

Portable three-dimensional fundus imaging using an oDocs nun ophthalmoscope, smartphone, photo montage software and a stereo viewer: A proof of concept

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INTRODUCTION

We describe a simple method, requiring little training, of acquiring, assembling and presenting smartphone retinal images for basic stereoscopic viewing.

METHODOLOGY

Patients in Dunedin Eye Department with three-dimensional fundus pathology were recruited from February to September 2020 following ethical and Dunedin Hospital locality approval from Health Research South (Sep 2019 H19/194). Right and Left fundoscopic image pairs taken by the nun ophthalmoscope device were then coupled onto a montage app and mounted to camera roll (thanks to RCSEd & Sight Scotland for funding). Stereoscopic viewing of the dichoptic images was enabled through commonly available, low-cost source viewers (e.g. Google Cardboard).



Figure 1: Left: Examples of types of phone screen stereo viewer available. Right: The O-docs nun fundoscopy device.

Technique, using landscape images and downloaded <i>PicStitch</i> app.
1. Centre the first view of the feature on a point IDD (disc diameter) to <u>your</u> left of its centre while still including the feature in the view; and capture this image, which is the 'left aspect'.
2. Similarly, centre the second view of the feature on a point IDD to your right of its centre while still including the feature in the view; capture this 'right aspect' view.
3. Choose a magnification combining sufficient visualisation of detail with an adequate field of view.
4. In <i>PicStitch</i> , select and click on the template which shows a landscape view consisting of two portrait views side by side; follow the on-screen instructions on how to mount the two acquired images into the respective sides of the template.
5. 'Drag' each image horizontally in the template so as to centre the feature in question on each side. For vertical centration and suitable enlargement, first use two fingers on screen to enlarge the image of the feature and arrange the two images symmetrically about the vertical dividing line between the two sides of the landscape.
6. Follow the App instructions for 'exporting' or filing this montage in the destination image file of choice on the phone, and for resetting the App for subsequent use.
7. To view the stereo montage, display it in landscape mode on the phone, magnified as necessary. The wearing of any personal near refractive correction is not strictly required

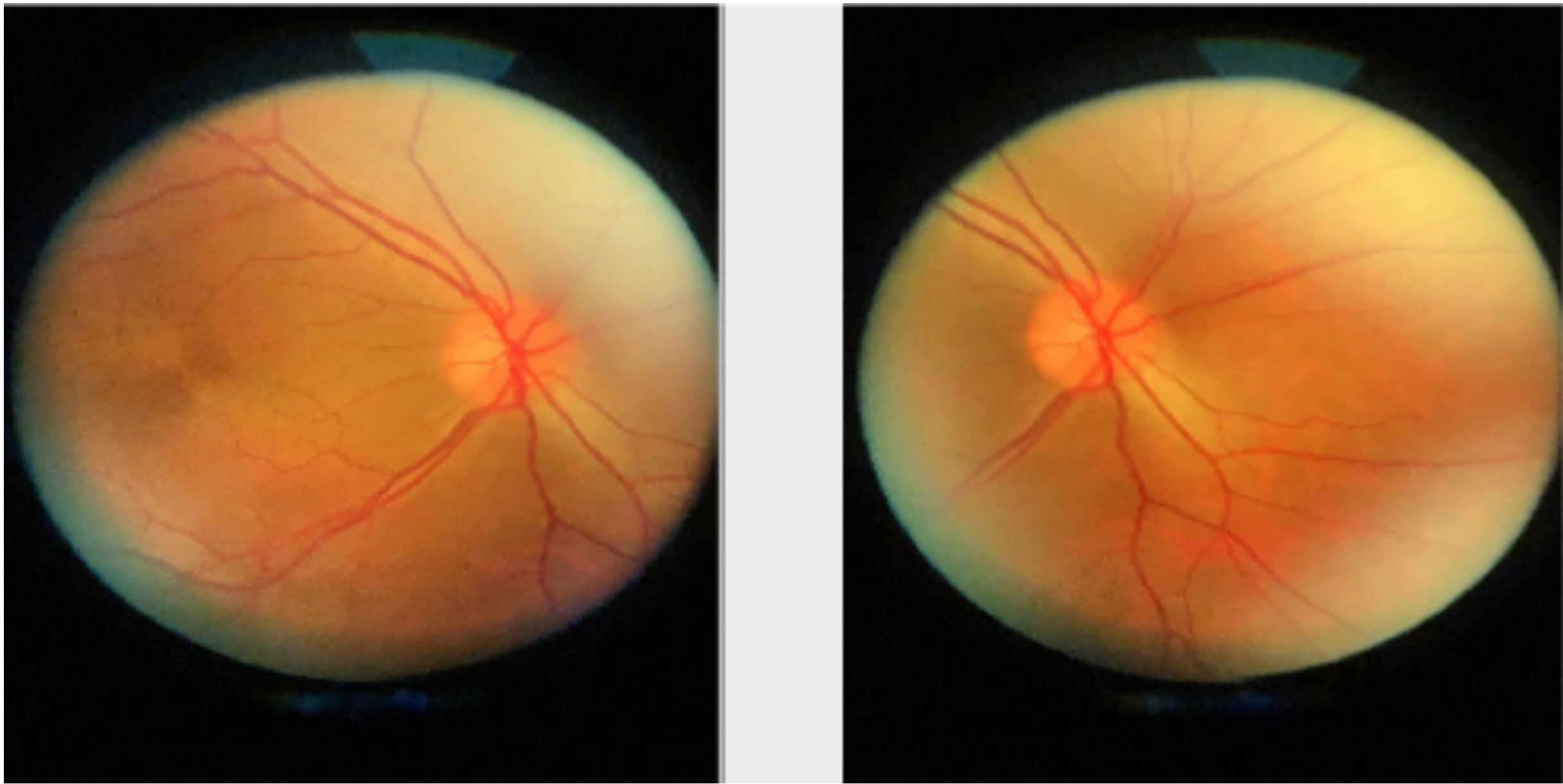


Figure 2: Left & Right Portrait pair of offset images of disc with small shallow cup (L Walsh, using oDocs nun).

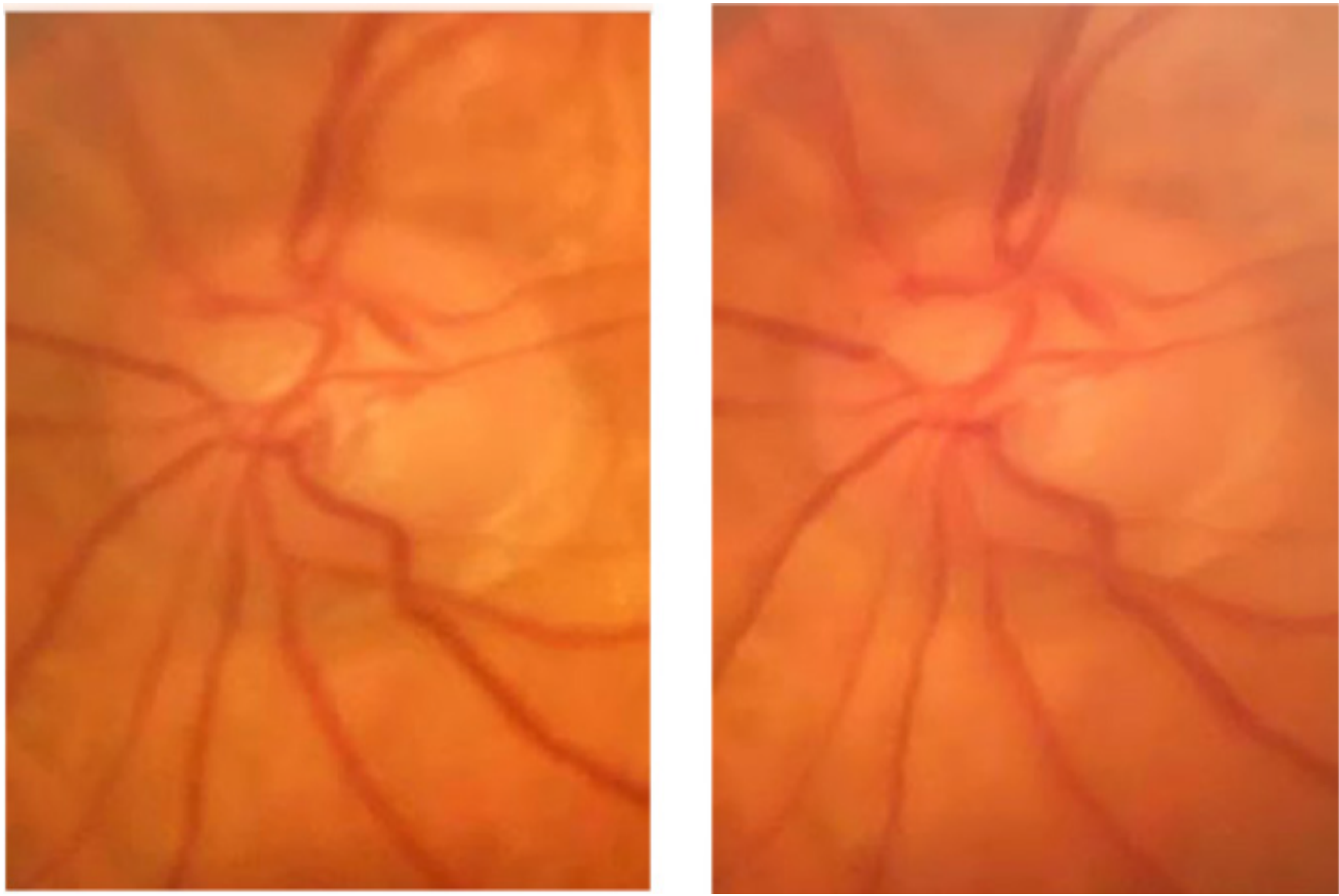


Figure 3: Cupped disc in stereo (from L & R images by L Walsh, using oDocs Nun). The two images have been reversed so that they can be fused without a viewer, using the 'cross-eyed' technique.

RESULTS

Eight paired images were taken, with 3 excluded due to poor image quality or unclear stereoscopic pathology. There were 2 pairings of oedematous discs and three that were shallow or tilted. All images could be viewed successfully stereoscopically by a third party. Some of these attached images are presented for personal stereoscopic viewing and discussion.

DISCUSSION

There is little scope worldwide, outwith highly equipped eye clinics, for imaging three-dimensional fundus pathology and presenting stereoscopically. We hope that our method, still under development, may help to rectify this, adding the undisputed benefits of 3D display to the 2D retinal viewing now generally available with smartphones.

CONCLUSIONS

Portable ophthalmic devices such as the oDocs nun demonstrate potential to produce easily accessible stereoscopic images on any phone screen when combined with commercially available 'apps' and basic handheld viewers; providing significant usefulness in educational and clinical settings.

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[2] Singh A, Cheyne K, Wilson G, Sime MJ, Hong SC. On the use of a new monocular-indirect ophthalmoscope for retinal photography in a primary care setting. The New Zealand Medical Journal (Online). 2020 Apr 3;133(1512):31-8.