Indoor Navigation
for Low Vision Individuals

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Introduction

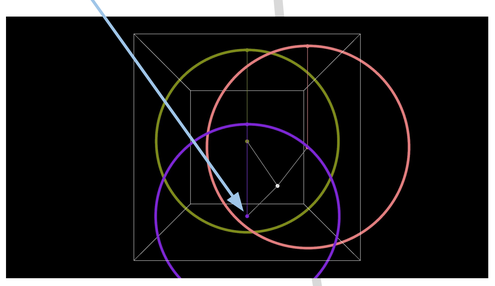
The purpose of this project was to create the foundation of an indoor navigation system that increases the autonomy of low vision individuals. To that end, we have completed a functional prototype that demonstrates distance- and location-finding capabilities as well as the user interface for an iPhone app.

How do you navigate indoors without sight?
You need to know...

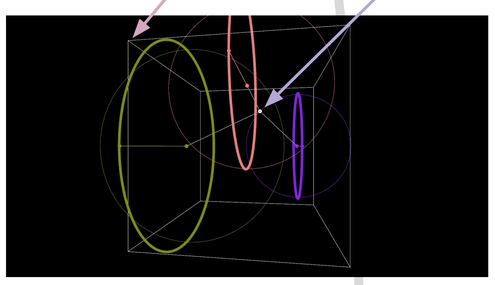
Where you are

Location only makes sense in reference to some landmark. To find a user's location within a building, we use beacons with known locations (i.e. landmarks) to determine the user's position in 3D space.

Each colored dot is a beacon; each beacon is surrounded by a circle indicating how far away it is from the user.



Using the three distances, we determine the user's position, and display it as a white dot. The box shown represents the room the user is in.



How do you find location?
You need to have...

Beacons

There are **two kinds of beacons:**

A **tag** is carried by the user and responds to messages from the anchors.

Anchors send and receive messages from the tag. The time of flight of each message is timed by the anchor and converted into a distance.

In terms of hardware, beacons have three parts:

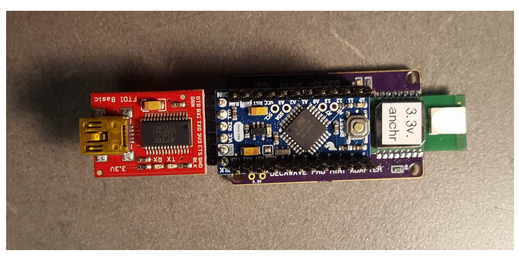
- Arduino Pro Mini
- DWM1000 adapter board
- DWM1000 Ultra Wideband transceiver

The adapter board is an interface between the Ultra Wideband radio transceiver and the Arduino.

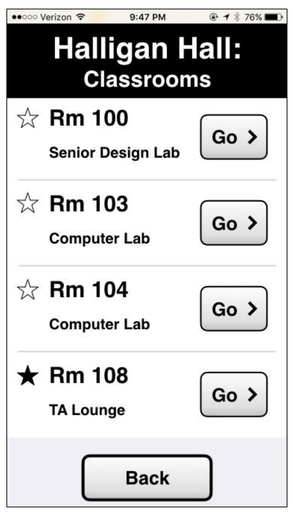
Trilateration Software

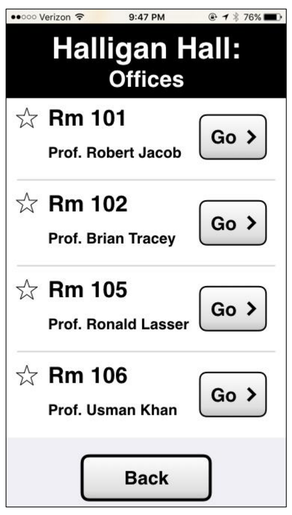
Anchors send each distance measurement to a central server.

The server uses the measurements to determine the position of the tag, which it displays in a visualization, as shown above.



Where you're going



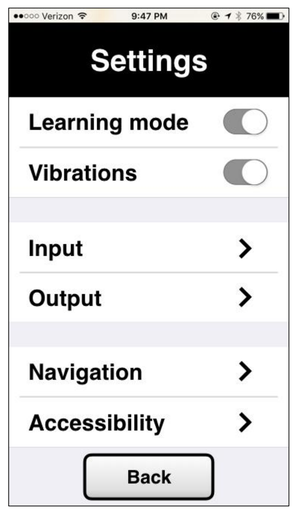


Directory screens

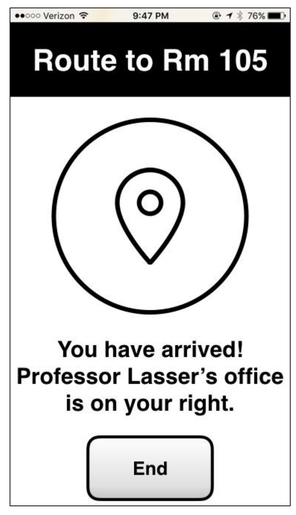
Knowing your destination is critically important for navigation. The accompanying iPhone app helps users find their destinations quickly and easily.

The app is designed for maximum usability by low vision users. It features high contrast displays, large buttons and icons, and keywords.

How to get there



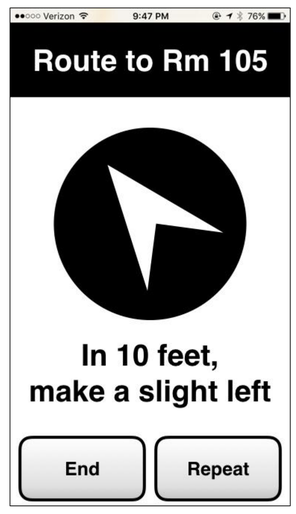
Settings screen



Arrival screen

The accompanying iPhone application will interface with the beacons and help guide the user to their destination. The iPhone app screens above will be accompanied by **audio feedback** for ease of use by low vision individuals.

Our design was inspired by **user research** conducted to identify the target demographic and better understand the needs of low vision individuals. **Expert reviews** gave insight into high quality design strategies for the app UI. Additional **usability testing** will guide the final design.



Navigation screen

Conclusion and Further Work

The prototype successfully demonstrates that our method is a viable solution to the challenge of navigating indoors with low vision.

Future efforts will involve improving the range of the beacons, implementing the iPhone UI, and developing a pathfinding algorithm to guide the user to their final destination.