A literature survey on Detecting Anemia from eye images using Machine learning

19MIS1018 – B DEVI PRASAD

Abstract:-

Anemia is a health issue which occurs due to the iron deficiency and low blood haemoglobin levels. This health issue is mainly common for the children and pregnant women. The main deficiency in healthy Red Blood Cells and low vitamin which leads to insufficient oxygen to be carried to whole blood tissues. To overcome this issue many researches came with their unique ideas with different applications. To detect anemia we can detect mainly by using Eye conjunctiva part, Nails, Blood samples and shortness of breath by using the machine learning techniques and algorithms. So, by taking eye images we can measure the blood haemoglobin level and making the analysis of the image to predict the haemoglobin level and anemia condition.

Keywords: Machine learning, Anemia and Haemoglobin.

Introduction:-

Anemia is an important health problem for childhood morbidity and mortality. The most recent WHO estimates that 42% of children less than 5 years of age are anemic. Anemia is a common blood disorder characterized by a reduced number of red blood cells or a deficiency in the haemoglobin concentration. It can result in symptoms such as fatigue, weakness, and shortness of breath. Traditional methods for diagnosing anemia involve blood tests to measure parameters such as hemoglobin levels, hematocrit, and red blood cell indices. While these methods are generally reliable, they may have limitations in terms of accessibility, cost, and speed. Moreover, the interpretation of results often relies on the expertise of healthcare professionals. Timely and accurate detection of anemia is crucial for effective medical intervention and management. Machine learning (ML) techniques have emerged as valuable tools in healthcare for automating the diagnosis and prediction of various medical conditions, including anemia. Timely detection allows for early medical intervention, preventing the progression of anemia a nd associated complications and also anemia can result from various underlying causes, including nutritional deficiencies, chronic diseases, and genetic factors, making it a complex condition to diagnose. The proposed models will describe the steps involved in developing the proposed machine learning model and its performance in detail.

3. Preliminaries:

3.1 Algorithms used for detecting Anemia by machine learning:

- Bayesian Network (BN)
- Naive Bayes (NB),
- Logistic Regression(LR)
- Multilayer Perceptron (MLP)
- k-Fold cross-validation
- Scleral segmentation algorithm
- Neural Network algorithms
- K-Nearest Neighbour (KNN) algorithm
- Decision Tree
- Support vector machine
- Artificial Neural Network (ANN)
- Random Forest
- Two-class Bayesian decision rule

3.2 Datasets used:

- Nail image dataset.
- Sickle Cell Dataset
- WHO Dataset 2014.
- Combination of three (3) different dataset, that is, the conjunctiva of the eye, palpable palm and colour of the fingernail images for the detection of iron deficiency anemia.
- To predict with easy smartphone implementation, the proposed model uses image analysis techniques to estimate the haemoglobin level.
- First the eye images where captured and trained and tested. Then, Device creating constant light to Prepare mask for ROI using MATLAB image thresholding app.

4. Literature review:

Peter Appiah Ene a, Enoch Justice [1] developed model was embedded into a smartphone application that can detect anemia by capturing and processing a patient's conjunctiva with a sensitivity of 90%, a specificity of 95%, and an accuracy of 92.50% on average performance inabout 50 s.

Sivachandar Kasiviswanathan and Thulasi Bai Vijayan [2] developed a noninvasive method for identifying the anaemic status of a person by estimating their hemoglobin (Hb) level. Data collected from 135 participants is used for developing this model in which 80% of them (108 participants) were classified as a training group

and the rest (27 participants) were grouped into a test group and their data is used for testing the model that's based on the Ridge Regression algorithm.

Mohammed Sami [3] proposed a deficiency in healthy Red Blood Cells (RBC) leads to insufficient oxygen to be carried to whole blood tissues. Such a disease can be diagnosed by blood test called Complete Blood Count (CBC), which evaluates Hemoglobin levels of patient's blood. untreated left disease, such as anemia, can cause health Problems such as severe fatigue and pregnancy complications.

Shubham Bauskara and Prakhar Jaina[4] proposed a Initial screening for Non-invasive detection of anemia is done by examining the color of eye conjunctiva and after that by accommodating the outcomes with intrusive blood test extracting the eye conjunctiva and obtaining the region of interest(ROI).Once ROI is extracted, these images are processed to obtain the mean intensity values of red and green components of image pixels corresponding to ROI. Then attuned machine learning algorithm is used to predict whether the patient is anemic or not. The model employed is run over 99 test subjects using k-Fold cross-validation and had achieved an accuracy of 93 percent.

Sagnik Ghosal and Debanjan Das[5] proposed a Significant drawbacks include high costs, lack of state-of-the-art facilities, invasive techniques, and lack of smartphone implementation, using additional equipment and non-autonomous functioning, for smart anemia-care techniques. These problems in the form of a spectroscopy based blood hemoglobin level monitoring model. This approach uses a smartphone camera as a sensor. It quantifies the hemoglobin level based on the region of interest's color spectroscopy, which is the conjunctival pallor, extracted autonomously.

Giovanni Dimauro and Mauro Giuseppe Camporeale [6] developed to prove that the colour of the sclera and scleral blood vessels extracted from digital images of the eye can be used to check the anaemic status of a person. For anaemia estimation consisting of three main contributions: a sclera segmentation algorithm applied to near-taken digital photos of the eye, a vessel extraction algorithm, and a classifier to predict the anemic status of person vs normal controls.

Peter Appiahene and Justice Williams[7] developed a conjunctiva image-based dataset is supported with Hb levels (g/dL) annotations for accurate diagnosis of anemia. A joint deep neural network is developed that simultaneously classifies anemia and estimates hemoglobin levels (g/dL) based on the conjunctiva pallor images. The experimental results demonstrate the efficacy of the joint deep neural network in both the tasks of anemia classification and Hb levels (g/dL) estimation.

Nahiyan Bin Noor and Md. Saeid Anwar[8] developed eye conjunctiva picture that has been taken utilizing a 12-megapixel cell phone camera. It has been finished by

pulling the lower eyelid and snapping the photo of the eye conjunctiva. Then the image is cropped and taken only the conjunctiva portion. After cropping the image, it is taken to MATLAB for further processing. As everyone uses a smartphone nowadays, the cost of a smartphone camera is neglected as a part of our device. The color thresholding app of MATLAB can eliminate the unwanted portions of an image efficiently using RGB pixel color thresholding technique and predicts the output.

Sohini Roy Chowdhury and Donny Sun[9] proposed work analyses on the pallor sites of conjunctiva and tongue for anemia screening purposes. First, for the eye pallor site images, the sclera and conjunctiva regions are automatically segmented for regions of interest. Similarly, for the tongue pallor site images, the inner and outer tongue regions are segmented. Then, color-plane based feature extraction is performed followed by machine learning algorithms for feature reduction and image level classification for anemia

Giovanni Dimauro And Danilo Caivano[10] proposed a non-invasive approach to Hb estimation based on the image analysis of a specific conjunctiva region. Our goal is to develop a device that is not expensive and simple to use for assessing the anemic condition. This device could be used by the physician to decide whether to take a blood sample or even by a patient at home to decide whether to inform a physician. This way, we can avoid having the patient go frequently to the laboratory to take a blood sample.

Justice Williams Asare and Peter Appiahene[11] developed a Image capturing (dataset collection); taking images of the palpable palms, conjunctivae of the eyes, and fingernails. Preprocessing of images; extraction of the ROI of the captured images. Afterwards, we separated the component of the CIE Lab (also known as CIELAB) color space of the images, segmented the images, and calculated the mean intensity of the various CIE L*a*b* color space components of the images (extraction and segmentation of the ROI).Development of the detective (anemic or non-anemic) models. Machine learning algorithms (Naïve Bayes, CNN, SVM, k-NN, and decision tree algorithms) were developed to detect anemia using various captured and processed images (datasets). This means that for anemia to be detected, the dataset goes through three phases

Sivachandar Kasiviswanathan and Thulasi Bai Vijayan[12] The objective of this work is to develop a non-invasive method for identifying the anaemic status of a person by estimate their hemoglobin (Hb) level. Hemoglobin level of a person is predicted from their digital image of the lower palpebral conjunctiva and basic details like age, sex, height, weight and BMI.

Samer Muthana Sarsam a and Hosam Al-Samarraie[13] proposed a novel mechanism for recognizing anemia based on the associations between disease symptoms and patients' emotions posted on the Twitter platform used k-means and Latent Dirichlet Allocation (LDA) algorithms to group similar tweets and to identify hidden disease topics. Both disease emotions and symptoms were mapped using the Apriori algorithm.

Saurabh Mitra and Dr. Shanti Rathore [14] proposed a novel non-invasive algorithm which is able to detect the anemia using the human nails. In this approach they use computer vision, machine and deep learning concept and based on that only we decide the anemia level on any particular patient.

Sagar Yeruva and M. Sharada Varalakshmi [15] in proposed model early identification of sickle calls will help people recognize signs that can assist antibiotics, supplements, blood transfusion, pain-relieving medications, and treatments etc. The manual assessment, diagnosis, and cell count are time consuming process and may result in misclassification and count since millions of red blood cells are in one spell.

5. Tools supported to Detect anemia:

- **MATLAB:** MATLAB is a proprietary multi-paradigm programming language and numeric computing environment developed by MathWorks. MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages.
- **Android and iOS:** iOS only runs on Apple devices, while Android runs on Android phones and tablets made by a number of different companies.
- **Python 3.6.8:** Python 3.6.8 is the final bugfix release for the 3.6 series. It was released on December 24, 2018. It is no longer supported and does not receive security or bug fixes. Apps still using it contain potential security vulnerabilities.

6. Conclusion:-

In this approach we can use computer vision, machine and deep learning concept and based on that only we decide the anemia level on any particular patient. The early identification of sickle calls will help people recognize signs that can assist antibiotics, supplements, blood transfusion, pain-relieving medications, and treatments etc. This study proposed a novel mechanism for recognizing anemia by using machine learning.

7. References:-

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