VIRTUAL REALITY FOR THE BLIND

Simulating outdoor navigational experiences for the visually impaired

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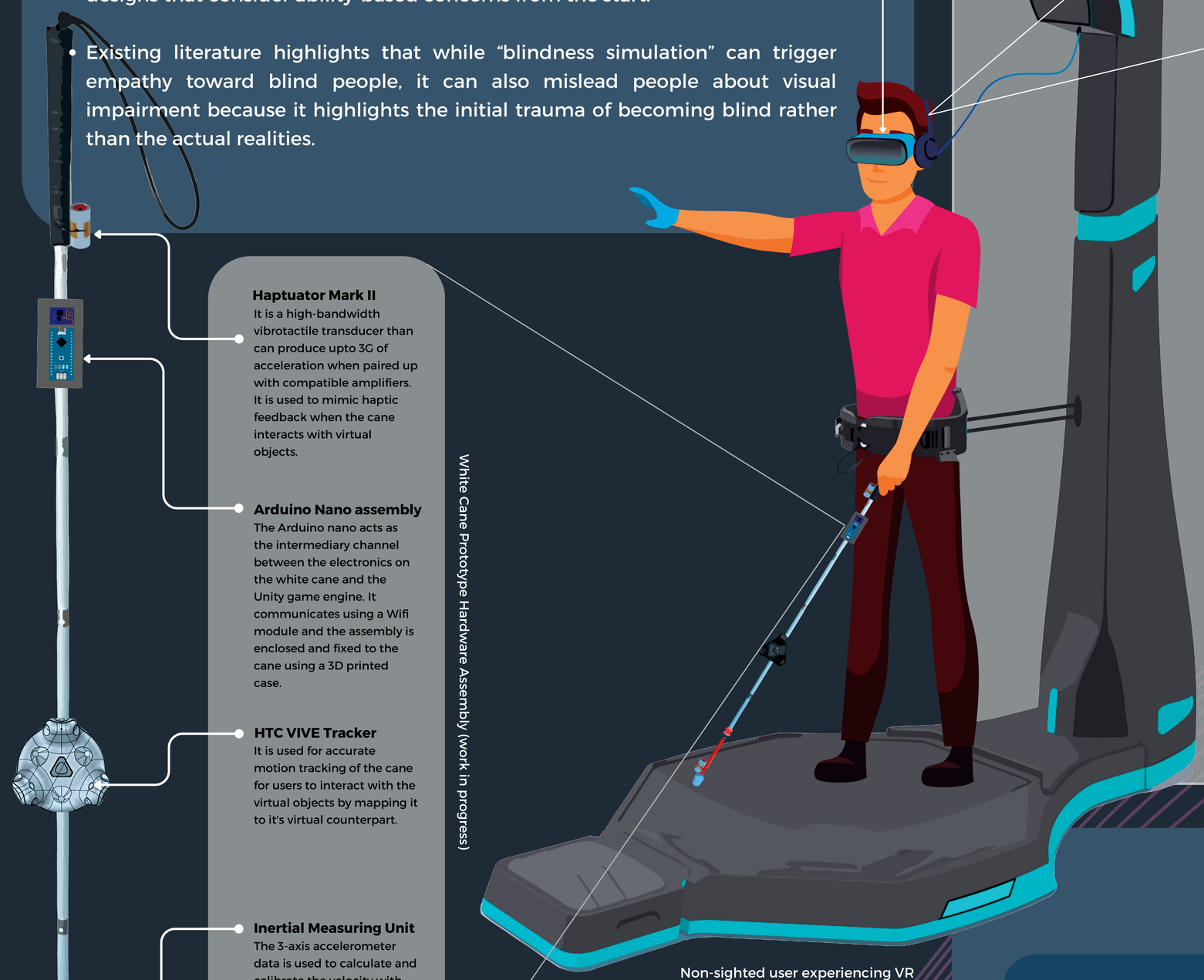
BACKGROUND

- Virtual Reality (VR) technology has traditionally been associated with visual experiences; however, in our view, other sensory feedback mechanisms such as audio and haptics that constitute a more immersive VR experience have not been thoroughly leveraged.
- Too often, the accessibility of VR technology to people with visual impairments is an afterthought (if it is considered at all); post hoc or third-party patches to accessibility, while better than no solution, are less optimal than interface designs that consider ability-based concerns from the start.
- Existing literature highlights that while “blindness simulation” can trigger empathy toward blind people, it can also mislead people about visual impairment because it highlights the initial trauma of becoming blind rather than the actual realities.



Non-sighted user experiencing VR simulation using the novel white cane and VR slide mill

"Soundscape" in outdoor navigational simulation

How would you distinguish between these surfaces without visualizing them?

Tactile Feedback and Auditory Perception

Following the same principle, in this research, we enable visually impaired users to interact with virtual surfaces using a novel white cane and identify them only through their haptic and acoustic profile. Additionally, we aim to create a "soundscape" for the users in the virtual world using not only kinesthetic feedback through the cane but also ambient sound from the surroundings. This helps users to create a mental map of the surrounding ultimately enabling them to navigate in a simulated environment,

RESEARCH OBJECTIVES

1. Creating a Mobility & Training Aid
2. Empowering Accessibility
3. Fostering Empathy

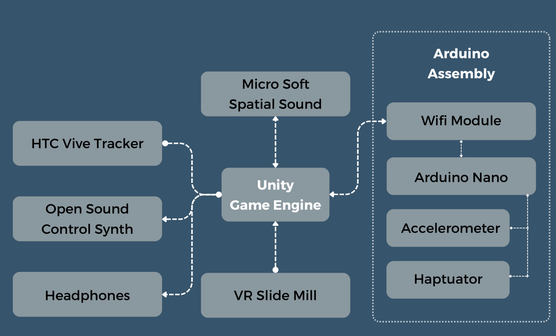
METHODOLOGY

Phase 1. Collection and Analysis

- In this phase we create a hardware assembly to measure and store vibration and sound profile of different real world surface textures.
- Vibration pattern - using Inertial Measuring Unit
- Sound samples - contact and air microphone

Phase 2. Game Develoment and configuration

- Small scale city navigation map in Unity.
- Sound and haptic profile configuration of game objects (road, side walk, grass lane, dirt road).
- Addition of ambient sound (traffic light system, traffic sound, footsteps, and etc).



High Level System architecture

Phase 3. Interaction and Navigation

- Configuration of user navigation in the game and interaction with game objects.
- Locomotion - VR slide mill
- Position and orientation - HTC vive tracker
- Cane interaction Velocity - 3-Axis accelerometer

Phase 4. Synthesis

Spatial Audio	Haptice Rendering
Cane velocity data & Sound profile of virtual object	Cane velocity data & Haptics profile of virtual object
OSC	
User (Headphones)	User (Haptuators on cane)

WHAT'S NEXT?

1. Directed Studies
2. Prototype version 1.0 implementation
3. In-game navigational refinements
4. User study with non-sighted and/or sighted participants
5. Data analysis
6. Research paper publication

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2. *Wobbrock, J.O., Gajos, K.Z., Kane, S.K., Vanderheiden, G.C. Ability-Based Design. Communications of the ACM, June 2018, 61(6), pp. 62-71.*
3. *Silverman, A. M. (2015). The Perils of Playing Blind: Problems with Blindness Simulation, and a Better Way to Teach About Blindness Section. Journal of Blindness Innovation and Research, 5(2). Retrieved from https://nfb.org/images/nfb/publications/jbir/jbir15/jbir050201.html. doi: http://dx.doi.org/10.5241/5-81*
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