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The Seeing Machine Camera: An Artistic Tool for the Visually Challenged Conceived by a Visually Challenged Artist

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Although sensory inputs include auditory, olfactory and tactile stimuli, many regard visual stimuli as the predominant signal for human orientation. Vision does not merely constitute the phenomenon of visible light triggering our nervous system; it is a multidimensional perceptual experience that allows us to become conscious of the environment, to construct our reality and to determine a sense of self.

Along with the graying of society, an increasing number of persons are experiencing the onset of severe vision impairment. According to the National Center for Health Statistics, the number of Americans with visual impairments has grown to 25 million, and almost 70% of these individuals are over the age of 45 [1]. This number does not take into account natural vision changes that come with aging and are easily corrected with reading glasses or conventional eyeglasses. The major causes of vision loss in the adult population are diabetic retinopathy and age-related diseases, such as cataracts, glaucoma and macular degeneration, many of which either are only partially treatable or have no known cure.

Individuals suffering from these conditions may face the inability to perform routine tasks of living and a loss of independence and visual interaction with family members and friends.

Many tend to confine themselves to known environments and lack the confidence to venture to new places [2]. In some cases, individuals may lose visual memory, from the simplest recognition of letters in the alphabet to the recollection of an acquaintance's face.

Co-author Elizabeth Goldring, an artist and poet, believes that her persistent low vision should not be an obstacle to living a functional, artistically vibrant life, nor should it remove access to aesthetic enjoyment. She founded the Vision Group at the Center for Advanced Visual Studies (CAVS) at the Massachusetts Institute of Technology (MIT) with the goal of studying perceptual and artistic awareness in order to design machines that extend sentient, creative capabilities for visually challenged persons. The research of this transdisciplinary team of artists, scientists, engineers, physicians and students from MIT and Harvard University bridges domains of art, science and technology, often producing projects that are defined not only as technological devices but also as artistic tools that could help people communicate and express themselves in new ways.

ABSTRACT

The Vision Group at the Center for Advanced Visual Studies (CAVS) at the Massachusetts Institute of Technology (MIT) has developed the Seeing Machine Camera (SMC) under the direction of Elizabeth Goldring, a visually challenged artist. The SMC is an innovative tool that enables artistic expression for those with decreased vision. The camera enhances the ability to see the face of a loved one, look at a painting in a museum, photograph landscapes or create digital artwork. For visually challenged artists who may feel isolated from their visual world, the SMC provides an opportunity to connect to the people around them, enjoy a greater sense of independence and expand their creativity.

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Group web site: <<http://web.mit.edu/veb/intro.html>>.

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Fig. 1. The Seeing Machine Camera can be connected to a standard video source, such as a digital camera (shown) or a computer. It is portable and easy to use. (© E. Goldring. Photo © Stephanie Lin.)





Fig. 2. A sighted person's perception of a face [8]. (Photo © E. Goldring)

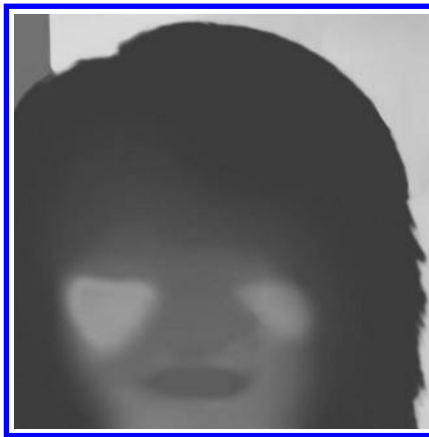


Fig. 3. Goldring's perception of the face shown in Fig. 2: she sees in blobs of solid colors but cannot distinguish detailed facial features [9]. (Photo © E. Goldring; digitally altered by Quinn Smithwick.)



Fig. 4. Goldring's perception of the face shown in Fig. 2 when using the Seeing Machine Camera: she is able to perceive enough details to recognize the identity of the model [10]. (Photo © E. Goldring; digitally altered by Quinn Smithwick.)

With the insight Goldring provided into the needs and concerns of those with severely limited vision, the CAVS Vision Group has recently developed the Seeing Machine Camera (SMC). The SMC is a device that allows sight-impaired persons to live with more independence. It is furthermore an instrument for creative inquiry, experiences and artwork. The SMC offers two-way visual communication that includes both the active looking toward the outside world and the passive receiving of projected feedback. The artistic expressions of the seeing-disabled could reveal reflections not previously captured and encourage creative explorations. Ultimately, the SMC could serve as a first step toward improving the quality of life for those now isolated from the visual world.

THE INNOVATION

While conventional low-vision aids, such as magnifying glasses or video magnifiers, can bring some life enhancement to people by allowing them to effectively use any existing vision, magnification is often not useful with advanced visual impairments. In the latter case, the images seen through low-vision aids may encounter poor-quality ocular media opacity, such as cornea and lens, or visual changes caused by retinal diseases, such as distorted views and blanked-out areas. The resulting visual resolution and blurred images hence remain problematic. Exotic alternatives, such as Scanning Laser Ophthalmoscopes (SLO), can bypass the effects of cornea and lens diseases by scanning a laser beam through a tiny point in the eye, drawing an image directly on the remaining healthy retina [3]. These devices, however, are expen-

sive and require sophisticated and sensitive laser-scanning systems.

Using liquid crystal display (LCD) and light-emitting diode (LED) technologies, the CAVS Vision Group was able to design a device that integrates the portability and affordability of common low-vision aids with the high functionality of scanning laser devices. The SMC works on the same principle as the SLO by projecting images directly onto the retina, thus enabling the user to see subjects with sufficient clarity to frame and compose scenes. The SMC connects to standard video sources (e.g. video output from a digital camera, television or computer), the signal of which is fed to a micro-display illuminated by a white collimated LED. The SMC focuses the light entering the viewer's pupil into a single point, bypassing the scattering and distortion of the visually impaired eye, and casts a brighter image directly onto the retina. The user is then instinctively able to center the portion of the remaining healthy retina with the highest visual acuity on the image. Additional magnification or image processing of the color video signals, such as increasing contrast and enlarging details, can be applied for further enhancement. To operate the lightweight and easy-to-use prototype, the user can either hold it by hand or mount it on a flexible tripod, as shown in Fig. 1.

The SMC is not intended for use as a reading or active navigation aid but rather as a complement for aesthetic viewing needs, such as seeing the face of a loved one or a distant landmark or studying a painting or sculpture in a museum. It can also be connected to a computer, allowing the viewer to visit unfamiliar places via a virtual environment

or to browse on-line image and video galleries. More than just a tool used to see and enjoy art, the SMC allows visually handicapped artists to continue expanding their creative vocabulary (e.g. through photography and digital works of art). Visual explorations of ranges and limitations of perceptive capabilities using the SMC could further inspire new types of artwork, especially for persons with visual challenges.

THE EVIDENCE

Our group conducted clinical trials involving patients suffering from various eye diseases to examine the physiological and receptive effects of the SMC. Improvements in subjects' visual performances when using the SMC can be seen in both the quantitative data from the trials and the qualitative results, including visualization of what the users see and anecdotal testimony.

Objective Clinical Trials

A pilot clinical trial involving an earlier version of the SMC was conducted in 2005 at Joslin Diabetes Center's Beetham Eye Institute [4]. The black-and-white desktop prototype demonstrated that the technology can be used to help the visually impaired to read specially designed word images or take a virtual walkthrough of an architectural space. Most of the 10 participants with a visual acuity of 20/70 or less believed that the SMC allowed them to see things they would otherwise be unable to see. In a survey taken after the trial, they further reported that the machine may have the potential to assist their mobility in unfamiliar environments.

After receiving approval from the In-

Table 1. Results of 20 subjects identifying the positions of geometric figures placed 10 feet away.

Answers	Unaided Eye	Camera	SMC
Correct	19	20	20
Incorrect	1	0	0
% Correct	95.0%	100%	100%
% Incorrect	5.0%	0.0%	0.0%

stitutional Review Boards at Joslin Diabetes Center and Massachusetts Institute of Technology to recruit subjects, we performed another clinical trial in 2009, testing the ability of the present handheld prototype to improve each subject's performance in common photography tasks related to viewing, composing and framing scenes and subjects. We compared these task results to those obtained using a digital camera's LCD display, as well as to results with unaided eyes. All subjects with visual acuity of 20/60 or worse caused by a variety of eye diseases, including diabetic retinopathy, retinal detachment and Stargardt's disease, exhibited improvements in identifying geometric figures, a model's orientation and especially small details in facial features (Tables 1 and 2). In subjects using the SMC, an average 250% increase in correctly answered questions was seen compared with results with the naked eye and an average improvement of 61% was seen compared with results using a commercially available digital camera. Most of the subjects also displayed greater confidence and required shorter response time when using the SMC. For details in the methods and results of the latest clinical trial, see the Appendix.

Anecdotal Evidence

Apart from the test data and analysis, user feedback gave valuable insight into the visual enhancement possibilities of

the SMC. Many participants from the clinical trials described the hopelessness they constantly feel being visually challenged. It appears that using new technologies is especially difficult for these visually impaired individuals. The glare of LCD screens, the miniaturized size of buttons and the lack of tactile feedback from touchscreens are some of the factors that deter them from using commercial products. High definition television is not seen differently from normal television; cellular phones and music players, even those with low-vision features, do not work for them. A subject from the recent clinical trial commented that "the frustration is what's getting [to] you . . . just because you are visually impaired does not necessarily mean you are stupid."

Given prior negative experiences with electronic devices, the subjects were generally fascinated with the ease of use of the SMC. One participant from the pilot study told us, "[I have] tried every seeing aid available, and this machine [early prototype] was by far the best, even in this rough, rough shape." Another participant of the most recent trial indicated, "I know [the model] is there but it is a blur, and I can't see anything else . . . but when I look through [the SMC], you are as clear as a doll!" The participants expressed great pleasure when seeing small details of facial features. "[The model] is smiling, I can see some of her teeth . . . she just blinked!" Exclaimed one participant, "If I didn't have [the SMC] on my eye, I couldn't see it." Family members of the subjects were also thrilled with the results. One said of her friend, "His vision is bad, so he can't tell one person from another. It is amazing for him to see anything at all with [the SMC]."

Visualization

To further understand the extent of the SMC's performance, the CAVS Vision Group attempted to simulate the sight of the visually impaired with and with-

out the SMC. The inability to distinguish a person's features is one of Goldring's greatest challenges. To illustrate this difficulty experienced by Goldring, we took a photograph of a model's face (Fig. 2) then iteratively altered it with Adobe Photoshop according to Goldring's description of what she saw [5]. Due to vision loss resulting from diabetic macular edema, proliferative diabetic retinopathy and glaucoma, Goldring cannot distinguish detailed facial features such as a person's eyes and nose under normal lighting. As shown in Fig. 3, she viewed the model in blobs of solid colors separated by distinctive borders. When Goldring looked through the SMC, however, she could better perceive the model (Fig. 4). Although the eyes and mouth were in shadows and details of the hair and skin were still blurry, Goldring was able to see clearly enough to recognize the model's identity. "Wouldn't this alone make the Seeing Machine Camera worthwhile?" Goldring posits.

THE ART

As Claude Monet, Edgar Degas, Esref Armagan and many others have done, Goldring wished to continue creating artworks despite visual impediments. The SMC has the potential to help visually disabled artists to mitigate "bad" seeing while providing new venues for creativity. Photography was one of the media arts that Goldring explored as an independent, visually challenged artist. In addition to viewing details in the landscape, the SMC allowed her to frame, capture and compose her photographs, as shown in Fig. 5. The ability not only to see something but also to freeze the image and revel in the meaning it carries at that particular time and space is invaluable to Goldring. "Blind people . . . may have a lot of pent-up desire to express themselves visually," Goldring explains, "and [the SMC] is a first step to attaining that desire."

Table 2. Results of 20 subjects answering questions about the appearance of a model.

Answers	Unaided Eye				Camera				SMC			
	Position	Accessory	Eyes	Teeth	Position	Accessory	Eyes	Teeth	Position	Accessory	Eyes	Teeth
Correct	18	20	4	3	19	16	7	9	20	18	14	11
Incorrect	1	0	0	1	1	2	3	5	0	2	0	4
Unsure	1	0	16	16	0	2	10	6	0	0	6	5
% Correct	90%	100%	20%	15%	95%	80%	35%	45%	100%	90%	70%	55%
% Incorrect	5.0%	0.0%	0.0%	5.0%	5.0%	10%	15%	25%	0.0%	10%	0.0%	20%
% Unsure	5.0%	0.0%	80%	80%	0.0%	10%	50%	30%	0.0%	0.0%	30%	25%



Fig. 5. A photograph Goldring took using the Seeing Machine Camera. (© E. Goldring)

For years, Goldring has been working on a unique art form that she calls the “retina print” [6,7]. The retina print appears as a composite of retinal images captured using the SLO and photographs. The prints both demonstrate the way an afterimage remains in one’s visual memory and refer to the presence of a bold impression left by a single image scanned on the retina. They often convey how Goldring sees the world, in addition to the fear and frustration she

feels due to her acute low vision. Goldring took many of the photographs used in her retina prints without seeing what she was capturing. The SMC has enabled her to be more conscious of what she is photographing. Connecting the SMC to a computer can also ameliorate the difficulties she experiences in working on the prints digitally. Figures 6–8 and Color Plate D No. 1 are examples of retina prints created by Goldring.

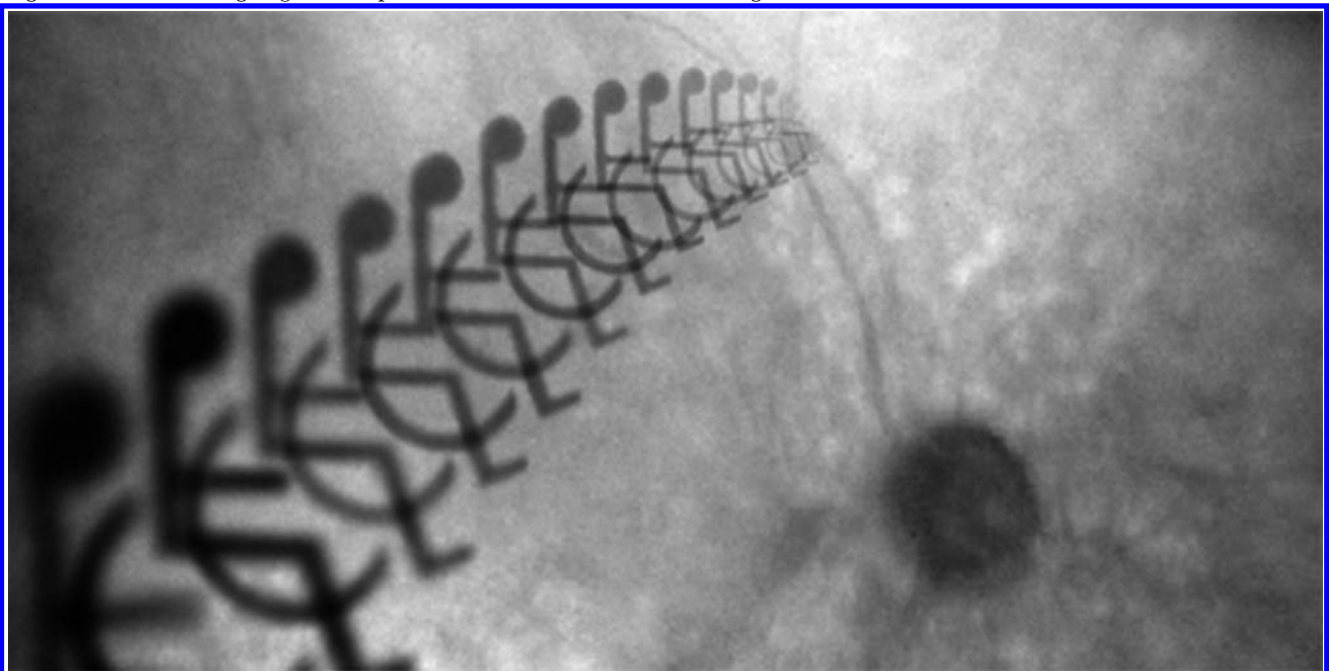
The SMC can open doors to other art

forms and activities. Goldring’s retina prints are just one example of visual artwork created by a legally blind person. Participants from the latest clinical trial expressed hope of once again engaging in activities they used to enjoy, such as attending a play at the theater, reviewing old recipes or reading hymn books. One 90-year-old woman, a former dancer, wished to use the SMC to watch her granddaughter’s dance recital so she could comment on the performance and dance techniques. Another individual hoped to regain the ability to design her own greeting cards. As a tool for artistic exploration, the SMC allows those who are eager to embrace new aesthetic experiences or express themselves visually to realize creative ambitions in spite of their inability to see.

THE FUTURE

Based on the feedback from the latest clinical trial, the CAVS Vision Group is working on the redesign of the SMC for better ergonomics, ease of use and functional flexibility. The new prototype could help produce and inspire works of art that were not possible using previous versions. Possible ideas include binocular-shaped, head-mountable or arm-mountable devices. Functions such as voice control and audio feedback may be advantageous. The CAVS Vision Group will expand the testing of the new prototype to explore the efficiency of the SMC with respect to other visual impair-

Fig. 6. Elizabeth Goldring, *Logos*, retina print, 24 × 55.75 in, 2001. (© E. Goldring)



ments. Clinical trials and long-term tests will involve patient populations with a diversity of eye diseases in low vision centers, rehabilitation centers and senior homes, resulting in improvements to the SMC.

The CAVS Vision Group is working in collaboration with the world-renowned theater producer Robert Wilson on a low-vision robotic stage production inspired by the SMC. The “eye-robot,” an amplified version of the SMC, will serve as a guide and mediator between the fully sighted and the seeing impaired. On the one hand, the eye-robot enables seeing-handicapped actors to see the world around them; on the other hand, the eye-robot shows a sighted audience what it is like to be severely visually challenged. The prototype eye-robot was taken to Wilson’s Watermill Center on Long Island for a weeklong workshop in the summer of 2010. Ideas generated by the workshop inspired a preliminary sketch of a stage production, with the working title “My New Friend Su: The Moon’s Other Side.” As of November 2011, Wilson was continuing the workshop production as an artist-in-residence at MIT. The CAVS Vision Group is currently developing a second eye-robot, whose function is to open a dialogue between the visually challenged and the

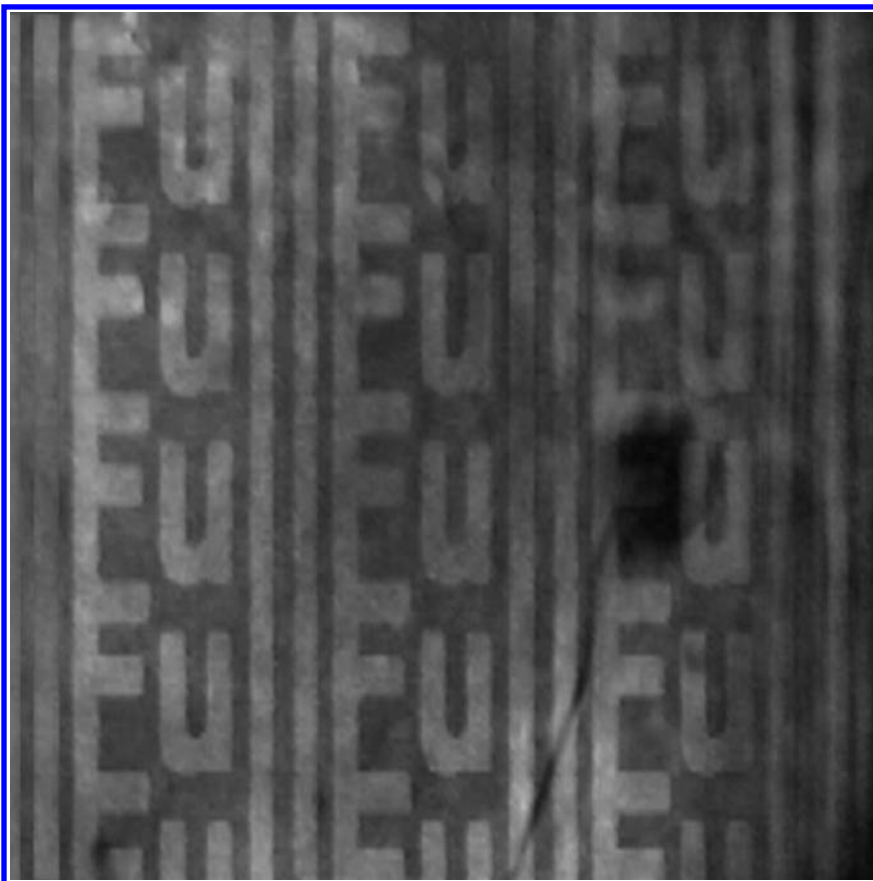


Fig. 7. Elizabeth Goldring, *Full on Goldring's Retina*, retina print, 21 × 20 in, 2001. (© E. Goldring)

Fig. 8. Elizabeth Goldring, *Descent*, retina print, 19.25 × 30 in, 2001. (© E. Goldring)



fully blind. This project has the potential to create an awareness of the psychological impact of vision and the loss of it, as well as to be useful in the development of effective low-vision aids.

Further investigations into other artistic uses of the SMC will be conducted, particularly related to on-line media. The SMC endeavors to allow the visually impaired to actively use and stay in stride with rapidly advancing information technology. Those who were once discouraged from using new technology may also utilize the SMC to keep up with future advances for the benefit of the blind or almost blind. Eventually, the SMC could be used to connect artists and provide impetus to a burgeoning global visual art culture in the low-vision community.

APPENDIX

For the most recent clinical trial, in 2009, we obtained approval from the Institutional Review Boards (IRB) of Joslin Diabetes Center and the Massachusetts Institute of Technology. A total of 20 participants, all of whom signed the IRB-approved informed consent, were recruited, ranging in age from 43 to 94 years. Eight (40%) of the subjects were men; two (10%) were African American and the remaining 18 (90%) were Caucasian. Subjects had visual acuity of 20/60 or worse, caused by diseases including diabetic retinopathy, retinal detachment and Stargardt's disease.

For each participant, we divided the session into two sections. Before the experiment began, participants were instructed on how to use the SMC, allowing practice time. In the first section of the study, participants were asked to identify the position of a series of three geometric figures (e.g. a triangle, a square and a circle) shown in black on a white background to maximize contrast. We asked participants to identify the location of one of the geometric figures a total of three times, in this order: (1) using the SMC, (2) using the camera LCD viewfinder and (3) using the unaided eye. In the second part of the experiment, participants were asked questions about the appearance of a model, including the orientation, presence of fashion accessory such as a hat or a scarf and facial expression such as open or closed eyes or mouth. Again, these tasks were completed first with the SMC, then with the camera's LCD viewfinder and finally with the subject's unaided eye. We changed the order of geometric figures and model's appearance for each view-

ing medium. We allowed the subjects to zoom in to up to 8x magnification using the camera and the SMC.

The results of the clinical trial exhibited the SMC's effectiveness in enhancing vision. Although the quantitative data in the first phase of the test showed only minor differences between the results with use of the unaided eye, the viewfinder or the SMC (Table 1), the subjects displayed greater confidence and required shorter response time when using the SMC. Subjects reported that the SMC allowed them to view the figures more clearly and with more distinctly defined edges. The contrast between the figures and the background may have contributed to the ease of identification. Other color arrangements and geometric shapes will be considered for future testing to better examine the SMC's capabilities as a low-vision aid.

The results from the second phase of the test presented more significant improvements with SMC usage, as shown in Table 2. When viewing small details of facial features, such as eyes, mouth and teeth, there was an average 250% increase in correct answers when using the SMC compared with the unaided eye and a 61% increase compared with using the camera. Furthermore, the "unsure" answers were reduced by an average of 65% compared to use of unaided eyes and 28% compared to use of the camera. The lighting at the testing site, the contrast between the model and the background, the glare of the camera LCD screen and the model's facial structure may have caused some visual confusion. We will take these external conditions into consideration in future testing.

References and Notes

Unedited references as provided by the authors.

1. Pleis J.R., Lucas J.W. Provisional Report: Summary health statistics for U.S. adults: National Health Interview Survey, 2008. National Center for Health Statistics. Vital Health Statistics 10 (242), 2009.
2. Goldring E., Cain J., Larson K., Price L., Smith L., Rayej S., Cavallerano J. "Enhanced Visual Experiences and Seeing Hardware for Reduced Vision," *Optometry: Journal of the American Optometric Society* 2006; 77: 88-92.
3. Webb R.H., Hughes G.W. "Scanning Laser Ophthalmoscope," *IEEE Transactions on Biomedical Engineering*, Vol. BME-28, No. 7, pp. 488-492, July 1981.
4. Goldring et al. [2].
5. Smithwick Q., Goldring E., Wu F.Y., Taylor B., "What do you see . . .," the World Technology Summit, 2009.
6. Goldring E., *Eye: Poems & Retina Prints*, BkMk Press, Kansas City, 2002.

7. Elizabeth Goldring has exhibited her retina prints at MIT, Harvard University, the University of Missouri at Kansas City, the University of Nebraska and at the Kunstverein in Jena, Germany.

8. Smithwick [5].

9. Smithwick [5].

10. Smithwick [5].

Glossary

diabetic macular edema—a collection of fluid in the macular portion of the retina associated with diabetic changes in the eye and resulting from leakage from small blood vessels within the eye damaged by diabetes. Macular edema is sight threatening when it involves or threatens to involve the center of the macula.

glaucoma—an eye disease usually, but not always, characterized by elevated eye pressure that results in damage to nerve fibers in the eye, leading to progressive and irreversible loss of vision.

proliferative diabetic retinopathy—a type of retinopathy associated with diabetes mellitus, characterized by proliferation of connective tissue and the formation of new blood vessels in the retina and by hemorrhages into the vitreous.

scanning laser ophthalmoscope—a clinical tool for capturing images of the retina or cornea in high spatial sensitivity. It is often used to diagnose retinal diseases such as glaucoma and macular degeneration.

visually challenged—while the minimum visual acuity requirement for unrestricted driving is 20/40 and legal blindness is characterized by best-corrected visual acuity of 20/200 or less in the better-seeing eye or a visual field loss of less than 20° in the better eye, low vision, or visually challenged, is defined at visual acuity of less than 6/18. The designation 6/18 indicates that what the average person sees at 18 ft, the visually impaired person sees at 6 ft. The normal visual field is 120°.

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Her poetry, visual language, interactive installations, performances and video and audio works offer a bridge between seeing and unseeing.

CALL FOR PAPERS

Arts, Humanities, and Complex Networks

The Arts, Humanities, and Complex Networks 3rd Leonardo Satellite Symposium at NetSci2012 takes place Tuesday, 19 June 2012, at Northwestern University (Evanston, IL). The aim of the symposium is to foster cross-disciplinary research on complex systems within or with the help of arts and humanities.

The symposium will highlight striking examples where artists and humanities researchers make an impact within the natural sciences. Running parallel to the NetSci2012 conference, the symposium will provide a unique opportunity to mingle with leading researchers and practitioners of complex network science, potentially sparking fruitful collaborations.

In addition to keynotes and interdisciplinary discussion, we are looking for a number of contributed talks. Selected papers will be published in print in a special section of *Leonardo*, as well as on-line in Leonardo Transactions.

Confirmed keynote speakers: Burak Arıkan, Pedro Cano and Miriah Meyer.

Organizing committee: Maximilian Schich, Roger Malina, Isabel Meirelles and Cristián Huepe.

Attendance: Free of charge. As space is limited, we require registration. NetSci2012 attendees can register directly during main conference registration. For the NetSci2012 registration fee and deadline please see <www.netsci2012.net>.

In addition we will give out a limited number of free tickets via Eventbrite at <<http://ahcn2012.eventbrite.com>>.

In case of questions, please drop us a mail at <artshumanities.netsci@gmail.com>.