

Commentary: Tsunami of grassroots innovations from makers

Healthcare is a field which needs rapid improvements in technology as well as lowering of costs. Large companies may feel that low-cost innovations are not a viable option, especially if it makes their older technology obsolete. Individual innovators have used the available resources and opportunities, to make affordable and smart innovations that can perhaps replace expensive technology. These innovators represent the growing "Maker Culture", which embodies the spirit of Do-It-Yourself using technology.

In the accompanying article,^[1] the authors describe about a cheap and easy method to make a smartphone fundus camera using things available in the ophthalmology clinic. It follows the principles of open source hardware (OSH) by giving step-by-step instructions with pictures, as it was done earlier by my colleagues in a similar article for making DIYretCAM.^[2] Even though the instructions for DIYretcam had been published in 2016, not many ophthalmologists actually made the device, perhaps because of their inertia. The device described in the current article is similar to the Plastic Bottle Fundus Camera described by Dr Ramesh Dorairajan in a YouTube video^[3] in June 2015, but makes it easier to build and also function as a slitlamp photography adapter like the DIYretCAM.^[2] But, this

is just the tip of the iceberg, as I see many more innovative methods of fundus imaging being developed every couple of months, including a technique that uses only an unmodified iPhone X and no additional lenses.^[4]

Considering the low cost of making these smartphone fundus cameras, I hope these will be made atleast by postgraduate students of ophthalmology and used for fundus documentation, consultation with seniors, teaching, presentations, publications and much more, especially for bedridden patients and on duty calls. Individual practitioners will particularly find it very useful to document interesting findings, show them to patients and get opinions from other colleagues. I often use similar devices, like 3D printed oDocs Fundus, Ahmed Ateya's Fundus camera, and HopeScope,^[5] to record fundus photos and videos of interesting findings. If a picture is worth a thousand words, then a video is worth so much more. Thus, a video of exudative retinal detachment, central serous retinopathy or moving floaters, conveys much more 3D information due to parallax effect, and demonstrates lighting, temporal and positional changes.

This is just one of the several affordable grassroot innovations happening across healthcare with some notable ones being from Indian innovators. Aum^[6] is a low cost trachea-esophageal voice prosthesis for total laryngectomy patients. Paperfuge^[7] is a hand-powered centrifuge of sorts based on a spinning toy and made out of paper. It has been field tested to centrifuge blood for various tests. Foldscope^[8] is a low cost microscope made out of paper, a lens, and an LED. It has been used for viewing microscope slides to diagnose schistosomiasis and cervical cancer. The Innovations Lab of LV Prasad Eye Institute, Hyderabad has developed a Folding Foropter, Pediatric Perimeter, Open Indirect Ophthalmoscope, and helped other projects including a 3D printed smartphone based keratometer named BullsEye. These low cost, yet effective devices can potentially be combined with advanced technologies like artificial intelligence for screening of fundus photos.^[9]

Those interested in developing hardware innovations in ophthalmology should try to learn the basics of technologies like 3D printing,^[5] Raspberry Pi, Arduino, smartphone apps development,^[10] optics and so on, to help bring their ideas into reality. The resources to learn these are available for free on the internet and the hardware resources are affordable for individuals to develop as a hobby. Hope this leads to a tsunami of grassroot innovations in ophthalmology.

John Davis Akkara^{1,2}, Anju Kuriakose³

¹Department of Glaucoma, Westend Eye Hospital, Cochin,

²Department of Glaucoma, Little Flower Hospital, Angamaly,

³Department of Ophthalmology, Jubilee Mission Medical College, Thrissur, Kerala, India

Correspondence to: Dr. John Davis Akkara,

Westend Eye Hospital, Kacheripady, Chittoor Road, Cochin, Kerala - 682018, India.

E-mail: JohnDavisAkkara@gmail.com

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