NaVI: Aid for Independent Navigation of Public Spaces for the Visually Impaired

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BACKGROUND

Over 250,000,000 people worldwide have some visual impairment (VI)

Public spaces are not designed for those with VI, especially indoors.

Those with varying levels of VI use a wide array of tools, from canes to GPS.

PROBLEM

Those with visual impairments (VI) have trouble independently navigating unfamiliar environments, especially those that require indoor navigation and specific points of interest.

DESIGNS

Design #1: Navigation Band

- Vibrating band to suggest a path of motion

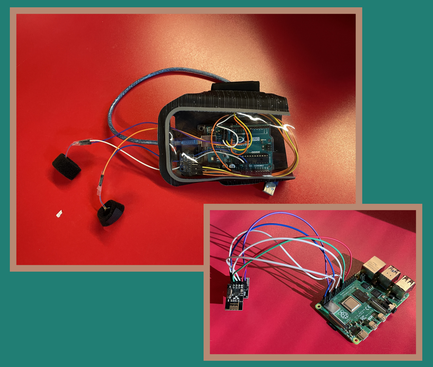
Design #2: Audio Nav-Box

- Communicates with the user through audio-based suggestion

Design #3: Haptic Glove

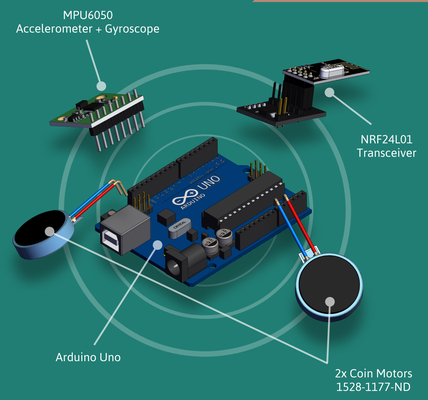
- Vibrating glove that directs a user along a navigation path

PROTOTYPE



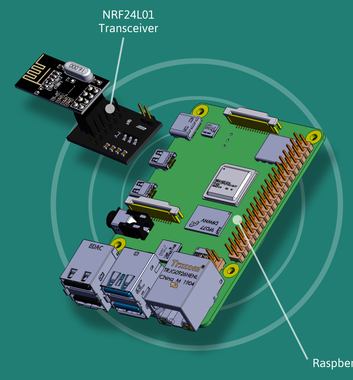
- Glove-band hybrid design worn on the client's wrist
- Vibrations on fingers direct the user along a navigation path.
- An optimal navigation path is computed on a peripheral device.
- Minimal setup required and no costly/bulky equipment.

BAND SYSTEM



- Vibrating motors provide motion feedback to user.
- Accelerometer computes a user's change in position.
- Gyroscope computes the user's change in orientation.
- Secured to the user's hand and connected to the fingers.
- Can direct left, right, and stop.
- Transmit navigation path between on-site navigation peripheral.

NAVIGATION PERIPHERAL

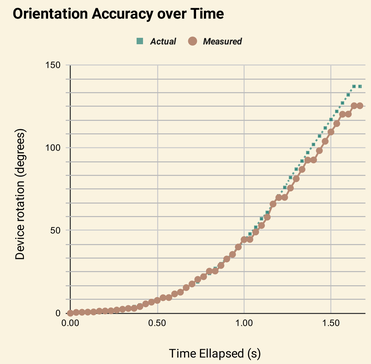


- Takes a list of items or points of interest (POIs) from the location.
- Stores a layout associated with the location.
- Computes an optimal navigation path for the user to travel.
- Navigation path goes through the locations of all desired POIs.
- Utilizes a modified A* algorithm on a coordinate grid layout.
- Certain grid spots are blocked off to indicate static obstacles.

REQUIREMENTS

Level of Importance	*Requirement Description*
Level 1	Independent use of device; able to be used by those with VI.
Level 1	Able to utilize existing assistive technologies without interfering with the device.
Level 1	The device is developed using affordable materials and costs < $40 and is <1 lbs.
Level 1	The device should be able to direct users to specific points of interest.
Level 2	The device can be easily adapted to both outdoor and indoor environments.
Level 2	Physically discrete and not developed using overwhelming materials.

DESIGN STUDY



- Inherrent noise is found within accelerometer and gyroscope hardware
- Orientation error grows quickly over time
- Accurate positioning with consumer-grade arduino parts seems challenging.
- Additional questions surrounding the accessibility of vibration-based feedback.

CONCLUSIONS

- Achieving accurate indoor positioning is challenging with consumer-grade arduino components-- this is a limitation of our current prototype.
- With smaller components and PCBs, it appears providing positioning and navigation in indoor environments is possible.
- There is a lack of sufficiently inexpensive and non-invasive products available for the above goals.

REFERENCES

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