LEMELSON-MIT

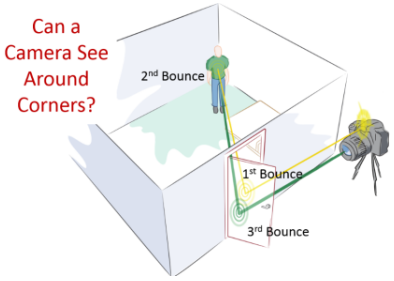
Winner of the 2016 $500,000 Lemelson-MIT Prize – Ramesh Raskar, PhD

Ramesh Raskar, director of the Camera Culture research group at the MIT Media Lab and associate professor of media arts and sciences at MIT, is a pioneer in vision technologies and invention for social impact.

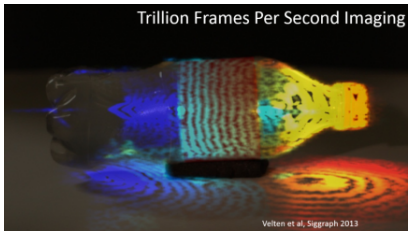
New Fields of Vision

Femto-Photography: Visualizing light in motion at a trillion frames per second, to see around corners

- Femto-photography is an ultra-fast imaging technique, a camera and software, to visualize propagation of light at roughly half a trillion frames per second. This technology is used to create a camera that can peer 'around' corners and create slow motion movies of light in flight.



- A laser pulse is fired, hitting a wall and scattering light in all directions. Some of the scattered light will hit the hidden object around the corner, in turn scattering the light again, resulting in the door reflecting some of that scattered light once more. A tiny fraction of the photons will come back to the camera, all at slightly different times. The femto camera, with a time resolution of 2 picoseconds, captures dozens of these images that when put together and analyzed show the hidden object in full 3-D.



- Potential applications include locating people in smoke engulfed buildings, navigating foggy driving conditions, novel endoscopy in unreachable parts of the body, industrial imaging to analyze faults and material properties, scientific imaging for understanding ultrafast processes and medical imaging to reconstruct sub-surface elements.

EyeNetra: Smartphone-powered refraction tool for mobile eye clinics and vision screenings

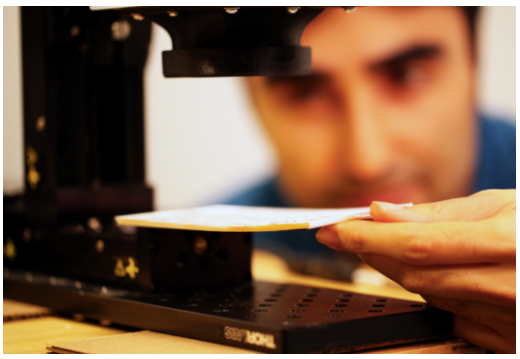
- The EyeNetra auto-refractor snaps onto a mobile phone to measure sphere, cylinder, axis and pupillary distance through a series of game-like interactions in a virtual-reality environment. Using simple knobs on the device, patients adjust the images into focus; the mobile phone then produces the results directly on the screen allowing patients and doctors easy access to screening results and prescriptions.

- EyeNetra is as accurate as top-tier auto refractors and took 340 product iterations and 35,000 product tests to achieve the current level of precision and control accommodation.

- EyeNetra enables highly accurate, self-administered tests with minimal training. Its ease of use and compact size reduce the barriers of access and affordability for those in more remote areas of the world, serving individuals who have traditionally never had eye care access.

Reading a Book without Opening it: Terahertz time-gated spectral imaging for content extraction through layered structures

- A camera and software that uses time-of-flight-like measurements to read through the pages of a book. The system extracts and localizes each page based on the statistics of the reflected THz electric field and uses a novel, time-gated spectral analysis that tunes to the highest contrasting frames in spectral domain for each page.



- There is an abundance of layered structures with sub-millimeter layers of which THz time-domain spectroscopy can extract content including coatings and polymer-based lamination and objects of cultural value (e.g. documents, books, and art works).

- Potential applications include research in industrial imaging, seismic imaging, and cultural heritage. Furthermore, because the imaging modality is in reflection mode, it has potential for extension to long-range imaging applications with other types of time-of-flight sensors.

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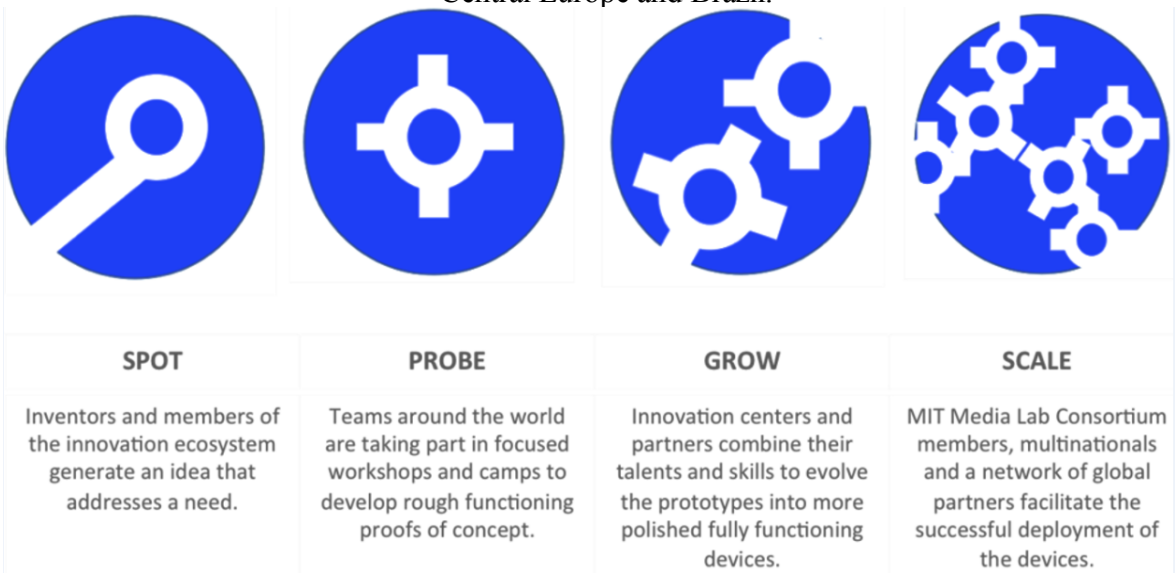
A Proven Framework for Impact Innovation

Emerging Worlds: Innovating for Billions

The Emerging Worlds initiative is designing solutions to some of the world's most pressing problems using modern technology by connecting students, MIT scientists, leaders from government, academia and industry. The emphasis is on bottom-up innovation to yield impactful outcomes in health, learning, financial inclusion and security, energy and environment, food and agriculture, housing and transportation. Emerging worlds has plans to expand to Mexico, Central Europe and Brazil.



Co-innovation Pathways for Young Inventors

Empowering smart citizens in Nashik, India

The DISQ Center (Digital Impact Square), a Tata Consultancy Services Foundation initiative, opened in March 2016 with a focus on digital solutions. In 2013, the MIT Media Lab began collaborating with the Kumbhathon Foundation in Nashik, and in 2015 the first solutions were successfully launched at the Kumbh Mela festival. DISQ solutions address seven broad themes: education and skills, financial and personal security, housing and transportation, food and agriculture, energy, water and environment, health and hygiene, citizen empowerment and transparency. Nine solutions in Nashik were deployed during Kumbh Mela and 11 are being developed at DISQ including pop-up housing, real-time crime detection and a supply chain innovation to connect farmers and markets.

Low-cost health diagnostics in Mumbai, India

The REDX (Rethinking Engineering Design eXecution) lab in Mumbai at the Prin. L.N. Welingkar Institute of Management Development and Research (WeSchool) began in 2014. The lab leverages the WeSchool's skills in industry research, analysis and management. The emphasis is on diagnostic health devices. Four solutions are in progress in Mumbai including a web-based diagnostic tool built to screen for cardiovascular diseases, a wearable device for home-monitoring of Obstructive Sleep Apnea, differential diagnosis of skin conditions using fluorescent spectroscopy of skin and a novel device to image conditions and infections of the outer ear using a mechanically stable form factor.

Enabling all to see in Hyderabad, India

The LVP-MITRA innovation lab , that started in 2013, is hosted at the L V Prasad Eye Institute (LVPEI). Medical professionals from major health centers including LVPEI and Massachusetts General Hospital in Boston provide mentorship and guidance. The focus is on building and deploying the next generation of screening, diagnostic and therapeutic tools to enable all to see. Four solutions are in development in Hyderabad including an ultra low-cost portable screening device made of paper to rapidly screen for refractive error in eyes, a novel device that assists in the early detection of neonatal eye diseases and vision-threatening conditions, an open-source portable screening device for retinal diseases and a portable binocular device to identify existence of medical conditions that manifest as abnormal pupillary reactions.