

Infectious diseases remain one of the leading global causes of illness and death in both community and hospital settings. Infections lead to lasting health issues, such as life-threatening chronic conditions or even cancer. Early detection is crucial for timely intervention, such as isolation and treatment. Hematology originated from the Greek word *haima*, meaning blood. It is a unique discipline in medicine that involves the study of blood and its contents. White blood cells (WBC) are at the forefront of the body's immune system. WBCs are categorized into five main subtypes: neutrophils, lymphocytes, monocytes, eosinophils, and basophils. Monitoring the total WBC and its subtypes is critical for assessing immune function and diagnosing various health conditions. Granulocytes—comprising neutrophils, eosinophils, and basophils—play key roles in inflammation and infection response. In case of infections, WBC production is increased to fight off foreign pathogens. Although not part of the immune system, red blood cells (RBCs) can indirectly reflect immune activity, as inflammatory responses may alter iron metabolism and reduce hemoglobin levels. Monitoring hemoglobin changes can help assess disease severity, immune response, and recovery, making it a valuable biomarker in infection-related diagnostics and patient management. Conventional techniques in the form of the Complete Blood Cell (CBC) count test require blood samples and specialized equipment, limiting frequent assessments. Another prominent defense mechanism against infections is the body's ability to elevate its temperature to create an environment that hinders pathogen growth. This rise in temperature results in fever, and it effectively enhances the activity of the immune cells. The most common way of measuring core body temperature is using a thermometer, but using shared thermometers may pose a risk of cross-contamination in clinical settings. Given the limitations of conventional diagnostic methods, this study explores innovative, smartphone-based solutions for non-invasive monitoring. With these in mind, this study introduces UbiWhite, UbiWhite-Plus, UbiHemo-AI, and UbiFaceTemp to serve as a non-invasive Hematologic and thermal biomarker assessment tool. UbiWhite is a novel smartphone-based, non-invasive OptoMagnetic system for real-time WBC counting from fingertip videos. UbiWhite-Plus serves as a smartphone-based, non-invasive granulocyte detection framework leveraging optical absorption, scattering properties, and deep learning-based image analysis. UbiHemo-AI augments real-life datasets with generative AI and accurately quantifies hemoglobin levels from a 10-second video of the fingertip captured with a smartphone under near-infrared lighting. UbiFaceTemp embodies a fully contact-free, core body temperature estimation system using image processing and thermodynamics that solely utilizes a 10-second face video recorded using smartphones. This dissertation suggests a new system that utilizes photoplethysmography (PPG) signals

extracted from facial and fingertip video recordings captured using a standard smartphone. The system accomplishes real-time, contactless health monitoring without the necessity of specialized medical equipment by employing advanced image processing and signal analysis techniques. This method addresses critical health challenges, particularly for vulnerable populations, by facilitating continuous monitoring in resource-constrained environments. The development of a context-aware mobile application that is capable of collecting high-quality PPG signals, mitigating motion artifacts, and improving signal-to-noise ratio (SNR) is a critical focus of this research.

In Process