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Computer Graphics Research May Lead to Electronic Eyes

By Archives
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Computer graphics simulations at Cornell may lead to improved vision for people affected by low vision disorders such as glaucoma, cataracts and macular degeneration.

Thanks to a three-year, $450,000 grant from the National Science Foundation's Information Technology Research program, James Ferwerda Ph.D. '98, is creating computer models to simulate the way people with low vision see the world.

Using the models, Ferwerda, a psychologist and a research associate in the Computer Graphics Program, plans to create assistive technologies, such as web browser enhancements that will help people read, and small hand-held devices that will process images of the real world into a format that will allow people to move around more easily.

"The most challenging part for me will be that we do it right, that the models we make will reflect the actual problems people have," Ferwerda said.

To make sure that happens, Ferwerda will collaborate with Gordon Legge, the distinguished McKnight University Professor of Psychology at the University of Minnesota and director of the Minnesota Laboratory for Low-Vision Research, who will test the models and simulations on human volunteers.

"We will see if there is a correlation of the way people with normal vision navigate the world [under simulated low-vision] to the way people with actual low vision navigate the world," Legge said.

The project is also supported by the Cornell Program of Computer Graphics, founded and directed by Donald Greenberg, the Jacob Gould Schurman Professor of Computer Graphics.

Low vision, which is defined by Ferwerda as vision that can't be corrected to normal, affects about 10 million people in the United States.

According to Ferwerda, low vision disorders such as glaucoma, cataracts, and macular degeneration produce very specific deficits.

With glaucoma, a person loses peripheral vision, which leads to "tunnel vision." Cataracts causes a general loss of contrast and macular degeneration results in the loss of detail in the central part of the visual field.

Many psychology textbooks include illustrations showing how people with low vision see the world. However, "most of the conventional drawings and descriptions of low vision are fairly inaccurate," Legge said.

For example, people with macular degeneration don't see a dark spot in their visual field. Instead, the brain fills in the missing visual information and the person sees a poorly detailed image. Similarly, people with glaucoma don't see a dark area in their peripheral vision, but instead have trouble orienting themselves in their surroundings.

Therefore, to create accurate models, Ferwerda will use data taken from clinical studies of people with low vision.

Using those models, it should be possible to process images to compensate for the exact defects suffered by a person.

"The models will be general enough to be tailored to individuals," Ferwerda said.

Although assistive technologies for low vision sufferers currently exist, most of them are magnifiers, telescopes or other optical devices that rely on prisms to shift an image to a different part of a person's retina.

Ferwerda's idea is to create hand-held devices that rely on micro-displays, which allow high definition images to be displayed on very small screens.

A person would look into the device and see a scene that is modified in some way. It could be shifted so it projects onto a different part of the retina, displayed in higher contrast or even have an outline of the scene added onto the image.

In addition, each device could be personalized, just like prescription lenses are distributed today. The technology could also be used in web browsers to allow low vision users to more easily view web content.

"I think it has great potential for useful applications," Legge said.

Archived article by Luke Hejnar

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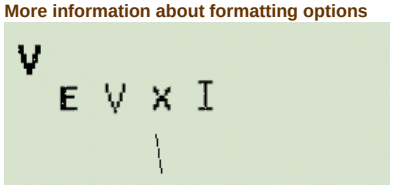

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