

Non-mydratiac wide field fundus camera with flexible shape field of view

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Meinert Jordan¹, Peter Voigtmann², Georg Michelson³, Bernhard Schmauss¹

¹ Institute of Microwaves and Photonics, University of Erlangen-Nuremberg, 91058 Erlangen, Germany

² Voigtmann GmbH, 90443 Nuremberg, Germany

³ Department of Ophthalmology, University of Erlangen-Nuremberg, 91058 Erlangen, Germany

Purpose:

Non-mydratiac type fundus photography offers significantly less stress to patients in screening while it is limited in imaging area. We've integrated a digital micromirror device (DMD) into our camera design to get an arbitrary field of view (FOV) and fixation mark. Therefore, we are able to record an image of 68°x60° from three shots.

Methods:

In contrast to common cameras our design uses a spot illumination in the pupil. This way we get reduced reflection size in horizontal direction. The resulting FOV is 68° in width and up to 25° in height at a pupil diameter as small as 2 mm. Now, we have extended the illumination path by a DMD in the image plane as shown in figure 1. With the DMD it is possible to control the light pattern in the area of 68°x45° on the retina and change it quickly.

This flexibility is used to project the FOV to areas, which are not outshined by reflections. Therefore, interferences can be reduced as the intensity of the reflections are proportional to the illuminated area. The illumination area can also be limited to small regions like the disc. While the camera shutter is closed, a fixation mark is projected into the patient's eye by using the same light source and the DMD. The mark can be shaped arbitrary, it can be animated and moved to any location of the projection area.

Using the movable fixation mark, a combined FOV beyond the illumination size can be used. For a single orientation, the camera is video capable with 11 frames per second.

Results:

With our camera, we are efficiently able to capture a wide field fundus image at small pupil diameters. A retina image of a 68°x60° taken from three shots of our camera is shown in figure 2. While the FOV is progressively shifted downwards, the fixation is shifted upwards. The single shots have been reference subtracted, low-pass filtered, and gamma extended before stitching.

Conclusions:

The interplay of adjustable FOV and fixation helps minimizing interferences. This enables wide-angle fundus imaging at pupil diameters down to 2 mm. The flexible design also allows integration of further checkups like a visual field test. Still, the design contains only common mass-market components resulting in moderate system costs.

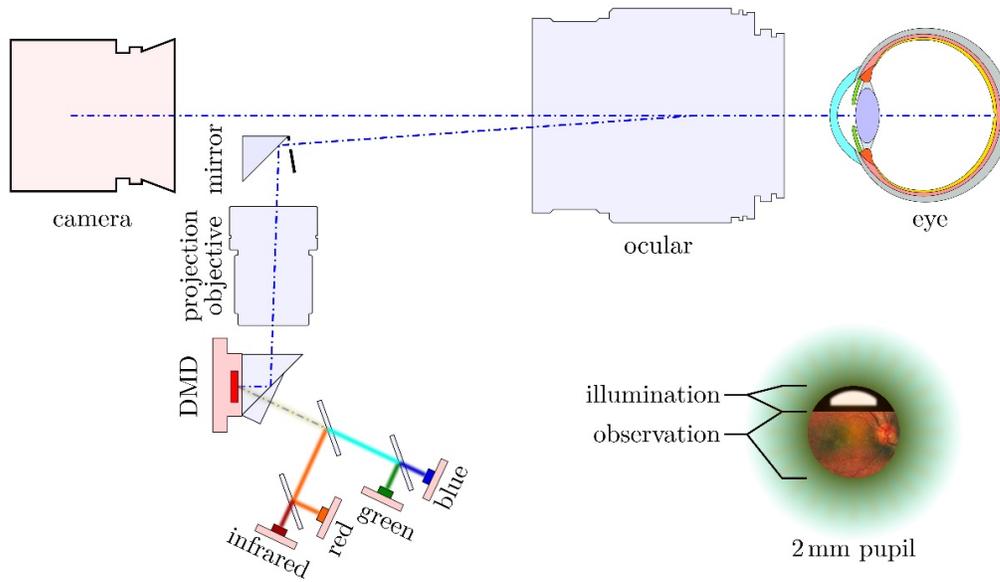


Fig 1: A DMD is integrated in the illumination path and projected onto the retina. The pupil is separated into a illumination area and an observation area.

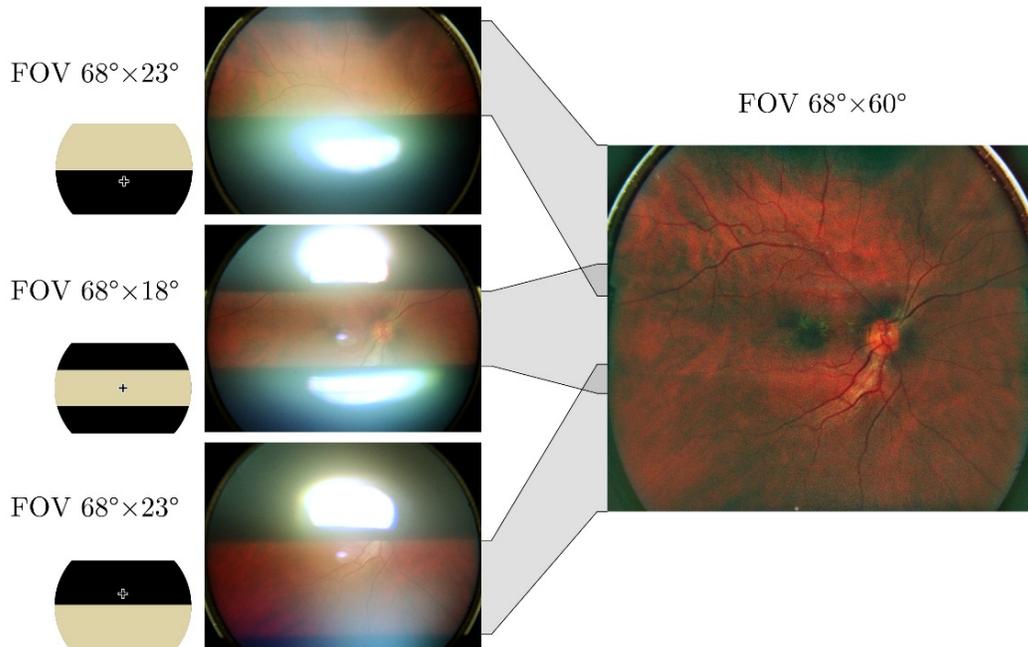


Fig 2: The retina has been captured by three shots through a pupil of about 2.2 mm.