Blind in a Virtual World: Mobility-Training Virtual Reality Games for Users who are Blind

Shachar Maidenbaum[1] Amir Amedi[2]
Hebrew University of Jerusalem, ELSC, IMRIC, Israel

ABSTRACT

One of the main challenges facing the practical utilization of new assistive technology for the blind is the process of training. This is true both for mastering the device and even more importantly for learning to use it in specific environments. Such training usually requires external help which is not always available, can be costly, and attempts to navigate without such preparation can be dangerous. Here we will demonstrate several games which were developed in our lab as part of the training programs for the EyeCane, which augments the traditional White-Cane with additional distance and angles. These games avoid the above-mentioned problems of availability, cost and safety and additionally utilize gamification techniques to boost the training process. Visitors to the demonstration will use these devices to perform simple in-game virtual tasks such as finding the exit from a room or avoiding obstacles while wearing blindfolds.

Keywords: Universal access; Sensory substitution; blind; Virtual reality; navigation; scene recognition assistive technology

Index Terms: B.4.2 Input/Output Devices: Image display; H.1.2 User/Machine Systems; H.5.2 User Interfaces: Auditory (non-speech) feedback;

1 KEY POINT OF THE DEMO

Using a virtual version of the EyeCane mobility device for the blind demonstrate how:

1. Even a limited amount of additional information can significantly boost accessibility of virtual environments without vision, and do so with minimal training and experience.
2. Virtual use of assistive technology for the blind can train you also for the real world both by enhancing general skills with the device and learning specific environments.

2 MOTIVATION, APPLICATION AND NOVELTY

The main mobility tools used by the blind population today are the White-Cane and the Guide Dog. While in wide use even these devices are not used or used only in a limited fashion by many blind people, mainly due to issues with the training process such as availability, cost and safety, especially as such training is often required for every new environment they venture to. These factors limit also the ability to offer practical use of new assistive tools. These problems are even greater when attempting to use new mobility devices, which do not have even this limited level of support and training available [1].

Emails:
[1]Shachar.maidenbaum@gmail.com
[2]amira@ekmd.huji.ac.il

IEEE Virtual Reality Conference 2015
23 - 27 March, Arles, France
978-1-4799-1727-3/15/$31.00 ©2015 IEEE

We have recently developed the EyeCane, a simple mobility aid for the blind which offers the distance to the object the device is pointed. The EyeCane augments the traditional White-Cane with additional angles and distance and does so non-obtrusively, i.e. does not require constant collisions with the environment to detect it. Rather it uses a series of auditory cues transforming distance to cue rate and frequency. We have previously shown with both blind and blindfolded-sighted user groups that even after only 5 minutes of training users can navigate in simple environments, avoid obstacles, find doors and objects and more [4-5].

We then created a virtual version of this device for use within virtual environments and performed similar tasks there, including simple navigation and shape recognition [6]. We also comparatively explored the mobility patterns in virtual environments of EyeCane users vs. White-Cane users, users without assistive technology and users who performed the task visually and found that the additional distance offered by the EyeCane shifts paths from being similar to the device-less and White-Cane groups to the being similar to the visual group [7].

As part of the work on the EyeCane we have expanded these virtual experiment into a series of training sessions in rising difficulty. This training program joins the current trend in the field of virtual rehabilitation and suggests the use of computer games in virtual reality as a way to mitigate these issues as they are available at one's own home, have a much lower cost and do include safety issues. These games do not fully replace real-world training but rather significantly shorten the required real-world time by teaching the layout of new environments and boosting the users general skills with the device. The legitimacy of this approach has been shown repeatedly over the past decade [2, 3, 8].

Some of these basic levels can be successfully completed even with minimal training and are suitable as a conference demonstration. Visitors will receive a short explanation and then attempt to use the virtual version of the EyeCane to perform simple tasks such as finding the exit of a room while blindfolded.

3 AUDIENCE INTERACTION

Following a short 2-3 minute explanation visitors at the demo will sit in front of a computer screen and play simple games while blindfolded. These will include navigating down simple corridors, avoiding obstacles and locating the exits of rooms non-visually.

The screen will be visible to enable the rest of the visitors to view the current users navigation progress.

Additionally, visitors will be able to experience the real-world version of the EyeCane and use it for simple tasks such as distance estimation and object location.

While explanations from the presenters would be useful the games will also have an inbuilt explanation and tutorial to enable independent function.

4 Link to video

The video will show an image of the EyeCane device, a flow-chart of its basic use and then navigation in an example level with annotated activity.

http://youtu.be/av2LLcjEQsY

5 The Amedi Multisensory Lab

We research the way the brain processes information from each sense and integrates them and the accompanying behaviour, and especially what happens when information comes 'from the wrong sense'. As part of this direction, the main component of the labs research is in the field of Sensory Substitution with emphasis on work with the blind.

The lab works in 3 different directions to achieve these goals. The first direction is to develop new Sensory Substitution Devices (SSDs) such as the EyeCane which converts distance into simple sounds and vibrations and the EyeMusic which converts whole-scene location shape and color information using complex musical soundscapes. For each of these devices a corresponding "virtual world" version has been developed.

The second direction focuses on behaviour in both real and virtual environments – how are these devices use? How do they affect users life? How can we use them for practical visual rehabilitation? How can we use them for increasing accessibility?

The third is focused on the neural basis of SSD usage using mainly fMRI, and employing virtual worlds within the fMRI scanner. Our work has demonstrated that many 'visual' brain areas such as the Visual-Word-Form-Area the Visual-body-shape-area and others are actually task and not sensory based.

The lab is headed by Professor Amir Amedi and currently has 2 postdocs, 8 graduate students and 8 undergraduate students. It is situated in the Hadassah Ein-Kerem Medical campus of Hebrew University in Jerusalem Israel.

Lab website: brain.huji.ac.il

6 Acknowledgements

The Amedi lab team. The European Research Council Grant (310809), the Israel Science Foundation (grant no. 1684/08), a James S. McDonnel Foundation scholar award (no. 220020284), The Edmond and Lily Safra Center for Brain Sciences (ELSC) Vision center.

References

[1] World Health Organization, (2012). Fact sheet no. 282.

[2] O. Lahav, “Improving orientation and mobility skills through virtual environment for people who are blind: past research and future potential,” in ICDVRAT 2012.

[3] S. Reardon, “Playing by Ear,” Science, vol. 333, no. 6051, pp. 1816-1818, 2011.

[4] S Maidenbaum*, S Hanassy*, S Abboud, G Buchs, DR Chebat, S Levy-Tzedek, Amedi A. The “EyeCane”, a new electronic travel aid for the blind: Technology, behavior & swift learning RNN 2014.

[5] G Buchs*, S Maidenbaum*, Amedi A. Obstacle Identification and Avoidance Using the 'EyeCane' EuroHaptics 2014.

[6] S. Maidenbaum, S. Levy-Tzedek, D.R. Chebat, and A. Amedi, “Increasing Accessibility to the Blind of Virtual Environments, Using a Virtual Mobility Aid Based On the,” PloS one, vol. 8, no. 8, pp. e72555, 2013.

[7] S Maidenbaum, S Levy-Tzedek, DR Chebat, R Namer-Furstenberg, and A Amedi. The Effect of Extended Sensory Range via the EyeCane Sensory Substitution Device on the Characteristics of Visionless Virtual Navigation. Multisensory Research, 27(5-6), 379-397. 2014.

[8] LB Merabet, EC Connors, MA Halko, and J Sánchez. Teaching the blind to find their way by playing video games. PloS one, 7(9), e44958. 2012.

[9] O Lahav, DW Schloerb, and MA Srinivasan. Virtual Environments for People Who Are Visually Impaired Integrated into an Orientation and Mobility Program. Journal of visual impairment and blindness, 109. 2015.