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Portable microscopic phase retrieval system using the transport of intensity equation on Android platform

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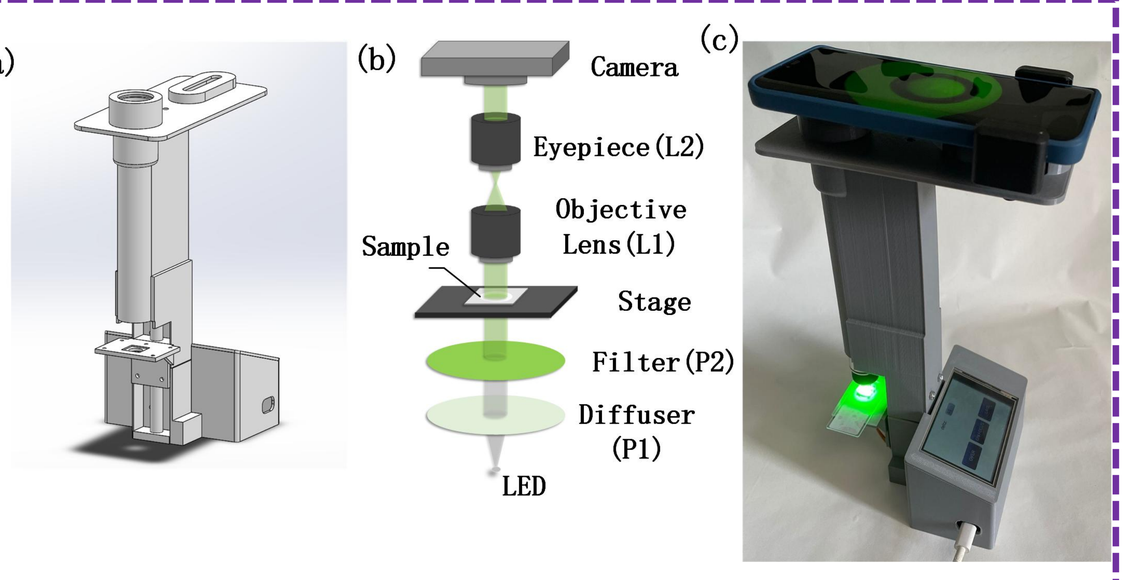
Abstract

The microscope used in the traditional phase retrieval method based on the transport of intensity equation (TIE) is not portable enough. In this paper, a microscopic phase retrieval software and hardware system with good portability, high precision and strong adaptability is designed under the Android system. The intensity images are captured by the system which uses a smart phone with a portable microscope, and controls the lifting and lowering of the stage through a high-precision motor. Then the self-designed Android application software calculate the phase of the obtained image by using TIE method. Finally, the effectiveness of the system is verified by simulation experiments and experimental measurements.

Introduction

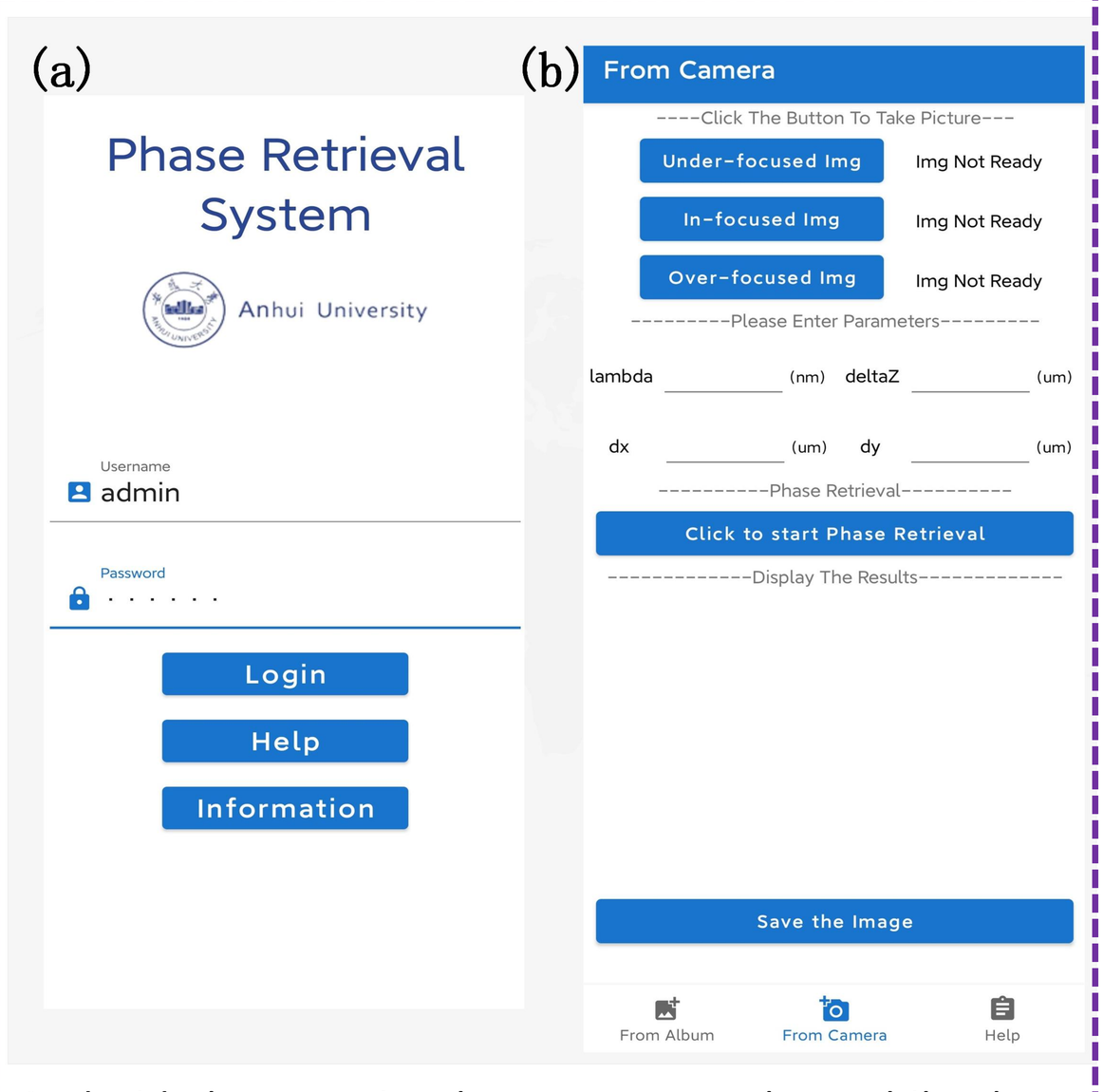
This paper proposes a microscopic phase retrieval system based on TIE under the Android system: First, a smartphone is used in conjunction with a portable microscope system, and a single-chip microcomputer is used to control a high-precision motor to lift the stage to capture in-focus, under-focus, and over-focus images. The captured images are then phase-retrieved by using a self-developed Android application. Finally display and save the retrieval results inside the application. The system has good portability, high cost-performance and high accuracy.

The hardware design of microscopic phase retrieval system



The hardware design of the microscopic phase retrieval system consists of the following parts: (1) Control component (2) Platform drive component (3) Light source component (4) Microscope component (5) Mobile phone support component.

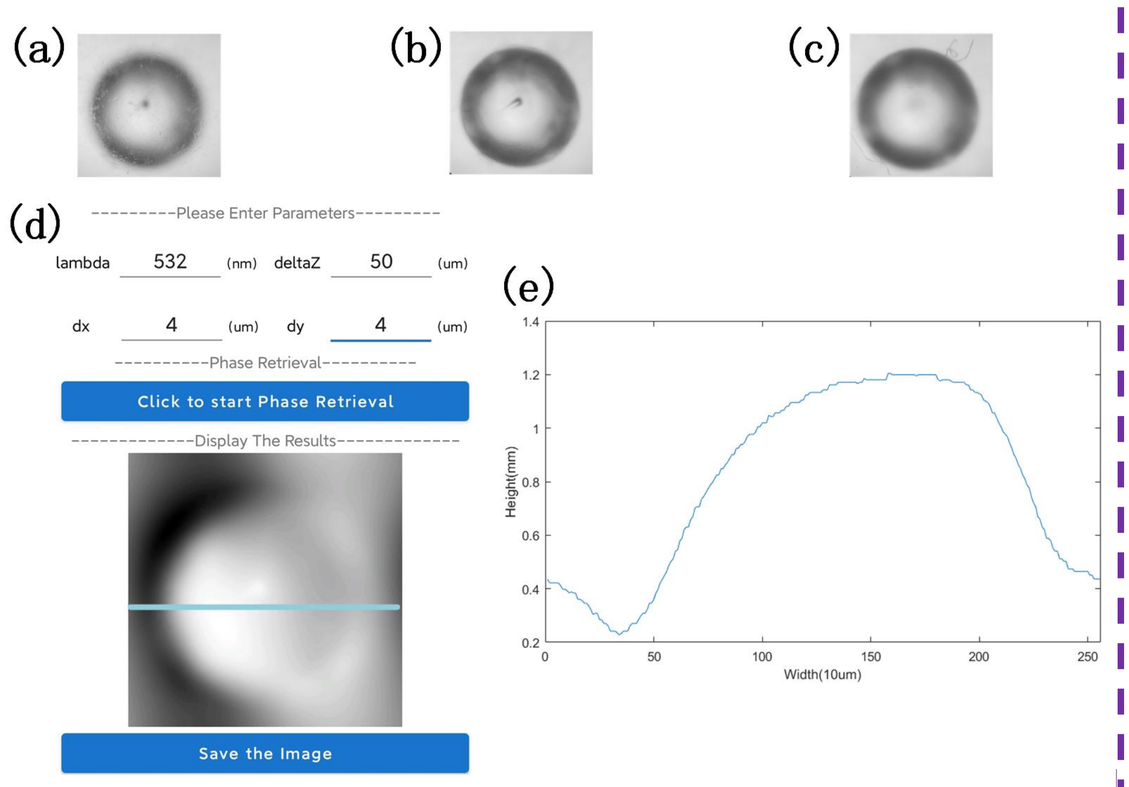
The software design of microscopic phase retrieval system



Android phase retrieval program uses the mobile phone to acquire the data, process the data for phase retravel and display the results.

Results

We measured a single micro-lens, and the depth value measured by the proposed method is about 1.21mm, and the relative error between it and the real height is 5.2%.



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