

# mBloodCounter

### IMAGE PROCESSING METHODOLOGY FOR BLOOD CELL COUNTING

## Objectives

The main objective of this project is to develop and integrate into mobiledevices an automated image processing methodology for red blood cell (RBC) counting and white blood cells (WBC) detection and recognition in mobileacquired blood smear images.

## Motivation

The circulatory system is the full-body network of blood and blood vessel. Consequentially, several dysfunctions induce fluctuations from normal levels of blood components, which can be assessed through the Complete Blood Count (CBC) test, a broad screening test to determine an individual's general health. However, this microscopy-based examination is a time-consuming expertise-dependent test, which is very problematic in regions with limited health and human resources. These limitations imperil timely diagnosis and population screening. Therefore, there is the need to develop cheaper and faster alternative tools for microscopic assessment of the cellular components of the blood.



Fig1. Screenshot of the RBCs segmentation in thin blood smear images.

## Description

This work aims to develop a mobilebased automatic analysis system capable of assessing the cellular components in the blood smears, contributing to the automated Malaria diagnosis module developed in the MalariaScope project. Furthermore, this work could be included in several other applications by exploiting its capability to detect variations from normal blood components levels, symptoms of several types of disorders such as leukemia or anemia.

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#### Features

- Mobile-acquisition of blood smear images
- RBCs segmentation and subsequent counting estimation
- WBCs detection and subsequent classification
- Android application that manages the acquisition, processing and storing of the results

#### Partners

The cooperation with INSA (Instituto Nacional de Saúde Dr. Ricardo Jorge) was crucial for the development of this work.



Fig2. Screenshots of the results of both methodologies in the MalariaScope prototype application: RBCs counting (left) and WBCs counting and recognition (right).

## **RBCs** Counting

One of the main goals of this work is to develop an image processing methodology for estimation of the number of RBCs in thin blood smears. The proposed algorithm consists in the segmentation of the erythrocytes and subsequent estimation based on the number of RBCs and area segmented. The regression analysis with the linear Support Vector Regression algorithm enables to make accurate RBC count estimations.

## WBCs Recognition

WBCs detection and classification methodology employed for thin and thick blood images is other objective of this work. The WBCs detection is prompted by the distinctive brightness of the WBCs nucleus and is followed by the merging process of neighbouring detached lobes. Subsequently, the WBCs candidates are classified as mono- or poly-morphonuclear and through the Support Vector Machine or the k-Nearest Neighbouring learning algorithms, this methodology is able to accurately label WBCs candidates.

## Android Integration

The integration of the developed image processing module in the MalariaScope Android application was an important starting point for ultimately integrating them in the final MalariaScope solution. Among other features, the application prototype has a built-in database, which enables to handle the patient's sessions and respective blood smear images, an analogous intuitive User-Interacting (UI) activity map, and the Java Native Interface (JNI) framework which, by bridging the Java-based application architecture with the image processing modules, enables these modules to be coded in a programming language whose handling of the images is computationally faster.

## Future improvements

Future improvements should focus on the optimization of processing costs and computation speed of the developed modules in mobile-devices.





