A Novel Algorithm for Detection of Plasmodium falciparum Parasites in Digitized Blood Samples

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While malaria has been eradicated in the United States since 1951, it affects almost 200 million worldwide, killing half a million a year in developing regions of the world. The disease occurs when mosquitos inject Plasmodium falciparum into the bloodstream of a human. Malaria is easily treatable when detected; however, it continues to ravage developing areas due to a lack of high-quality equipment and well-trained technicians. Recent advances in technology have resulted in the development of low-cost, smartphone-based microscopes for use in underdeveloped areas, but these devices still need trained technicians to analyze the blood samples. In this project, an algorithm was developed that automatically analyzes digitized images of Giemsa-stained blood samples to identify the presence of P. falciparum in the blood and calculate the parasite load. Using local binary pattern-based feature extraction and a cascade-based, multi-stage classifier, the algorithm identifies the presence of infected erythrocytes and counts the amount of detected parasites. The ratio of infected erythrocytes to uninfected ones is used to diagnose malaria. Testing of the algorithm on 10 infected and uninfected patients shows that the algorithm demonstrated 100% sensitivity (true positive rate) and 100% specificity (true negative rate). A smartphone implementation that works in conjunction with a portable smartphone based microscope has been developed. The work has the potential of creating an inexpensive but reliable malaria diagnosis tool that can potentially save millions of lives, especially those of children in underdeveloped countries.

Awards Won:

International Council on Systems Engineering - INCOSE: First Award of $1,000

U.S. Agency for International Development: Fourth Award of $500