RETINA RESEARCH FOUNDATION
NEWSLETTER

Foresight for Sight
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Augmented Reality Glasses Help Low-Vision Patients

Image: Scott Song, USC Roski Eye Institute

Researchers at the USC Ginsburg Institute for Biomedical Therapeutics have developed a pair of augmented reality (AR) glasses to help visually impaired patients navigate their surroundings and perceive depth more clearly.

The glasses are designed to help patients with a degenerative eye disease called retinitis pigmentosa (RP). The condition causes progressive vision loss, particularly on the periphery of one's vision, and makes it difficult to see in low-light conditions. Patients with RP often experience tunnel vision and have trouble perceiving their 3D environment. Specifically, they struggle to grasp objects and avoid obstacles in their path, and these issues are worse at night.

The AR glasses, customized by Anastasios Nikolas Angelopoulos and Dr. Mark Humayun, help solve the depth perception problem by allowing patients to see a color-coded mesh on top of the objects in their surroundings. The colors correspond to depth, with objects closest to the wearer appearing white, followed by green, blue and eventually red for objects that are farthest away.

The augmented reality color mesh enhances the wearer's depth perception while still allowing the patient to see the true color and texture of an object through gaps in the mesh. This is important for patients because it allows them to interact with the world around them as normally as possible without having to sacrifice any of the perception they still have.

The device is still in development, but researchers hope these glasses will eventually help improve quality of life by allowing patients to return to their day-to-day activities safely and with more confidence and independence.

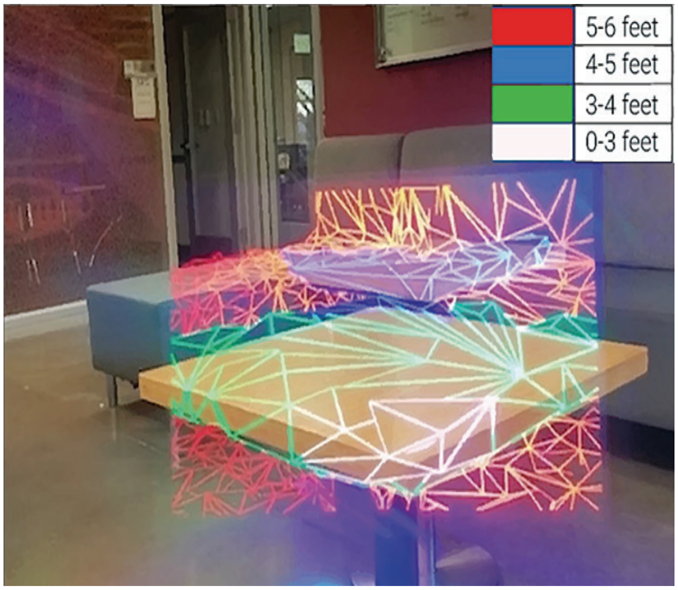


Image: Anastasios Nikolas Angelopoulos

Source: ibt.usc.edu/researchers-usc-ginsburg-institute-biomedical-therapeutics-develop-augmented-reality-glasses-help-low-vision-patients-navigate-environments/

Tackling the Root Cause of Treatment Resistance in Age-Related Macular Degeneration

By Ana María Rodríguez, Ph.D., From the Labs at Baylor College of Medicine, article excerpts

The leading cause of irreversible blindness in the elderly is an aggressive form of age-related macular degeneration known as choroidal neovascularization (CNV). The projected number of people with age-related macular degeneration is 196 million in 2020 and 288 million in 2040. Anti-vascular endothelial growth factor (anti-VEGF) has revolutionized the treatment for CNV; however, up to one-fourth of all treated patients are unresponsive to this treatment, and about one-third of the responders become resistant to it after repeated administration over time.

Dr. Yingbin Fu

Dr. Yingbin Fu, Baylor College of Medicine, and RRF Dana and Gil Petri Research Project researcher, has been investigating ways to overcome resistance to the promising anti-VEGF treatment. "Developing strategies to overcome the resistance has been limited by a poor understanding of its mechanism and the absence of suitable animal models," Dr. Fu said. "Researchers have explored various combination therapies in clinical trials. However, we still have not found a major breakthrough."

A new approach to combat anti-VEGF resistance

Dr. Fu and Dr. Longhou Fang, associate professor of cardiovascular sciences at Houston Methodist DeBakey Heart and Vascular Center, were inspired by previous work suggesting that macrophages may play a role in anti-VEGF resistance and that increased cholesterol accumulation in macrophages may promote CNV. Such cholesterol accumulation also has been associated with the formation of abnormal new blood vessels invading the retina, typical of CNV. These vessels leak, which promotes inflammation and rapid damage to photoreceptor (light-detecting) cells. In addition, the researchers had reported that AIBP promotes the removal of cholesterol from endothelial cells and macrophages, two cell types that are involved in the development of CNV. "Together, these observations suggested the possibility that AIBP might help overcome anti-VEGF resistance and effectively suppress CNV," Dr. Fu said.

To test their hypothesis, the researchers developed a mice model of anti-VEGF resistance. As they became older, the mice showed increased resistance to anti-VEGF treatment that correlated with increased intracellular cholesterol accumulation in macrophages. The researchers tested the effect of AIBP and anti-VEGF in disease progression in this mouse model.

The researchers provide strong evidence that the accumulation of cholesterol in old macrophages plays a central role in anti-VEGF resistance because the old mice became responsive to anti-VEGF treatment when macrophages were chemically depleted. In addition, they propose that the beneficial effect of AIBP is likely due to both its ability to enhance cholesterol removal from macrophages and its anti-inflammatory function. "Our findings encourage us to test the combination therapy of AIBP and anti-VEGF in clinical trials to determine whether it can help patients with the condition," Dr. Fu said.

Source: https://blogs.bcm.edu/2020/08/06/from-the-labs-tackling-the-root-cause-of-treatment-resistance-in-age-related-macular-degeneration/

RRF 2020 Pyron Award

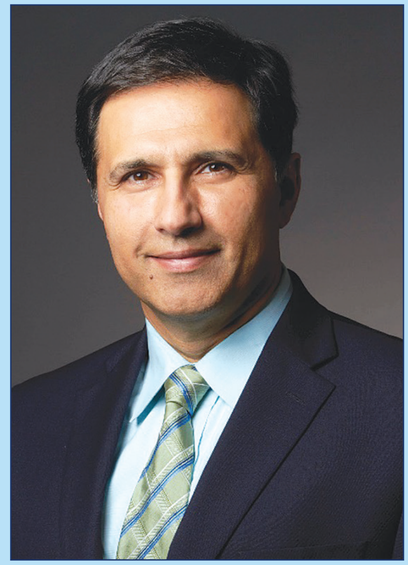
During the July virtual annual meeting of the American Society of Retina Specialists (ASRS), Dr. Mark Humayun was recognized as the RRF 2020 Pyron Award recipient. The Gertrude D. Pyron award was established to recognize outstanding vision scientists whose work contributes to knowledge about vitreoretinal disease.

Dr. Humayun considers the development of advanced implants for retinal diseases to be his major contribution to the field of visual sciences. Below are his comments on the subject.

"An example of an advanced implant is the bioelectronic implant Argus II; an epiretinal implant. The implant, placed on the top surface of the retina, uses controlled electrical pulses to stimulate the remaining retinal neurons in the setting of total photoreceptor loss. It has restored partial sight to totally blind patients with retinitis pigmentosa enabling them to see large letters and objects. To date, the Argus II is the only Food and Drug Administration (FDA) approved retinal implant and also is approved in Europe and in many other countries around the world. I was able to use my training in biomedical engineering and ophthalmology to lead a consortium of multidisciplinary investigators to achieve this goal. We are now focused on both improving the resolution as well as developing a visual cortical bioelectronic implant for those patients who do not have a viable optic nerve.

Another example of an advanced retinal implant is a bioengineered scaffold with stem cell derived retinal pigment epithelium (RPE). This implant is positioned subretinally and is for patients with advanced dry macula degeneration (i.e., geographic atrophy). This implant, called the CPCB1, is to help re-establish the host photoreceptor function by providing a healthy layer of RPE. As was the case for the Argus, this effort also required leading a multidisciplinary team but this time with both bioengineering expertise as well as stem cell expertise. We have advanced the implant from benchtop to completion of phase1/2a clinical trial. The results to date show an unprecedented gain after implantation in visual acuity in very advanced legally blind (20/200 or worse) patients."

Dr. Humayun is an internationally recognized pioneer in vision restoration. He holds more than 125 issued patents, and has authored over 250 peer-reviewed publications. For his extraordinary contributions, Dr. Humayun was awarded the National Medical of Technology and Innovation by President Barack Obama in 2016. Dr. Humayun received the RRF Award of Merit, given in collaboration with The Retina Society in 2009.



Mark S. Humayun, MD, PhD

University Professor of Ophthalmology;

Cornelius J. Pings Chair in Biomedical Sciences;

Director, Institute for Biomedical Therapeutics;

Co-Director USC Roski Eye Institute;

Director of Sensory Science Initiatives.

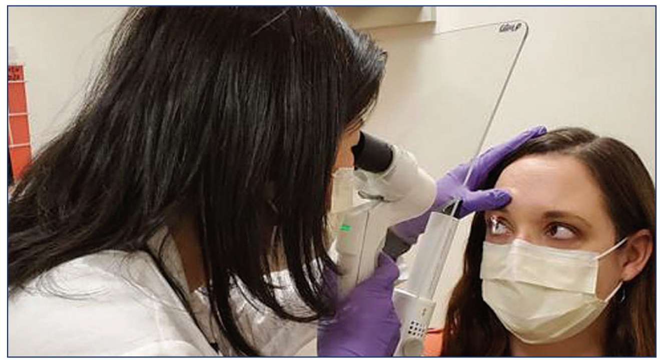
"I consider the development of advanced implants for retinal diseases my major contribution to the field of visual sciences."

Dr. Mark Humayun

Advances in Digital Imaging Lead to Better Eye Care

Today, ophthalmologists have technologically advanced tools to examine the eye and catch diseases early enough to treat or even prevent damage to the eye and save a patient's vision. Evolving from the ophthalmoscope, the primary instrument used to look into the eye, technology has advanced to the extent that imaging now allows scientists to examine the retina at the cellular level.

Hand-held ophthalmoscopes use a static light source to look into the eye. Scanning Laser Ophthalmoscopes (SLOs) use a laser beam and mirror to scan the back of eye quickly. Data stored from every point on the retina is combined to make a 2D image of the entire fundus.



Ophthalmoscope eye exam

Barbara Blodi, MD

From SLO technology has evolved the ability to examine eye tissue at the cellular level. Researchers at the University of Wisconsin are focused on Adaptive Optics (AO) technology. Dr. Barbara Blodi, RRF Daniel M. Albert Chair, McPherson Eye Research Institute, created a custom-built AO imaging system that allows researchers to visualize the structure and function of photoreceptors in humans. A clinical trial is now being conducted to standardize AO image capture and grading. The standardization will allow uniformity and develop accurate and reproducible protocols to grade AO images. This will make the technology useful in multicenter clinical research.

Jeremy Rogers, PhD

Dr. Jeremy Rogers, RRF Edwin and Dorothy Gamewell Professor at the McPherson Eye Research Institute is researching Adaptive Optics Scanning Light Ophthalmoscopy (AOSLO), an imaging method with much greater translational resolution that can be used to track minor lateral physical changes such as the effects of eye movements on the retina. In addition, Dr. Rogers' lab team is developing machine learning software to optimize image contrast and identify cells within the image. Machine learning is the frontier of data analysis and is becoming an essential step in image interpretation to ultimately benefit patients.

Another imaging technology that has evolved within the last 15 years is

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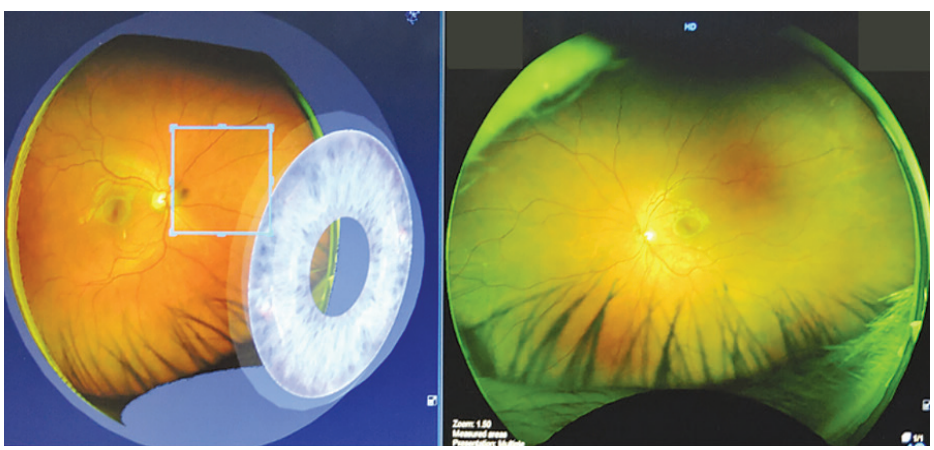
Optical Coherence Tomography (OCT), technology that enables taking pictures at many depths in the back of the eye, like a CT scan, and creates a 3D image. Last year, RRF recognized the inventor of the OCT technology, Dr. James Fujimoto, with the Award of Merit at the Retina Society annual meeting. OCT enables an optical biopsy by visualizing pathology in a patient's eye without excision or histological processing. The technology can generate micron resolution, cross-sectional and three dimensional images of subsurface structure in biological tissues or materials by measuring the magnitude and time delay of backscattered light. Every year, an estimated 20-30 million OCT imaging procedures are performed and importantly, between 9-30 percent of normal appearing retinas actually harbor subtle macular pathologies that can be detected with OCT. Additional OCT technology innovation includes ultra-wide imaging showing up to 80 percent of the retina in a single image. OCT is being used for surgical planning and follow-up and there has been progress in the development of OCT systems for use during surgery.

Digital imaging provides scientists with huge amounts of digitized imaging data. Availability of these 3D datasets has led to the advancement of software tools including machine learning programs for automated assessment of the images, capable of efficiently analyzing and summarizing these vast sets of data. These image analysis techniques may eventually be made widely available to clinicians resulting in improved diagnostic capabilities.



Ultra-wide OCT images. Photo source: islandecho.co.uk

Source: ncbi.nlm.nih.gov/pmc/articles/PMC3088542/

Ophthalmoscope eye exam:

Photo source: medicine.umich.edu/dept/ophthalmology/ protective-shield

James Fujimoto, PhD
Elihu Thomson Professor
Electrical Engineering

Massachusetts Institute of Technology

Virtually, Research Collaboration Continues

During the COVID-19 pandemic, many research laboratories have been completely closed to entry, yet vital research and collaboration continues using today's technology enabled electronic communication.

Meeting virtually, RRF pilot grant researcher Dr. Timothy Corson (top, center) and his laboratory team, Indiana University School of Medicine.

Telemedicine: A Virtual Visit To the Ophthalmologist

In this time of social distancing and stay-at-home orders, even patients with advanced eye diseases such as macular degeneration, glaucoma and other vision-threatening conditions can safely stay in contact with their physician with a telemedicine visit.

What Is Telemedicine?

Telemedicine has been in use since the early 1960s. NASA further developed the technology for treating astronauts, and it has been used to bring health care services to rural communities for decades. But with today's technology, the

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internet, and the ubiquitous smartphone, everyone can benefit from a virtual consultation. A telemedicine visit consists of a two-way, face-to-face video exam that meets health privacy protection requirements. Providers have many options for virtual appointments – patient portals or interactive patient care systems that are secure online gateways. These portals give patients access to review their medical records, to make appointments, and to conduct video consultations.

What To Expect During the Visit

Both the patient and physician will need a private, quiet place, with internet connectivity, and a computer or device like a smartphone or iPad with a webcam or video camera, and audio capability. The patient must give consent to receive care in this manner, and the clinician must disclose anyone else taking part in the consultation. A virtual exam will include a patient history and a visual examination consisting of a vision acuity evaluation. The American Academy of Ophthalmology (AAO) offers paper eye charts on their website, as well as information on smartphone apps to do these tests at home. Seeing the eye on video, an ophthalmologist can assess symmetry, color of the white of the eye, ocular movement, and reactivity to light. The physician can make a diagnosis, prescribe medications, schedule laboratory tests, or triage the patient for an in-person follow up visit. A diagnosis summary and physician instructions can later be accessed through the patient portal. Telemedicine visits are efficient and empower patients because they allow for shared decision making between the physician and patient as a patient care plan is created, which may lead to improved outcomes and reduced costs.

A virtual eye exam

The degree to which telemedicine can fully meet a patient's needs depends on the stage of their eye disease. According to ophthalmologists at the Cleveland Clinic, telemedicine can be used to visualize lids and lashes, and do an anterior segment exam, anything before the lens. Video capability is often sufficient to diagnose many red-eye issues, including acute red eye, dry eye, blepharitis, allergic conjunctivitis, styes and subconjunctival hemorrhages. Ophthalmologists can triage vision changes and other symptoms and assess whether an in-office visit is advised. Often a hybrid approach is necessary, combining an in-person visit with a video consultation. Telemedicine can reduce the number of contacts for both the clinician and the patient, and the time spent in clinic waiting areas. For example, patients with age-related macular

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degeneration who require regular OCT imaging may need a combination of an in-person visit for imaging OCT and visual fields, and a video consult to discuss the results. Patients who require invasive procedures, such as surgical repair for retinal detachment, can benefit from virtual, follow-up, post-surgery consultations.

Source: consultqd.clevelandclinic.org/how-to-use-telehealth-for-ophthalmology-patients-during-covid-19-crisis/

Ophthalmology Consultation

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