Smart glasses to help the blind to see

UNIVERSITY OF OXFORD
Stephen Hicks and Iain Wilson
stephen.hicks@ndcn.ox.ac.uk
Nuffield Department of Clinical Neurosciences

NHS National Institute for Health Research
i4i Invention for Innovation
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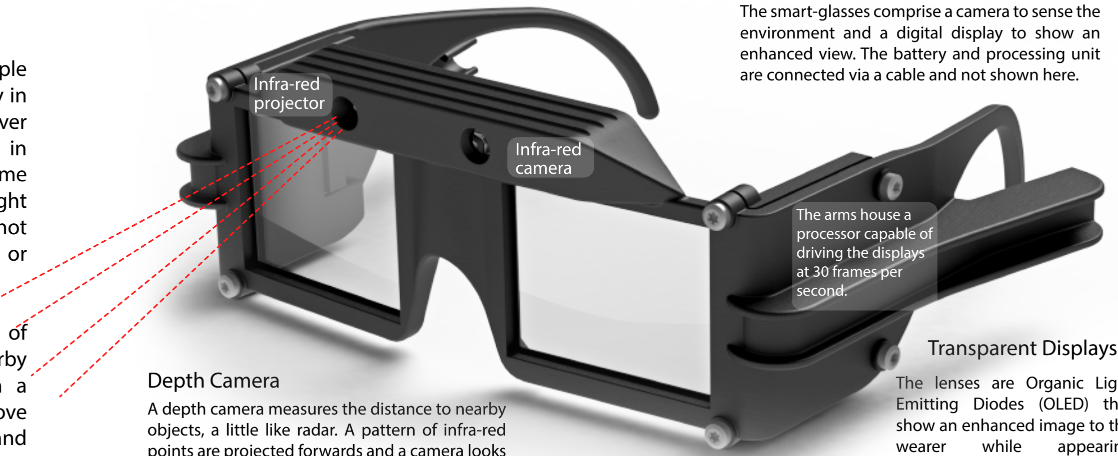
Introduction

According to the RNIB, 100 people start to lose their vision every day in the UK. Right now there are over 300,000 registered blind people in the UK. The majority have some vision, which is enough to see light and movement, but usually not enough to read, recognise faces or walk independently.

We have built and tested a pair of smart-glasses that detect nearby obstacles and present them in a simple high contrast way to improve the way blind people see and interact with their environment.



The smart-glasses comprise a camera to sense the environment and a digital display to show an enhanced view. The battery and processing unit are connected via a cable and not shown here.

Depth Camera

A depth camera measures the distance to nearby objects, a little like radar. A pattern of infra-red points are projected forwards and a camera looks for changes in these points. These changes reveal the 3D structure of nearby objects.

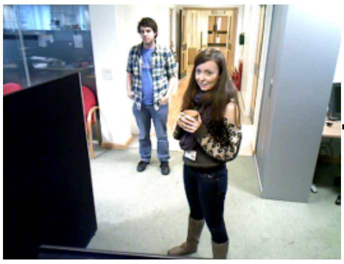
Transparent Displays

The lenses are Organic Light Emitting Diodes (OLED) that show an enhanced image to the wearer while appearing transparent to everyone else. This allows the eyes to be seen which is important for social interaction.

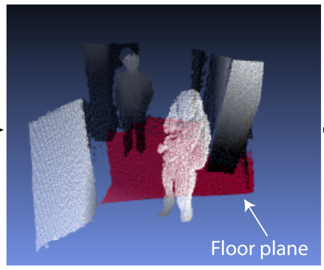
Computer Vision

A useful visual aid needs to be fast and intuitive. Our algorithms build, process and update 3D models of the local environment in essentially real time. Nearby objects shown as bright regions of light and distant objects or clear paths are shown as dark. The floor plane is detected in order to emphasise trip hazards and steps.

Conventional image



3D data

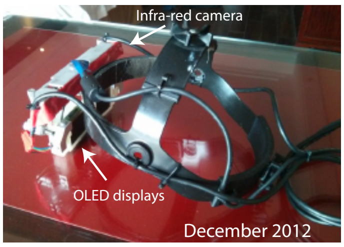


The 3D data allows us to segment objects, emphasise nearer ones and boost their contrast against the floor.

Depth-to-brightness display

The result is an intuitive high-contrast image that can be easily seen with residual vision. This image is displayed on the lenses.

Prototype Development



December 2012

December 2013

Over the last 12 months we have made a number of prototypes. Our most recent has a 3D printed frame and transparent OLED displays.

Quotes from participants using the glasses for the first time

"Gosh, it's my leg!", upon seeing their own legs for the first time in years.

"There you are girl.", said one man on seeing his guide dog.

"Wow I'm impressed." Participant reported that she could now detect which arm was being waved from several metres away.

"Better than my retinal implant." Participant continued that if this was available four years ago he would have chosen it over an implant.

User trials

Sixteen blind and partially-sighted participants took part in a mobility study using an earlier opaque version of our glasses. We asked participants to navigate an obstacle course with and without the glasses.

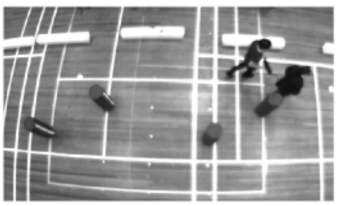


Image taken by the ceiling-mounted tracking camera as a participant navigates the course.

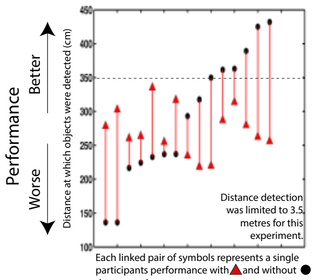
Results

All participants could use the glasses to report when they faced an obstacle. The majority could see people up to 5 metres away and navigate around obstacles with fewer collisions.

Collisions

The percentage of trials that resulted in collisions dropped from 34% to 3%.

Detection distance



Each linked pair of symbols represents a single participants performance with ▲ and without ● the smart glasses.

Participants who previously could only detect objects at close range (or by touch) were now able to detect them up to 3 meters away.

Conclusion

Mobility can be improved for many blind and partially-sighted people with these glasses.

The components used are all freely available which should allow us to produce these glasses affordably on a large scale.

We are now exploring computer vision techniques to allow the glasses to detect and decode meaningful objects, such as signs, bus numbers and faces. This should help increase the usefulness of the glasses and increase independence in the wide range of situations faced by blind and partially sighted individuals.

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