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Smartphone-Based Microscope for Pathogen Detection

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ABSTRACT

Vibrio cholerae is a water and food borne bacteria that causes cholera, a severe acute diarrheal disease, when ingested and when left untreated, can cause patient death within hours. Currently there is a lack of both sensitive and rapid portable detection technologies of V. cholerae for testing water and food samples. Combining nucleic acid amplification and particle diffusometry present an alternative detection method for V. cholerae in under 30 minutes, but the process requires an expensive laboratory microscope. In this work, we develop a smartphone-based microscope to detect V. cholerae DNA in environmental water samples using particle diffusometry. A modular iPhone case is designed with a detachable cartridge and an integrated ball lens to image a microfluidic sample slide. This sample slide is essential for performing the DNA amplification assay and contains the microparticles necessary for imaging and particle diffusometry measurements. The ball lenses to image these particles have diameters of 1.0, 0.79, and 0.5 millimeters and are tested in conjunction with the iPhone 6 camera to determine optimal magnification and focal length. We demonstrate the ability to detect the Brownian motion of 1.0 micrometer particles using a 0.5 millimeter ball lens with brightfield imaging. This field-portable imaging platform provides the capability to perform rapid detection of V. cholerae in the field, and in the future, can be applied toward detecting other diseases at the point of care.

KEYWORDS

Portable diagnostics, particle diffusometry, point-of-care diagnostics, pathogen detection, cell phone microscopy