Smart Leukemia Labs: A Low-Cost Microscope and Diagnostic Tool That Use Semantic Segmentation, Image Processing and Object Detection To Detect Acute Lymphoblastic Leukemia

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Acute lymphoblastic leukemia (ALL) is cancer to the blood and bone marrow, and its incidence spikes in very young children. Early detection and treatment is key to full recovery. Detection has traditionally relied on manual microscopic image analysis by trained experts. This is tedious and time-consuming. This is also difficult to perform in situations where trained experts are lacking. This project is an invention that can perform those functions in place of microscopes and trained experts. This invention is a device that can perform a thousand times magnification of blood slides, automated differentiation of cell morphology, and detection of malignant cells. This device is built at low cost using a phone case, styrene sheet, a 0.5mm glass sphere, plastic pipe, LED light bulb, polarized sheets, and 4 AA batteries. The device relies on a smartphone to perform the image capture and analysis in place of a trained expert. A software flow is implemented that uses semantic segmentation, image processing, object detection, and object recognition to detect malignant cells. The software flow is trained and tested on an image dataset from ALL-IDB initiative. The flow achieved 96% precision and 93% in recall for malignant cell images and 93% precision and 97% recall for normal cell images. This device offers opportunities to bring oncology medical care to people in impoverished regions of the world.

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IEEE Foundation: Third Place Award of $400

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