# An Enhanced Segmentation Technique for Smokers RBC Rouleax Coin Stacking

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**Abstract.** Smoking is one of the major factors of having coin stacking formation of Red Blood Cell or commonly known as RBC that can cause blood clots and can lead to stroke. Smokers tends have thicker, high count, and overlapping of RBC compared to non-smokers. Blood cell detection plays significant part in biomedical field. There are two methods in detection of RBC, manual inspection by medical experts and automated machines. The manual inspection process is detection of blood cells under a microscope that is more prone to human error and time consuming, while automated hardware solutions like automated haematology machines are available, due to high cost it is not widely available to poor and developing countries who have a high statistic of smokers. Smokers have a high tendency of overlapping RBC or commonly known as rouleaux coin stacking cell formation. This study presents an enhanced segmentation technique that can detect the high degree of overlapping RBCs of smokers using digital image processing that can be helpful in the medical field.

## 1. Introduction

Technology makes life easier. The introduction of new software and machines increases volumes of production in business. Moreover, technology does not only work with the engineering or business discipline, technology is also used in many fields.

Digital image processing is the use of computer algorithms to achieve image processing on digital images. Image Pro- cessing is widely used in the medical field and in videophone and character recognition, each image is characterized by numerical values related with positions in a regular grid. A single position is usually referenced as picture component or pixel, and the supplementary numerical importance usually gives a grey value or a colour [1].

Medical imaging plays a vital role in modern medicine and image data are found in an extensive selection of clinical specialties [1]. The use of Digital Image Processing is key to provide aid in facing challenges in medical field. According to World Health Organization, tobacco smoking kills to an exceeding number of seven million each year, eighty percent of the smoking population comes from low- and middle-income countries [2]. In South-East Asia, Indonesia, has the highest male smoking percentage followed by Laos, Vietnam, Cambodia, Malaysia, Philippines, Thailand, and Singapore as shown in Figure 1.

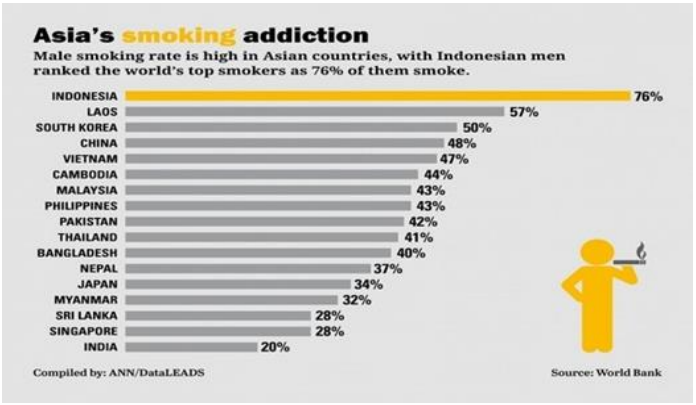


**Figure 1.** Statistics of Smoking Addiction in Asia – Male (Courtesy from http://www.nationmultimedia.com)

In a study conducted by National Heart, Lung, and Blood Institute, the chemicals in tobacco smoke damage the blood cells, arteries and function of human heart [3]. Studies show that cigarette smokers have five to thirty percent high WBC and RBC count compared to non-smokers [4]. Smoking harms almost all the organ of human body, it makes the blood thick and sticky.

Sticky blood affects heart and it makes it hard to pump blood on the body. People who have sticky blood are more prone to blood clots that can block blood flows to brain and heart. Over time, sticky and thick blood, damage the blood vessels and increase the risk of smokers to have heart attack and stroke Smokers are more prone to have Rouleaux or commonly known as coin stacking RBC as shown in Figure 2 [5].

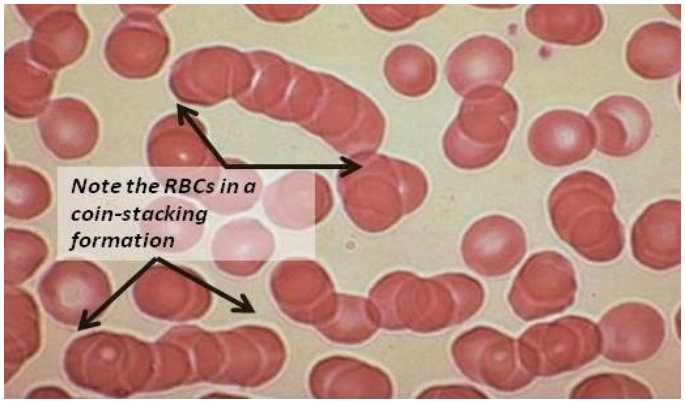


**Figure 2.** Coin Stacking of RBC - Rouleaux Formation (Courtesy from http://biogps.org/dataset/species/human/)

Complete Blood Count or commonly known as CBC is a test used to count the number of cells present in the blood. It is used by medical professionals to diagnose different types of illness like infections, and anaemia. Doctors often used a blood smear to test blood samples under the microscope. In a regular blood smear, RBCs will appear as regular, round donut like shape. Disparity in the size and shape of the cell will most likely suggest a disorder in a blood [6]. Detection of the blood cells of an individual are usually executed by medical technologist by inspecting slide with blood samples under a microscope and using a manual blood counter, because of human visual inspection and repetitive task of manual detection of blood cells the accuracy of cell sorting, detection, counting and classification is affected, it is also time consuming [7].

According to M. Thejashwini and M. Padma there are two drawback in using an automated machine, the first on is the cost, Haematology Analysers can eliminate the manual process of detecting blood cells and it is widely available in the market but the drawback of these machines is that it is expensive and not all clinical laboratories can afford it [8]. Haematology machine is not widely available to developing countries with high level of smoking statistics (poor and developing countries), and the second problem is that the machine cannot detect any variation in shape, size and irregularities of blood cells.

## 2. Related Works

There is a significant indication that poor and developing countries carry the substantial load of smoking linked to early mortality and disability [9]. One of the major obstacles is cessation of smoking in developing countries is poor healthcare system [9]. Smoking increase the risk of cardiovascular disease and acute stroke [10]. Rouleau formation is the overlapping of RBCs in a "curved coin roll" it is caused by poor lifestyle, like alcohol consumption and smoking. The field of blood cell examination has gained significance importance in biomedical engineering field. The main objective of image analysis in blood cells is to distinguished different elements of blood and counting of RBCs, WBCs and platelets.

Khan and et al. proposed a technique to count blood cell components. The process involves numerous pre-processing phases like using HSV before converting the original image to a binary image [11]. Image segmentation was implemented based on Otsu method, the group attained 95% accurateness with their suggested technique, and the downside of the method used is it is not consistent in detecting overlapping cells. On a similar study by the group of Berge and et al., the algorithm that was proposed is based on Otsu thresholding technique. Detection was performed on RBCs, including clumped cells, this method was not able to detect a high degree of overlapping cells [12].

Both studies used HSV and Otsu thresholding for the segmentation of the RBCs. These studies using HSV and Otsu thresholding methods to detect the RBCs have some disadvantages, for example, required additional calculation, some of the important details are eliminated since the segmentation is automatically calculated and fewer capacity in detecting irregular and overlapping cells. Using RGB conversion to grayscale and Iterative technique are better in segmenting as compared to HSV and Otsu's method in relation to time complexity and accuracy, since there are less procedure and less data is being eliminated during the process. The study of were able to detect overlapping cells using Hough Circle Transform but due to poor segmentation and image pre-processing techniques, some of the important data was eliminated in the process and it resulted to inconsistency of detecting overlapping RBCs, the proposed algorithm also uses Hough Circle Transform in detecting overlapping RBC however by using thresholding by calculating the structural element, converting the original image to grayscale, important data on the images remained intact [11] [12].

Today, the analysis of blood sample is prepared and tested manually, the outcome of manual process can result to an error. A solution to this problem is an efficient and cost-effective way automation of analysing blood cells [13].

## 3. Research Methodology

Figure 3 shows proposed algorithm using different image processing techniques that will be used for the smokers RBC sample, for Image pre- processing, grayscale method will be used for the image to have same level on brightness and Binarization with different structuring element will be used to identify the components of blood such as WBC, Platelets and for image segmentation for the RBC, binarization with a calculated structuring element and Hough Circle Transform will be used to identify the centre for detecting the RBC present on the blood sample.

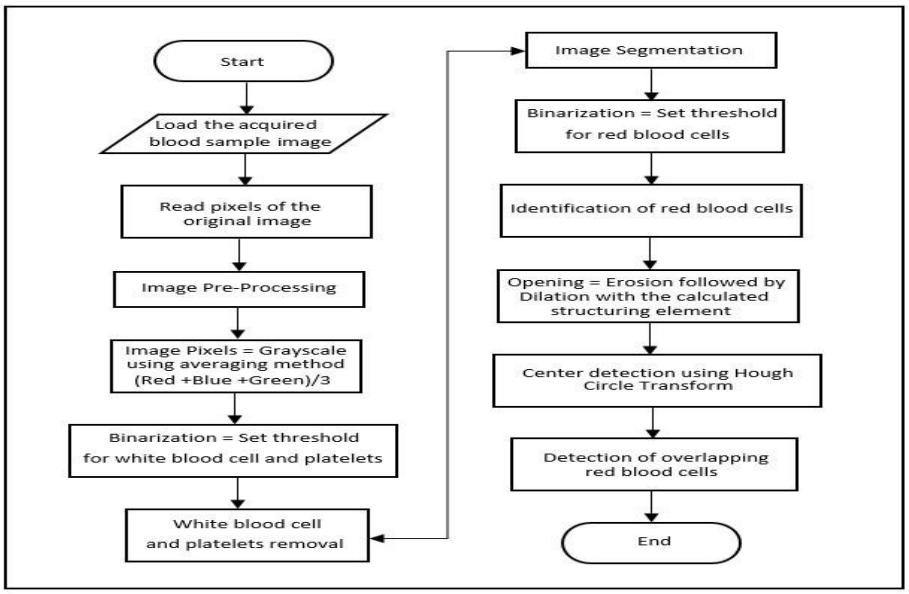


**Figure 3.** Proposed algorithm for segmenting coin stacking formation of RBC - Rouleaux Formation.

Figure 4 is a detailed process on segmenting overlapping coin-stacking RBC. After image pre-processing, the first step is binarization of the acquired image using thresholding by obtaining its histogram, second, is applying morphological transformation, using opening (erosion followed by dilation) to eliminate noise on the image to extract better data by calculating each RBC's structural element and last is using Hough Circle Transform by calculating each RBC's connected components and detecting its centre to identify each RBC for segmentation.

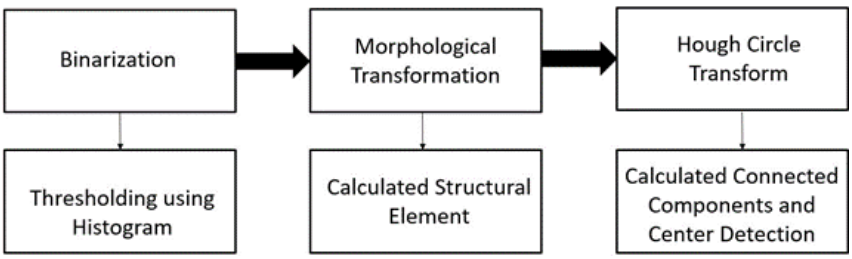


**Figure 4.** Detailed steps that will be used in segmentation part.

Figure 5 shows the proposed process in segmenting overlap- ping RBC where the manual individual inspecting of each cell is omitted. At first, the user will acquire the image of blood sample using digital microscope that needs to be analysed. After loading the acquired images, the proposed algorithm will be used to segment overlapping the RBC present on the blood sample that was used.

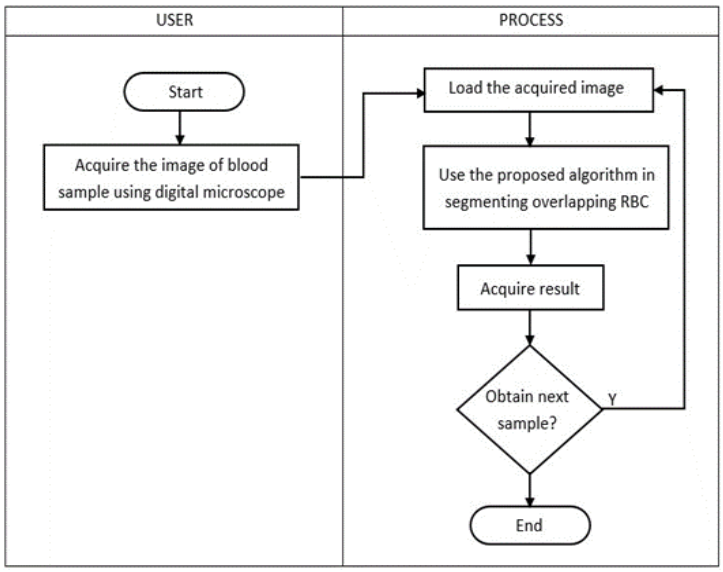


**Figure 5.** Proposed user workflow on segmenting coin stacking - rouleaux RBC formation

## 4. Conclusion

Technology is widely available in this day and age; it is used to make life easier and faster. Different sectors use a variety of technologies in their respective fields and one of this is the biomedical field. The use and integration of image processing is now common in the medical field. The aim of this study is to create an algorithm using different image processing techniques that can solve the detection of coin stacking formation of RBCs using smokers as a sample population in an efficient and cost effective way, solving segmentation problem of overlapping RBCs will have a positive effect and it will improve the counting of the blood cells. The primary aim of this research is to propose an enhanced segmentation algorithm that will be focused on segmenting high degree of overlapping RBC of smokers or commonly known as rouleax coin-staking formation. In this study the researchers focused on smokers since the smoking population have more tendency to have high degree of overlapping cell which is a problem in detecting and counting blood cells.

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