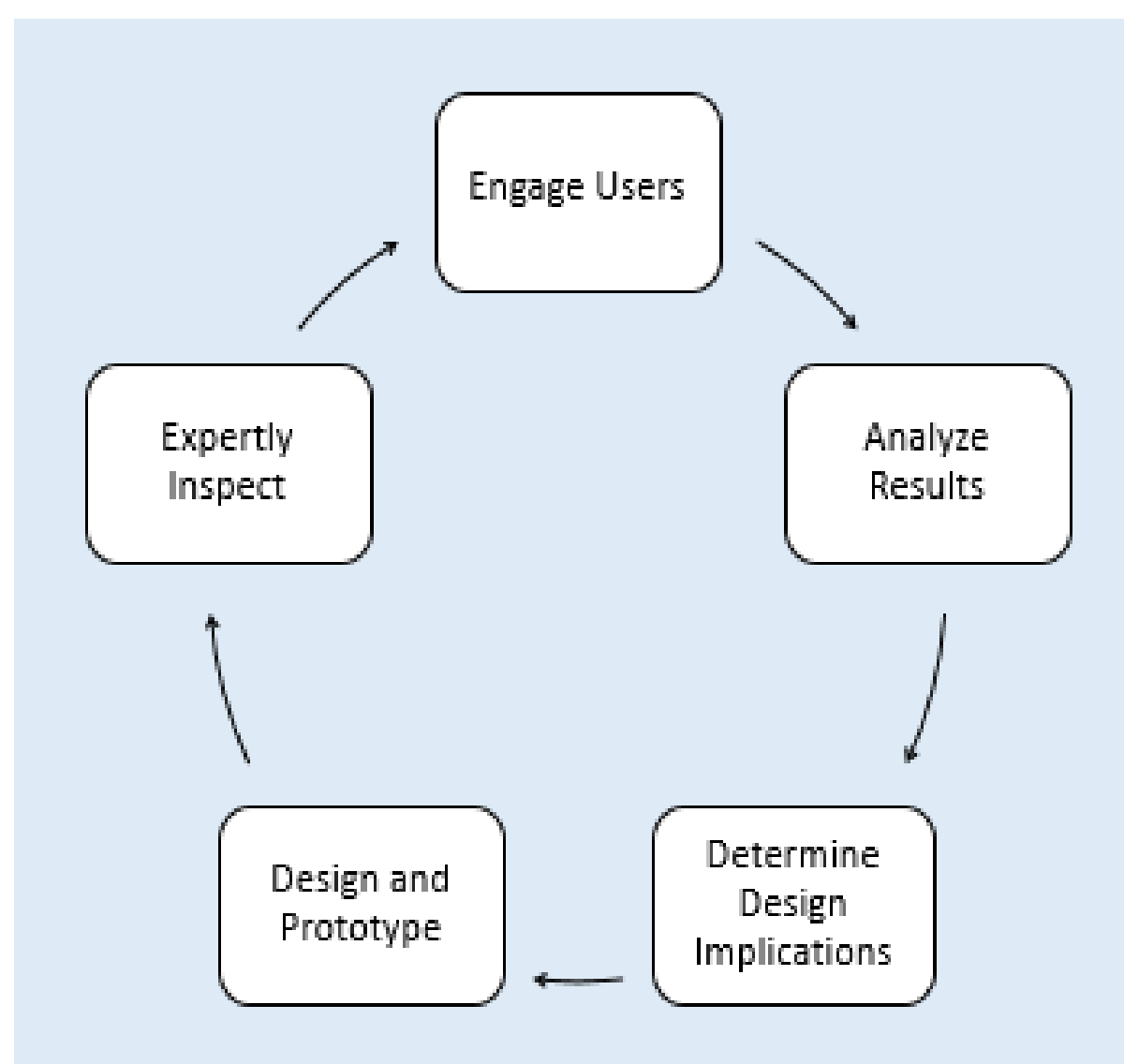


Research Problem

This research designed and evaluated an assistive technology that guides the visually impaired to safely evacuate a location during a crisis. This technology guides users with haptic feedback based on their current location.

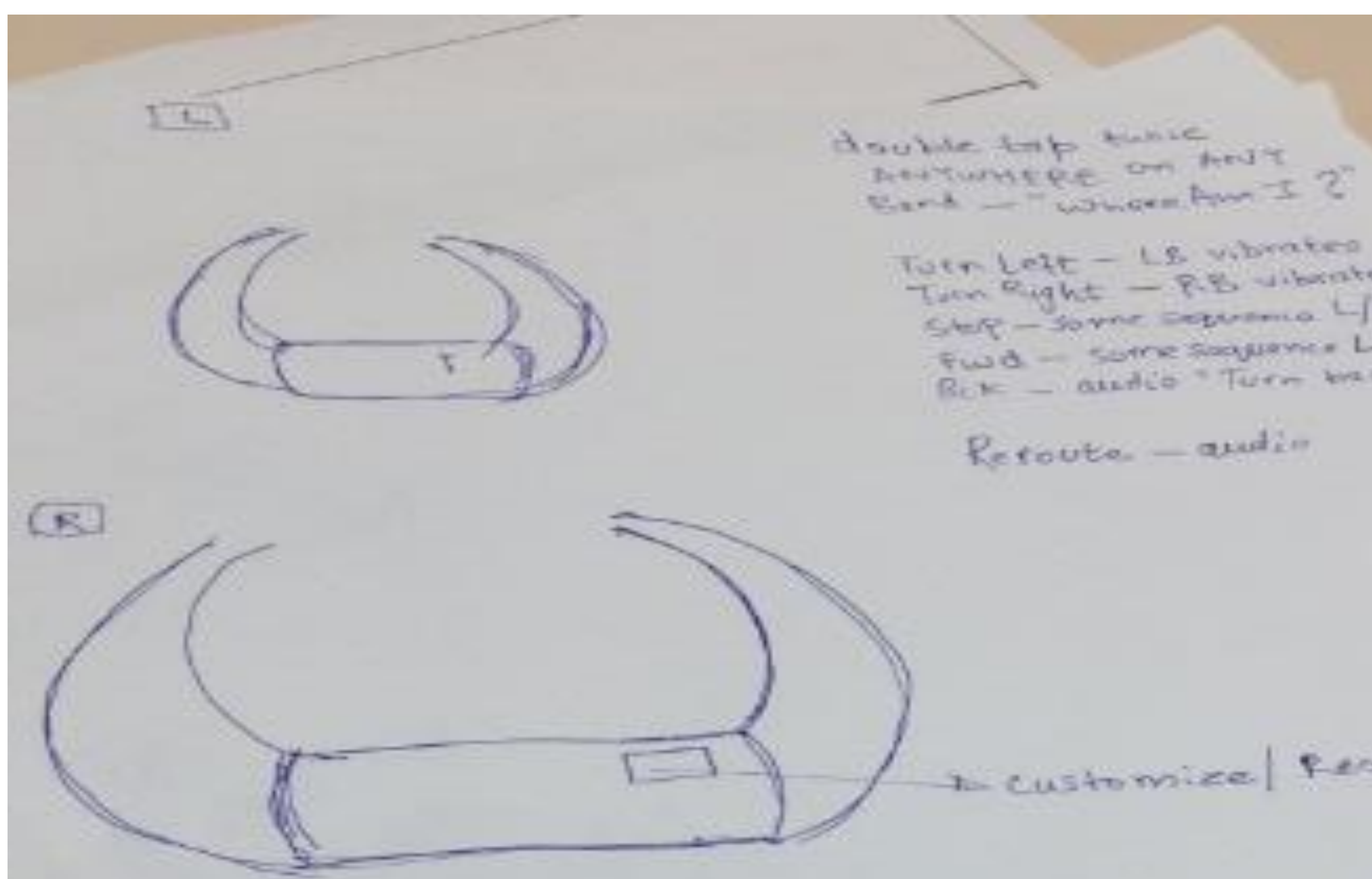
Research Process

We designed our assistive technology using the Human Centered Design Cycle (left). We analyzed data from similar research projects using an affinity diagram (right). This helped us to identify key patterns and relationships for our design. Additionally, we created personas and scenarios to help us think about potential users of our technology and the situations under which they would need it.



Initial Prototype

Based on our affinity diagram, personas, and scenarios, we designed a low fidelity paper prototype. This helped to refine the physical design and interfaces.



Final Prototype

After doing number of iterations on our initial prototype, we came up with a final prototype that consists of a smartphone, Bluetooth earpiece, and a pair of smart watches.



Final Prototype Functionality

Our final prototype assists the persons with visual impairment by giving them the haptic directions via 2 smartwatches and audio directions via Bluetooth earpiece.

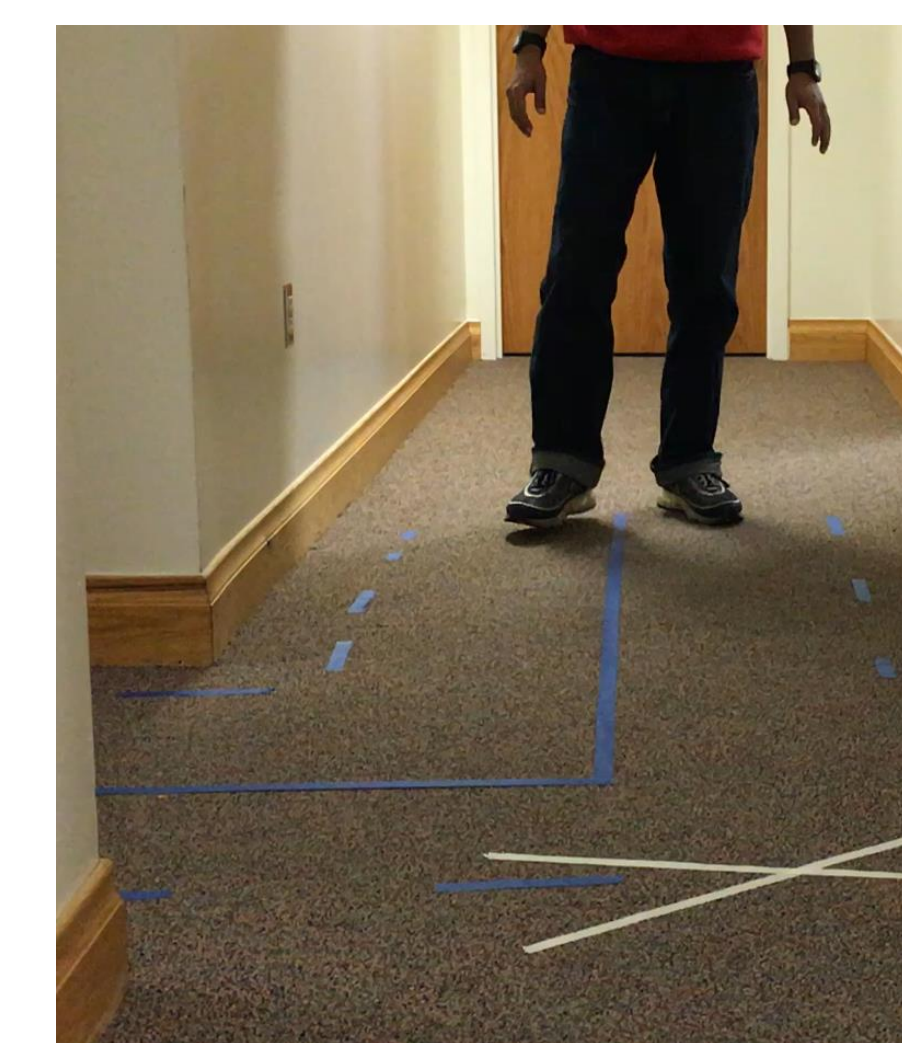
HAPTIC DIRECTIONS	ACTIONS
Vibrations on Left Wrist Watch.	Turn Left.
Vibrations on Right Wrist Watch.	Turn Right.
Light Vibratory Pulse on Left Wrist Watch.	Turn 45° Left.
Light Vibratory Pulse on Right Wrist Watch.	Turn 45° Right.
Strong Vibratory Pulse on Left Wrist Watch.	Turn 90° Left.
Strong Vibratory Pulse on Right Wrist Watch.	Turn 90° Right.
Light Vibratory Pulse on Both Wrist Watches.	Move Forward.
Strong Vibratory Pulse on Left Wrist Watches.	Stop.

AUDIO DIRECTIONS	ACTIONS
Follow the wall.	Follow the wall.
You have reached your destination.	Stop, and wait for further directions.

VOICE COMMANDS BY USER	ACTIONS
Repeat Directions.	User receives the appropriate vibration.

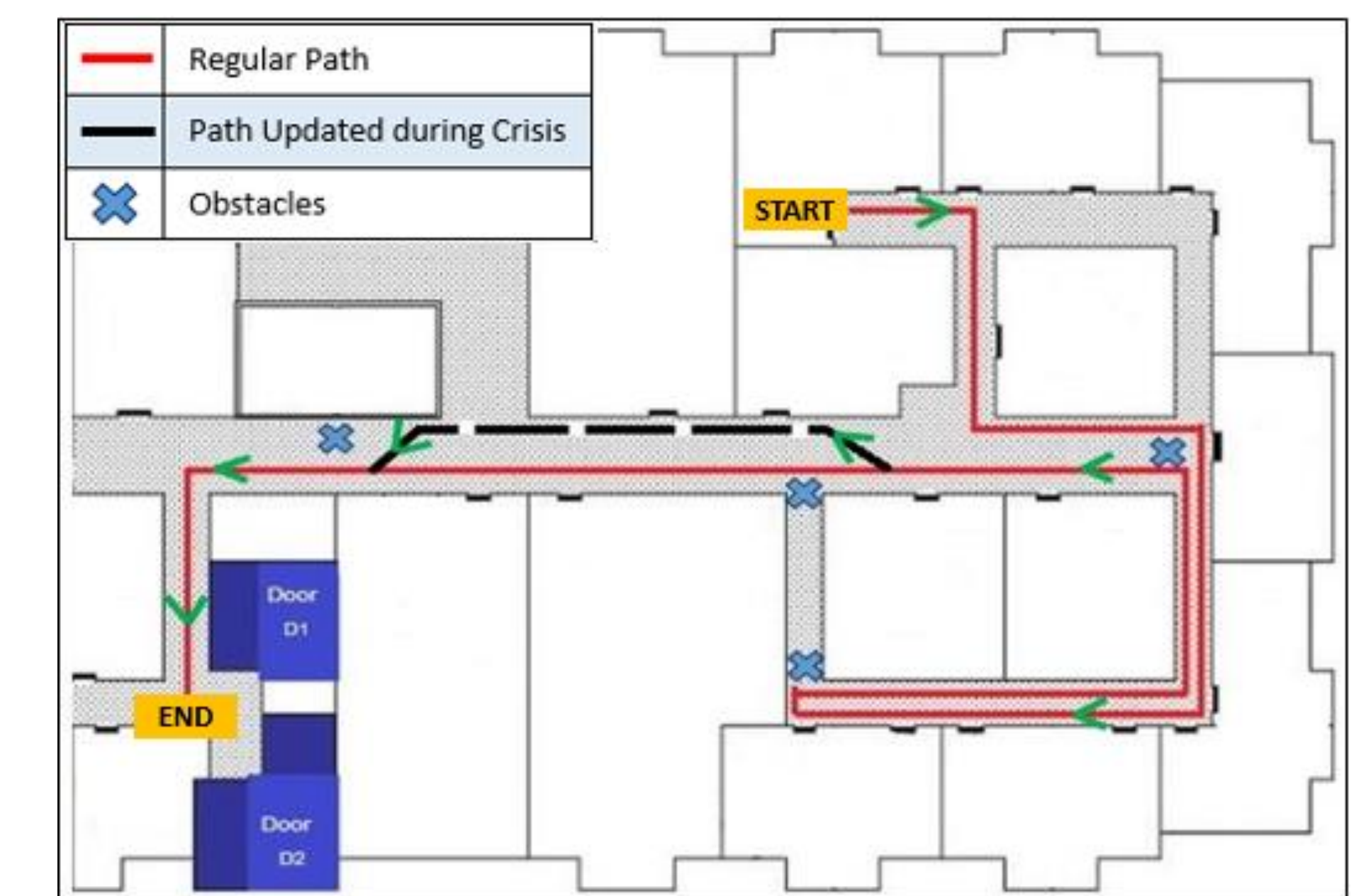
Testing Procedure

- Each participant was fitted with the prototype
- We gave instructions on how to interpret the different navigation cues
- The participant was directed to the beginning of the test path
- The navigation cues were given, and the participant's progress was recorded



Test Path

Our participants included five sighted individuals who were blindfolded. The path that our participants were instructed to navigate through included obstacles and re-routes.



Results

We analyzed data from the video recordings to look for key metrics.

Test Parameters	P1	P2	P3	P4	P5	Average
Total Time taken to walk	05:13	07:04	09:09	07:53	07:52	07:26
Number of times deviated from path	3	4	6	4	4	4.2
Number of times misinterpreted command	1	2	3	2	6	2.8
Number of times hit against obstacles/wall	2	0	2	2	0	1.2

Participant Feedback

A watch on each wrist helps to interpret the directions accurately.

It would be easy to follow in a more stressful situation because it's not something that you have to listen for. It doesn't matter what's going on around you, you can still figure it out.

Some cues [e.g., long vs. short] were difficult to differentiate.

Future Work

- Customizable vibration patterns.
- Customizable audio cues.
- Issue voice commands like: current location
- Time estimations until safe.

Acknowledgment

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