Week 1

Agendas to cover

A1. What is VR used for? For each , is it applicable for blind users?

A2. Culture of cane use: how are they used? how is it taught?

A3. Accelerations/forces measurable at the hand of a cane user: can we find existing measurements? Should we measure this ourselves?

A4. Designing & building an actuated cane: solenoids? vibration actuators?

Research outcome

Whatever the application of VR be possible for the blind, the usage of a “cane” for interacting with the surroundings in a virtual simulated environment should be preferred. Reasons :

1. Familiarity with the cane design
2. Standardized grip and techniques
3. Readily available forums for learnability
4. Provides natural stance (posture) and stride

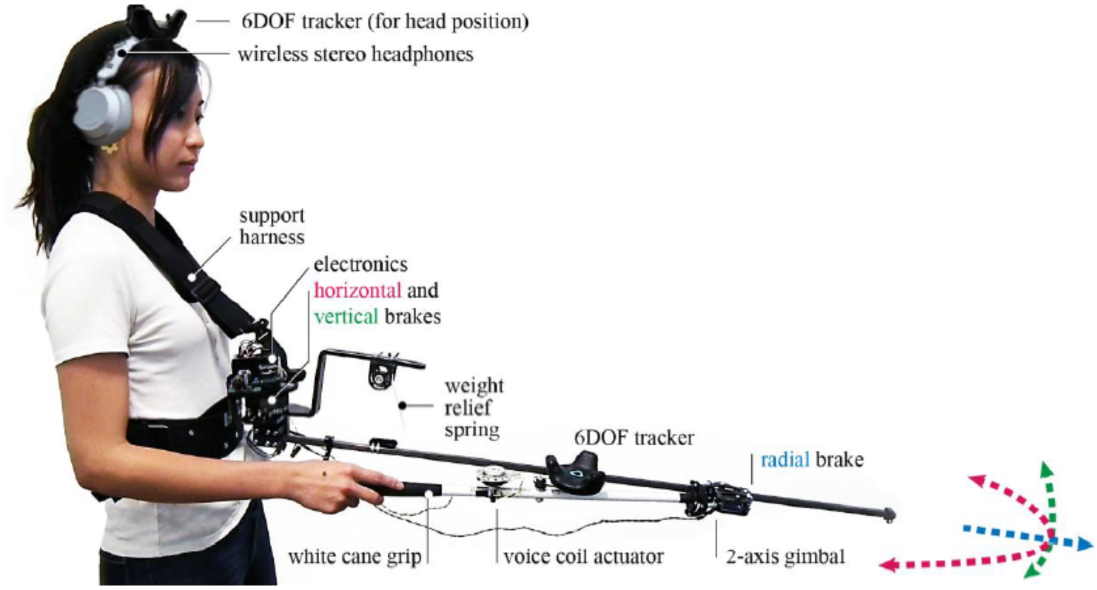
Limitations of physical white canes

- Inability to detect slippery surfaces due to water spilled on or fabric dropped onto the floor
- Inability to detect body-level or head-level obstacles in new unfamiliar places

Challenges in wayfinding in unfamiliar places

- Find → current location, way to the destination and maintain orientation
- Large areas (wide-open areas, hallways etc.) because of lack of landmarks which are used to detect orientation

Latest prototype developed by MS and Stanford university for a virtual experience without use of vision using a smart cane



Video link :

https://www.youtube.com/watch?v=rIuJuRvnOEw

A2. Culture of cane use

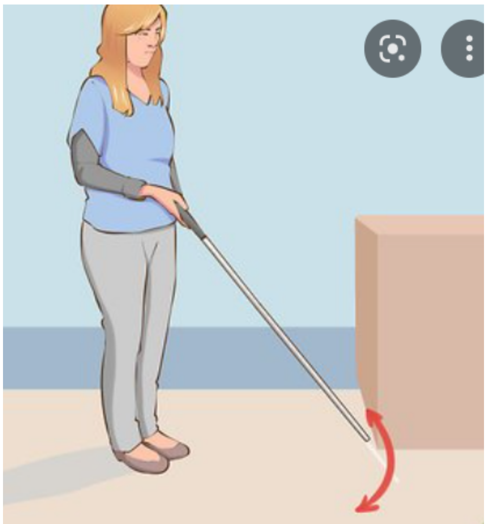
Prominently used Cane techniques

1. Constant contact

    - The cane is in constant contact with the ground/floor and it is swept at an arc
    - It is used when the level of the floor is plain or unaltering

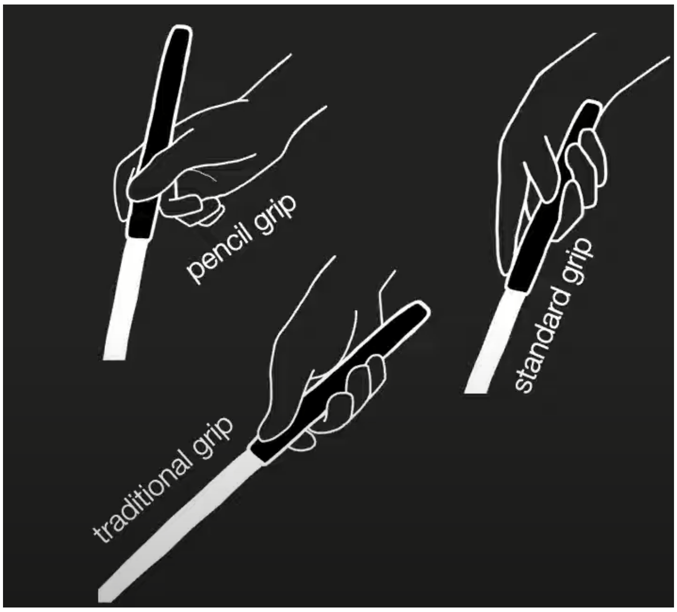
2. Two point touch
    - The cane is taped on either ends of the arc (of shoulder length) on the ground
    - It is used when the level of the ground in uneven as constant contact method can result in bumping the cane against the user.

3. Shore lining
    - It is used to maintain orientation against structures like walls
    - The arc is half in length and the cane is tapped horizontally against the structure



Grip and Hand position of the cane

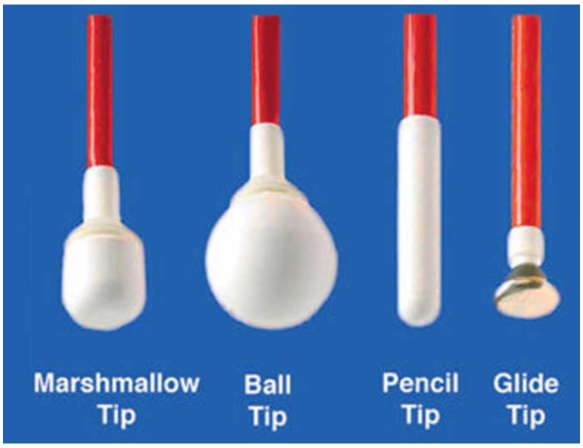
1. Pencil grip
2. Traditional grip
3. Standard grip



Can tip style for haptic feedback

1. Marshmallow
2. Metallic/Glide

3. Plastic/Ball
4. Pencil



A3. Forces to be measured in order to mimic virtual experiences

1. Measuring vibrations experienced on the tip and stem of the cane

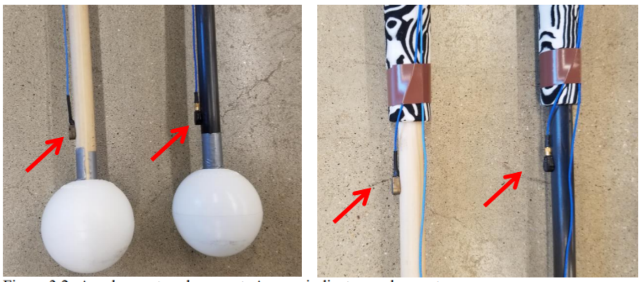


Figure 3.2: Accelerometer placement. Arrows indicate accelerometers.

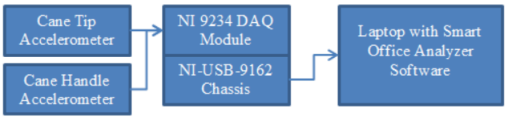


Figure 3.3: Block diagram of data acquisition setup for texture discrimination experiment.

2. Applying torque and force on the cane using brakes

Brake Axis	Object Location	Action	Torque [Nm]
Horizontal	Disengaged		0.072
	Counter-Clockwise	Collision	> 4.504
		Moving Away	0.082
	Clockwise	Collision	> 2.655
		Moving Away	0.082
Vertical	Disengaged		0.024
	Top/Bottom	Collision	> 6.01
		Moving Away	0.028
			Force [N]
Radial	Disengaged		0.405
	Front	Collision	> 15
		Moving Away	0.81

A4. Designing and building an actuated cane

- Range of motions (ROMs) to be considered : ***vertical, horizontal and radial***
- Length, weight and center of mass of the cane to be considered
- Fundamental experiences to imitate :

Virtual experience to create	Used for	Component
Kinesthetic Feedback From the collision of the cane	collision imitation (on all ROMs)	Brakes
Tactile Feedback Sweeping the cane across different surfaces	vibration generation	Actuators
Sounds and noise 2.1 Direct sound : Point touch sound 2.2 Ambient noise : Immediate Surrounding sound	spatial audio	Headsets

Current limitations of virtual canes

- Lack of library of audio and textures when different types of cane tips interact with different real-world materials
- Adjustment of impact force, its position and texture feedback (on tip or stem) depending upon the location of impact of an object with the cane
- ROM constrained and cant be used for head-level and body-level obstructions during navigation

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5. Dean, Aaron, "Investigation of Measured Cane Vibrations for Prediction of Blind Pedestrian Performance in Surface Preview Tasks" (2017).*Masters Theses*. 1132.https://scholarworks.wmich.edu/masters_theses/1132