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RETINA AUSTRALIA 2021 RESEARCH GRANT: FINAL REPORT

Project Title: Improving Sensory Substitution Low Vision Devices Through Novel Software Adaptations

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Project Synopsis

A number of sensory substitution devices (SSDs) have been developed for people with low vision. These devices translate information from the environment, such as the location of obstacles or people, into auditory or tactile feedback. Whilst promising, these devices have met with varying success and uptake by end-users. One of the challenges is that the visual environment is very complex, and it can be difficult to translate that into simple tactile or auditory input. Our team have expertise in both surgically implanted devices (i.e. the bionic eye) and non-interventional low vision devices. The aim of this study was to use the multidisciplinary skillset of our team to investigate the efficacy of several SSDs, and then to improve their function using novel software adaptations.

In the original project proposal, submitted towards the start of the COVID-19 pandemic, we were optimistic that we would be able to complete human research studies within the grant period. Obviously, due to lockdowns and other restrictions through 2020-22, this was not the case. To pivot, we altered our plan to involved three sub-studies (two not requiring face-to-face contact), all now completed:

1. Collaborative study with Vision Australia on the mobility needs and goals of people with low vision, using data collected on the Canadian Occupational Performance Measure (COPM; n=200).
2. An online survey for Australian people with legal blindness, to gauge current mobility use, knowledge of and interest in SSDs (n=53)
3. In early 2022, after COVID restrictions eased, we completed a human trial of a tactile SSD called the VibroSight (Bionic Vision Technologies, Inc., Sydney, Australia; n=11).

Results

Study 1: Identification of Mobility Goals Using the Canadian Occupational Performance Measure

In this study, we collaborated with Vision Australia to access anonymised, retrospective Canadian Occupational Performance Measure (COPM) data from 200 people with low vision. The COPM is an interview-based tool which allows people to identify their main rehabilitation goals. The tool covers three main topics including self-care (i.e. personal care, functional mobility, community management), productivity (i.e. work, household, school) and leisure (i.e. recreation and socialization).

Of the randomly-selected 200 participants, 114 were female (57%), with age ranging from 3 years to 103 years. The causes of vision loss were also broad, with the most common condition being age-related macular degeneration (22%). Around 5% of the cohort had inherited retinal diseases.

From this data, we used qualitative research techniques to code the data, resulting in main themes for both indoor and outdoor mobility. We found that the most common goal in indoor mobility was to feel safe, whereas outdoor goals were more often about feeling confident and independent (with safety also scoring high). We will utilise this data to direct the development of future mobility research, and also publish the findings in a scientific paper, hence providing more evidence on the use of COPM for people with low vision (paper currently being drafted).

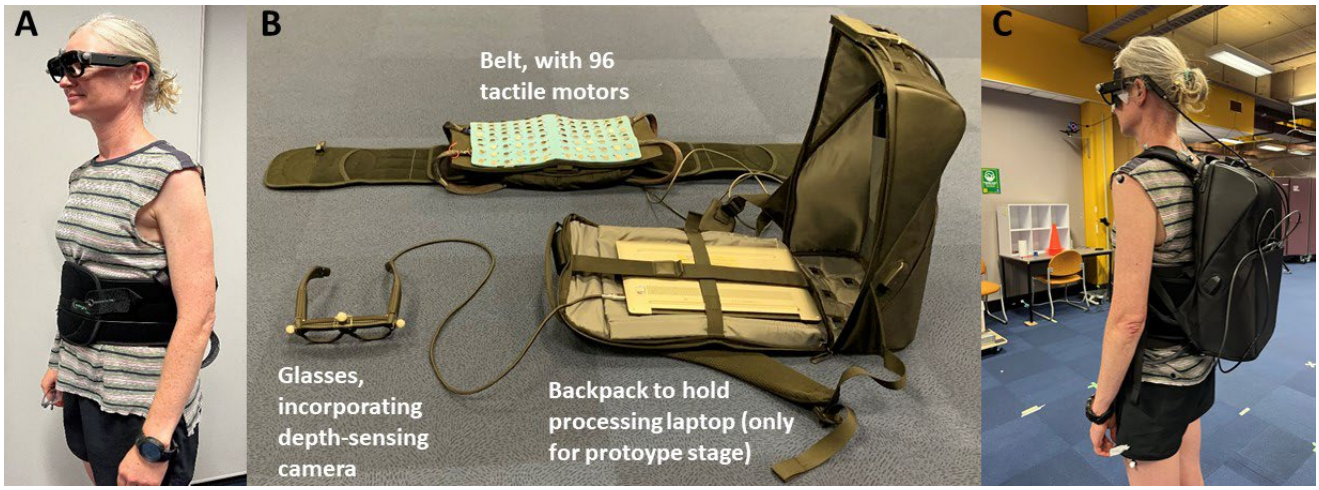
Study 2: Online Survey of Mobility Use and Knowledge and Interest in SSDs

This survey was completed online between 10 May and 10 August 2021. The questions covered: 1) general demographics, 2) current mobility aids, 3) advantages and disadvantages of current aids, 4) rankings of the importance of certain features of mobility aids and 5) knowledge of and interest in SSDs.

Fifty-three participants completed the survey (roughly half under 55 years, and half older). Around half used a long cane as their primary mobility aid. The most problematic situations for people with mobility aids were crowded places, when stepping down steps and curbs, and when doing exercise. Around one-third of participants had used an SSD before, one-third had heard of them, and one-third had never heard of them. In general, people were more keen to try audio-based SSDs than body-worn tactile devices, but were also quite interested in smaller tactile devices, such as a vibrating wristband. This data will direct the development of future SSDs, and will also be written up in the peer reviewed literature to assist other researchers and product developers in the field.

Study 3: Laboratory-Based Study of the VibroSight SSD (vision-to-tactile device)

Despite the restrictions on face-to-face research for most of the grant duration, we were able to do one study assessing functional vision and mobility with the VibroSight device. The VibroSight is a belt worn around the torso, with 96 vibrating motors that can provide spatially ordered information about obstacles in a person's environment. The device software has been optimised through collaboration with investigator A/Prof McCarthy to improve depth perception and face recognition. This device was trialled in 11 people (7 with low vision, and 4 orientation & mobility instructors wearing a low vision simulator). The data from this study is currently being analysed, and will be published in the near future. The findings will also directly influence the next phase of the device development, and we have plans to be involved in the clinical testing of the next device prototype.



Conclusion

Despite the challenges of the COVID-19 pandemic, the work has progressed well, and we are now planning further mobility trials with other SSDs. We are currently writing up all three studies for academic publication (anticipating three peer-reviewed publications from this work). In addition, PhD student Rui Jin will present the findings at the upcoming University of Melbourne Graduate Student conference. We have been able to forge a new industry collaboration this year with Bionic Vision Technologies (Sydney, Australia), enabling us to test the novel VibroSight SSD in our laboratory setup. This will hopefully lead to new industry opportunities in the future. We would like to take this opportunity to thank Retina Australia and the donors for making this work possible, and look forward to sharing more of this work in the future.