# Visi-Vest: A Device to Warn VIPs of Above-Waist Obstacles

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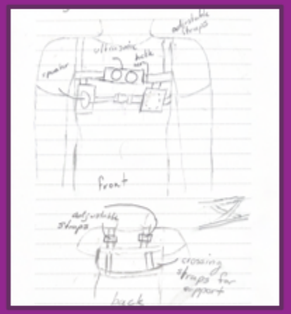
## Problem Statement

Oftentimes, visually impaired persons (VIPs) use white canes or guide dogs to navigate their environment. However, these aids are unable to detect obstacles above waist height. This means that VIPs are at risk of collisions with objects that the cane cannot detect, putting white cane users at risk of injuring themselves without aid from a sighted person.

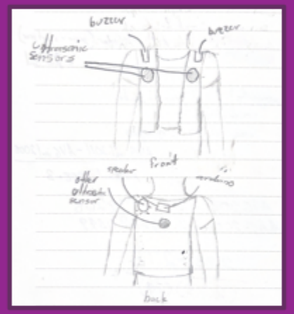
## Engineering Goal

To help visually impaired individuals (VIPs) navigate their environments independently, without fear of being injured by an object they can't see or detect without aid.

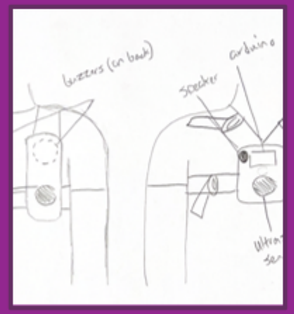
## Design Approaches



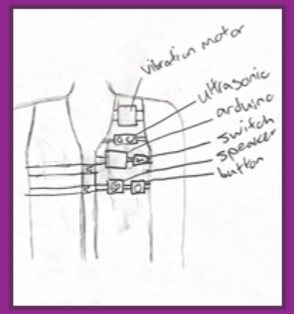
Design #1
Pros: Modular, adjustable, lightweight, ok for long hair
Cons: Looks like a dog harness, wires on both sides of the vest



Design #2
Pros: Simple to use
Cons: Difficult to attach sensors, wires on both sides, sensors on the back



Design #3
Pros: Modular, adjustable
Cons: Bulky, long hair interferes with function, sensors on the back



Design #4 (chosen design)
Pros: Modular, doesn't look like a harness, easier to put on
Cons: Heavier on one side, potentially more expensive

### Design Study #1 (CDR)

Pros: Detects flat objects such as walls, reasonably easy to put on, low-cost, modular design
Cons: Does not detect smaller objects, varying results with small changes in angle, fragile due to use of non-preferred materials, connected to laptop, vibration motor does not work

Methods of testing: Group members were blindfolded and led into common objects by another group member. Group members gave ratings on comfort and security while using.

### Design Study #2 (ADR)

Pros: Detects objects, easy to put on, low-cost, modular design, less fragile than CDR prototype because of improved 3D printed casings
Cons: Issues with small/angled objects due to weak ultrasonic sensor, connected to laptop

Changes from CDR: Latches were added to CAD files for all designs, so that all sensors have holders. A breadboard was used to get the vibration motor to work. Straps were sewn onto vest for a streamlined appearance.

## Methodology

- Used an ultrasonic sensor to detect objects within collision range
- Sensor input is directed to an Arduino
- Button switches mode between vibration motor and speaker
- OnShape used to CAD casings for all attachments, which slide onto nylon straps in a modular design
- Straps are placed on a safety vest for ease of use and comfort

## Testing

- Device was worn by the team around the school environment
- Max range: ~2ft (wall)
- Needs work to detect protruding objects and objects at offset angles

## Future Work

- Make a Printed Circuit Board
- Make the device easier to navigate without assistance
- Improve range of view by incorporating LIDAR or better ultrasonic sensors

| Level | Requirement | Satisfied? |
|---|---|---|
| 1 | The device shall be able to detect when the user approaches an object that they may walk into | Yes |
| 1 | The device shall make noise to alert the user that they are about to walk into an object | Yes |
| 1 | The device shall vibrate to alert the user that they are about to walk into an object | Yes |
| 1 | The user shall be able to use this device in conjunction with a guide dog or white cane | Yes |
| 2 | The device shall be able to be used continuously for 1 hour | Yes |
| 2 | The device shall function properly for people of varied heights | Yes |
| 2 | The device shall be durable | No |
| 2 | The device shall minimize the stress to the user's body | Yes |
| 2 | The device shall weigh no more than 1 lb. | Yes |
| 2 | The device shall cost no more than $125 | Yes |
| 3 | The device shall be easy to navigate without assistance from a sighted person | No |
| 3 | The device shall alert the user whether the object is behind, in front, to the left, or to the right | No |
| 3 | The device shall be free of exposed sharp edges | Yes |
| 3 | The device shall include a user's manual | Yes |
| 3 | The user's manual shall be accessible via audio or Braille documentation | Yes |