Editorial

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Smartphone-based sensors and imaging devices for global health

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With COVID-19 pandemic, remote access to healthcare units through telemedicine has been more important than ever. Mobile platforms, including smartphones and wearable technologies, provide promising solutions for a wide range of applications, including e.g., personalized healthcare. The advantages of these health technologies, for example, wide availability of smartphones across the world and their computation power either on the device or cloud, empower them as personalized data acquisition and transfer tools, not only in resource-limited settings but also for real-time monitoring of health status during daily activities.

These smart technologies usually utilize multiple optical units, such as a compound lens on the image sensor of the camera of the device, and other sensors such as gyroscopes and accelerometers. An external lens coupled to the camera together with a low-cost external light source (e.g., light-emitting diodes and laser diodes) for sample illumination can convert a smartphone into a portable and cost-effective microscope with submicron resolution. Different imaging modalities such as fluorescence microscopy, bright field microscopy, differential phase-contrast microscopy, and dark-field microscopy have been incorporated with smartphones for a variety of applications ranging from biomedical diagnostics to food analysis for automated detection of proteins, nucleic acids, pathogenic bacteria, cells, and viruses with high sensitivity and specificity values [1]. In addition, smartphones have been integrated with optomechanical units to convert them into field-portable and cost-effective colorimetric or fluorometric readers for *in-vitro* diagnostics in resource-limited settings. Rapid diagnostic test readers and plate readers are among the most common integrated devices for high throughput analysis of clinical samples. These readers convert paper-based assays or well-plate assays into quantitative measurements by automatically processing captured images using custom-developed applications and, therefore, enable the user to perform various biomolecular assays such as enzyme-linked immunosorbent assays (ELISA) in remote settings, without the use of bulky and costly plate readers, also eliminating the need of an expert to analyze the results.

This special issue covers three comprehensive review articles on smartphone-based diagnostic tools using different characteristics of image sensors and design considerations for a wide range of applications. The review article titled "*The power in your pocket – uncover smartphones for use as cutting-edge microscopic instruments in science and research*" by Wang et al. [2] focuses on the details of high-end cameras of smartphones available in the market and presents key features of smartphone-based microscopes studied in the literature, different imaging modalities that utilize smartphone camera to capture images at the cellular and subcellular level of resolution, and Raspberry Pi based microscopy for rapid prototyping of diagnostic tools for resource-limited settings.

Smartphone-based microscopes have also been studied as video microscopes for detection and counting of motile microorganisms and many other point-of-care applications. Another review article in this issue by Yan Wang, Shengwei Zhang, and Qingshan Wei [3] focuses on smartphone videoscopy. This article highlights different examples of biosensing applications of videoscopy, including temperature mapping, real-time assay analysis, fluorescence lifetime measurement, single-molecule imaging, and spectroscopic analysis, and emphasizes the future of smartphone videoscopy and the design limitations of commonly used smartphone cameras for single-molecule detection.

In addition to these, Dr. Tasoglu's group contributed to this issue with a review article on smartphone-based and selfcontained portable magnetic levitation technologies [4]. It provides detailed information on three main design components of the magnetic levitation platforms together with a comprehensive comparison of the main characteristics of nonoptical magnetic levitation to those of optical

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ones. The authors also discuss a variety of biosensing applications in the field of disease progression and cell sorting using optical portable platforms.

In closing this editorial, we wholeheartedly thank everyone who contributed to this exciting special issue. We believe mobile-phone-based measurement systems will change the existing practices of clinical testing and diagnostics for digital health and telemedicine application. Their unique advantages will speed up the transition to digital health and potentially improve the life quality of patients by early detection of diseases and timely treatment.

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