QUANTITATIVE PHASE MICROSCOPE USING a CELLPHONE for less than 100$

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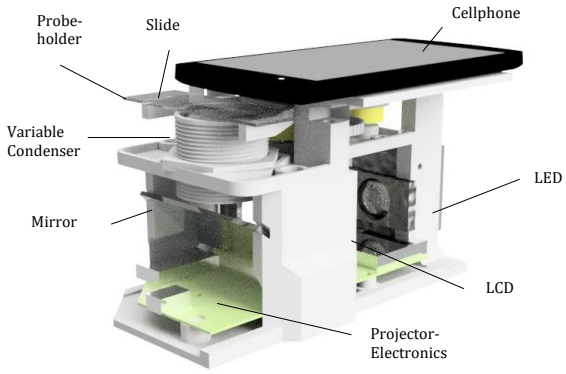
Cellphones equipped with high-quality cameras and CPUs/GPUs are widespread. This opens new prospects to use such existing computational and imaging resources to perform medical diagnosis in developing countries at a very low cost [1].

In many situations, it is important to measure the object's phase, i.e. to detect waterborne parasites in drinking water, where typical brightfield configurations fail and professional equipment is too expensive. Dedicated illumination approaches, tailored to the sample under investigation would help to boost the contrast. This is achieved by a programmable illumination source, which also allows to measure the phase quantitatively using the differential phase-contrast (qDPC) approach [2].

For the experimental setup, we developed a 3D-printed cell-phone microscope for less than 100 $ using only off-the-shelf components. The fully automated system assures true Koehler illumination with an LCD as the condenser aperture and a reversed cell-phone lens as the microscope objective [3]. The optical path was derived from an already existing low-cost LED-projector which is controlled by the cellphone. Any pupil shape, like the one used in qDPC or FPM (Fourier Ptychography Microscopy) can be used for the image acquisition. The image reconstruction is carried out on the cellphone's GPU to speed up the processing. We show that the effect of a varied light source shape does not only improve the phase contrast, but also the impression of an improvement in optical resolution without adding any special optics.



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