

Sample to answer visualization pipeline for low-cost point-of-care blood cell counting

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Abstract

We present a visualization pipeline from sample to answer for point-of-care blood cell counting applications. Effective and low-cost point-of-care medical diagnostic tests provide developing countries and rural communities with accessible healthcare solutions [1], and can be particularly beneficial for blood cell count tests, which are often the starting point in the process of diagnosing a patient [2]. The initial focus of this work is on total white and red blood cell counts, using a microfluidic cartridge [3] for sample processing. Analysis of the processed samples has been implemented by means of two main optical visualization systems developed in-house: 1) a fluidic operation analysis system using high speed video data to determine volumes, mixing efficiency and flow rates, and 2) a microscopy analysis system to investigate homogeneity and concentration of blood cells. Fluidic parameters were derived from the optical flow [4] as well as color-based segmentation of the different fluids using a hue-saturation-value (HSV) color space. Cell count estimates were obtained using automated microscopy analysis and were compared to a widely accepted manual method for cell counting using a hemocytometer [5]. The results using the first iteration microfluidic device [3] showed that the most simple – and thus low-cost – approach for microfluidic component implementation was not adequate as compared to techniques based on manual cell counting principles. An improved microfluidic design has been developed to incorporate enhanced mixing and metering components, which together with this work provides the foundation on which to successfully implement automated, rapid and low-cost blood cell counting tests.