Multisensory Navigational Aid for Visual Prosthesis Users

Checkpoint Presentation

An Chi Chen

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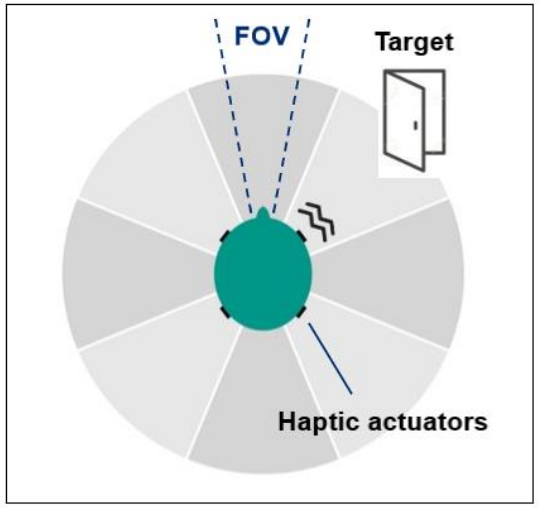
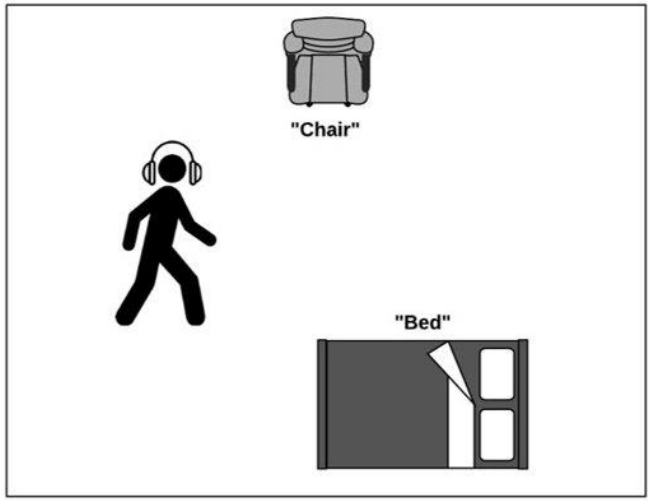
Project Summary

- Develop an haptic and auditory feedback system to supplement the Argus II retinal prosthesis system
  - Intuitive for users
  - Maintain low cognitive load

- Haptic Feedback System



- Auditory Feedback System



Deliverables

- Minimum
  - Operational haptic feedback system with intuitive haptic patterns to guide users' gaze direction
- Expected
  - Haptic feedback system
  - Auditory feedback system for target and obstacle identification
- Maximum
  - Argus II system integrated with haptic and auditory feedback systems
  - Participant tested synergistic visual prosthesis system
  - Evaluation of integrated system's performance with target navigation and obstacle avoidance

Dependencies

Dependency	Responsible Person	Plan of Action	Fallback Plan	Date Achieved	Expected Date	Status
Mapping, SLAM navigation (incl. required hardware)	Mentors	Required parts have been made /ordered and delivered	Develop haptic and auditory system without SLAM navigation	28 Feb 2022		Achieved original plan
IRB	An Chi	Do the required training as soon as possible		-		Not Attained
Participant availability	An Chi / Mentors	Start the participant recruitment 4 weeks prior to planned testing	Test system with seeing participants using VR headset	-	21 April 2022	Not started (fallback plan will be implemented with APL employees)

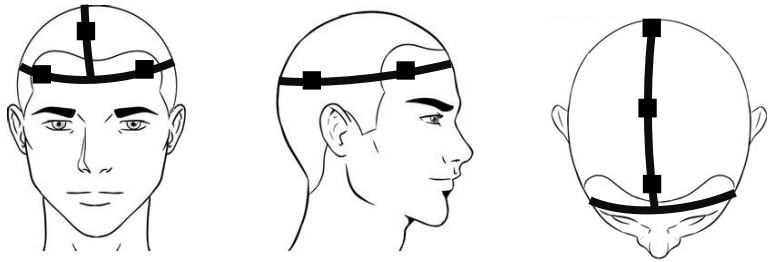
Deliverables – Current Status

Complete | In Progress | Not Started

- Minimum
  - Operational haptic feedback system with intuitive haptic patterns to guide users' gaze direction
- Expected
  - Haptic feedback system
  - Auditory feedback system for target and obstacle identification
- Maximum
  - ~~Participant tested synergistic visual prosthesis system~~
  - Argus II system integrated with haptic and auditory feedback systems
  - Evaluation of integrated system's performance with target navigation and obstacle avoidance

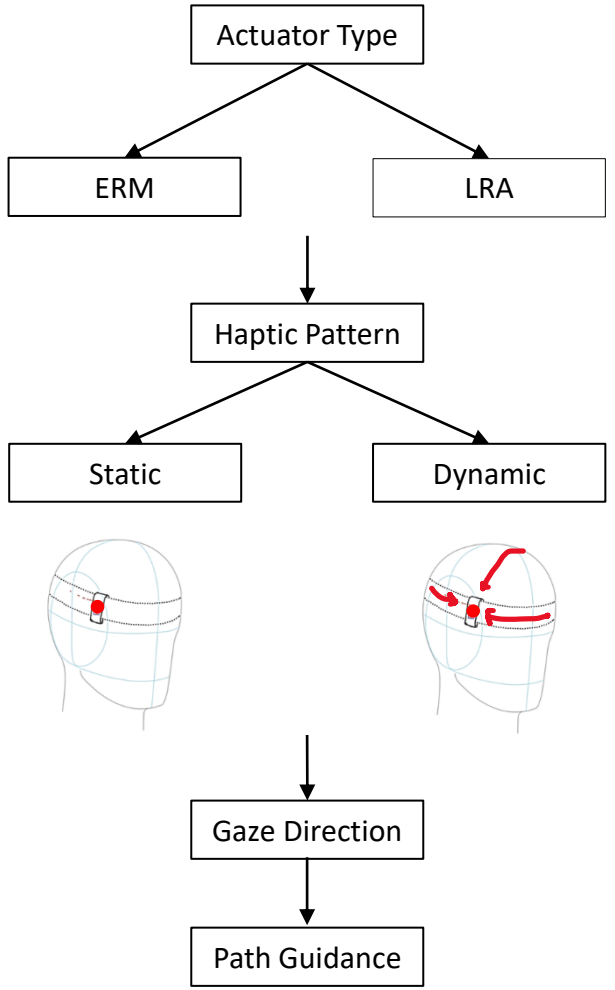
Haptic Feedback System – Progress

- Haptic system developed
  - 7 LRA haptic actuators
  - Static – left / right
  - Dynamic – up / down
  - Integrated with SLAM mapping
  - Path guidance



Front Sides Top

Haptic Headband Design



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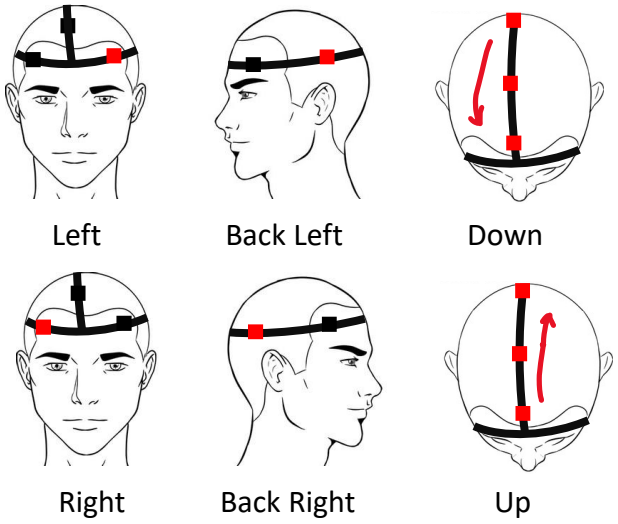
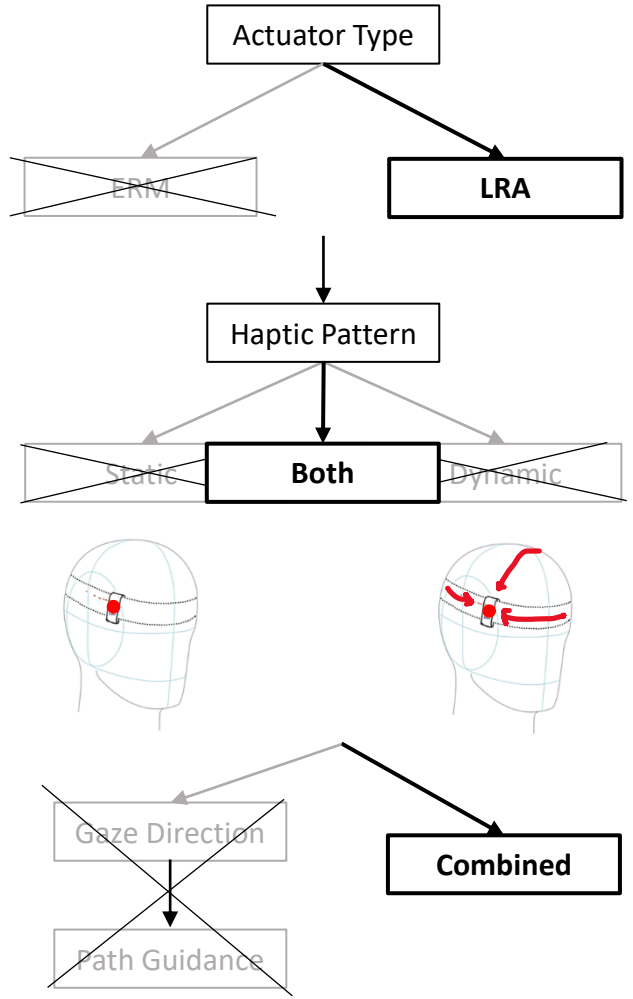


Haptic Patterns

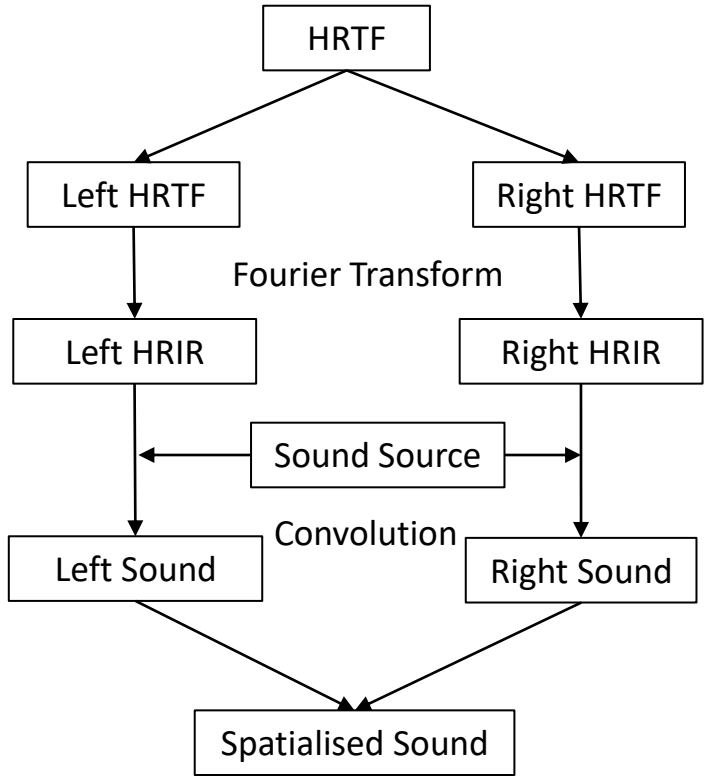


Haptic Feedback System – Difficulties

- Difficulty localising actuators at back of head
  - Difference between dynamic up and down
  - Not universal
- Alternative: use static patterns
  - Same issue would still exist but could be learnt

Auditory Feedback System - Progress

- Individualising HRTFs
  - Tournament style
  - Anthropometry
- Integrated with SLAM mapping
- Obstacles mapped via SLAM
- List of obstacles ‘announced’
- Fine localisation
  - Use beeps to help locate obstacles very close by



Auditory Feedback System - Difficulties

- Individualising HRTFs is challenging
- Update body position between each landmark
- Body position update not fast enough
  - SLAM updated to use odometry in cameras

Overall System – Progress

- Integrated haptic feedback and auditory feedback
  - Haptic guides to target
  - Auditory announces obstacles within certain distance
- Next step: visual simulation using oculus

Key Dates

		14-Feb-22	21-Feb-22	28-Feb-22	07-Mar-22	14-Mar-22	21-Mar-22	28-Mar-22	04-Apr-22	11-Apr-22	18-Apr-22	25-Apr-22	02-May-22	09-May-22
Haptic Feedback	Determine evaluation method and metric													
	Chose actuator type													
	Investigate static vs dynamic pattern type													
	Consider path guidance													
	Integrate with SLAM system													
	Project seminar													
Auditory Feedback	Determine evaluation method and metric													
	Research methods for implementing individualised HRTFs													
	Implement viable methods from research													
	Test and evaluate implemented methods													
	Integrate with SLAM system													
	Project checkpoint													
Participant Testing	Start preparations (IRB, participant acquisition)													
	Determine evaluation method													
	Participant testing													
	Final report													
	Final presentation													

Key Dates

today

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	Integrate Haptic and Auditory feedback with SLAM system													
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Documentation

- System requirements
- Required libraries / packages to be downloaded
- Structure of code
- Pseudo code / explanation of functions