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RESEARCH ARTICLE

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Neural network based non-invasive method to detect anemia from images of eye conjunctiva

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Abstract

Detection of anemia can be done by examining the hemoglobin concentration level in the blood using complete blood count, which is an invasive, time-consuming, and costly technique. Preliminary methods for detecting anemia include examining the color of the palpebral conjunctiva, which is a non-invasive method, but color perception may vary from person to person. This study aims to develop a computerized non-invasive technique for anemia detection. We propose a novel machine learning model using the artificial neural network to detect anemic patients from the images of eye conjunctiva. Since limited and small dataset has been used in the earlier approaches, this may cause over fitting of the model. We have improved the number of available training images using image augmentation techniques. To standardize a non-invasive method, we have used computer vision algorithms for preprocessing and feature extraction. This article derives the backpropagation rules mathematically for adjusting the weights for the proposed neural network model. After hyper parameter tuning and using the mathematically derived backpropagation rules, the model was able to achieve the best accuracy of 97.00% with sensitivity 99.21% and specificity 95.42% on the created dataset.

KEYWORDS

anemia detection, artificial neural network, backpropagation rules, hyper parameters tuning, image augmentation

1 | INTRODUCTION

Anemia is one of the most common blood disorder. According to the World Health Organization, nearly a quarter of the human population suffers from anemia, which is caused due to deficiency of healthy red blood cell or hemoglobin. But in most of the cases, it is not possible to detect anemia from the symptoms. In many underdeveloped areas, due to lack of medical facilities, anemia remains undetected.

Complete blood count test is an invasive method to detect anemia in patients. In this method, the blood sample of the patient is taken, and the volume percentage of red blood cells (RBCs) in the blood is calculated to identify anemia. This method is time-consuming, costly, and is also not suitable for handling a large volume of patients in smaller duration of time. Thus a cost-effective, fast, and non-invasive method to detect anemia is needed.

A lot of research has been conducted in this area to develop a non-invasive method for anemia detection using the images of eye conjunctiva of patients. In References 1-3, authors have shown the relationship between the images of eye conjunctiva and the presence of the anemia in the patient.

In Reference 4, authors developed a non-invasive technique to detect anemia from images of eye conjunctiva using support vector machine (SVM). This model was tested on 19 test images (10 images belong to the anemic-patient, and

