Design and Development of Smartphone-based Fundus Camera

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A fundus camera is an important medical device that can help the doctors to diagnose diseases by capturing the image of the retina. In my research, a handhold smartphone-based fundus camera was developed aiming to solve the problems of high cost, inconvenient operation and low intelligence of traditional ones. The camera consists of an imaging system and an illumination system. In the imaging system, 2 eyepieces lenses groups were adopted to form a zoom configuration. Optimized in optical software ZEMAX, the system can form a clear image of eyes with different diopters in the range of -8D to +8D by focusing. Results show the MTF values of the system are greater than 0.35 in all fields of view at the spatial frequency of 80 line pairs per millimeter while the distortion can be decreased to 2%-3%. In the illumination system, an annular LED light source was designed to eliminate stray light while ensuring sufficient and uniform illumination on the fundus. Based on the design, the prototype of the fundus camera was made. Experiments of fundus photography were carried out to test the imaging quality of the camera. Results show that the camera can image the fundus clearly and can meet the requirements of a convenient eye examination. Since the smartphone acts as a part of the system, its high capabilities in computing, image processing, transmission can contribute to improving the intelligence level of the camera, and realizing better mobile healthcare in the future.

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