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Measurement of Haemoglobin Using Digital Photographs of Mucous Membrane of Eye

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Abstract—

Conjunctival paleness or pallor is a result of low haemoglobin concentration in the human blood that can be caused by conditions such as anemia. Pallor sites of conjunctiva region are cluster segmented for regions of interest based on color using K-mean algorithm and color-plane based feature extraction is performed. Neural network is trained using the processed data of locally collected set of images in controlled conditions of wide demography of patients having taken the needed clinical Haemoglobin test using calorimeter method. Using a regulated set of standard images, the pallor screening system can detect the severity of disease like anemia.

Keywords— Conjunctiva, K-mean Cluster, Neural Network

Introduction :

Haemoglobin is one of the esteem which must be ascertained for the human to check his/her wellbeing found in red platelets. Haemoglobin ingests green light and reflects red light when a white is focused on the conjunctiva area of eye. Measuring haemoglobin level through intrusive estimation brings about torment, skin contamination, etc. The estimation of haemoglobin through obtrusive estimation needs the encompassing temperature and different parameters ought to be kept up, if any progressions happen, the haemoglobin value for a similar individual likewise fluctuates. The non-invasive estimation technique gives no agony and furthermore has no human blunder. In this work, the photograph of the individual's eye is taken and the computerized picture is handled through the MATLAB and the haemoglobin value is found by benchmarking the given contribution with the officially existing preclinical outcome. The minimum error value will be considered as the haemoglobin level of that individual. This procedure decreases clinical blunder and furthermore acquires the haemoglobin level with no torment.

RELATED WORKS :

There are specific numbers of approaches to calculate the haemoglobin value and there are numerous works going under this task. The haemoglobin value can be assessed by two principle ways one is invasive estimation in which blood is taken and experiences some clinical procedure to calculate the haemoglobin value, well this procedure is an agonizing one, and this procedure may at times wind up in false value likewise because of clinical blunder, human mistake or here and there may likewise differ because of the adjustment in temperature. The other technique is non-obtrusive estimation in which one strategy is IR beams anticipated on the hand and assessing the haemoglobin value. Yet this model doesn't generally give the ideal haemoglobin in all climatic condition. When the encompassing temperature is high, it doesn't give adjusted haemoglobin and the other primary issue with this strategy is that the IR influences the skin.

[1] Within the sight of paleness can unassumingly raise the likelihood of extreme iron deficiency while its non appearance can preclude serious pallor. Neither nearness nor non attendance of paleness, paying little mind to its seriousness can precisely discount in or manage direct iron deficiency.

[2] In Conjunctiva whiteness adds data to the clinical basic leadership process, despite the fact that it can't prompt sure analysis in like manner clinical circumstances.

PROPOSED WORK :

The existing method provides various possibilities for measuring haemoglobin from blood in the process of determining whether the person is anemic or not. Both the invasive and non-invasive methods have made it easy to determine the exact haemoglobin count from the blood which plays a crucial role in diagnosis of anemia. It is also an important factor for the blood donation, as the blood donated from the donor drops in haemoglobin count during the transportation by 1 or 2 g/dL. So as it reaches the patient, the blood should not make the patient sicker.

Invasive method has many techniques that acquire the blood from a person through the vein and does a CBC test for the cell count or a color scale method to determine the redness of blood and comparing it with the color cards. But this method is painful and has more discomfort to the patient. The blood obtained is by using a needle through veins or by pricking the fingers. In some case this leads to swelling up of that particular area or risk of infection. So it is viable to go for the non-invasive methods where the diagnosis is swift and provides easy analysis for the patient.

Digital photographs of the conjunctiva region of eye are used for the analysis. Conjunctival pallor or paleness is directly related to the presence of anemia as the paleness in the ocular region is due to the distinct amount of absence of haemoglobin from the blood which leads to anemia in human body. The digital photographs are obtained from an external hardware and are processed by color plane conversion in order to separate Red, Green, Blue, Hue, Saturation and Brightness value. From the obtained set of color-plane, the mean value of the separated color is calculated and is compared with the preprocessed data obtained from a wide demography of people ranging from gender and age, as anemia is classified differently for different people based on age and gender.

The process involved in this work is that the image is acquired using an external device such as raspberry pi camera board attached to the raspberry pi system connected through a CSI interface. The pre-processing involves filtering to preserve edge and homogeneity of the image. The proposed work includes filtering techniques such as Wiener filter and median filter, K- mean clustering algorithm and Neural Network Toolbox. The figure 1 shows the block diagram of the proposed method;

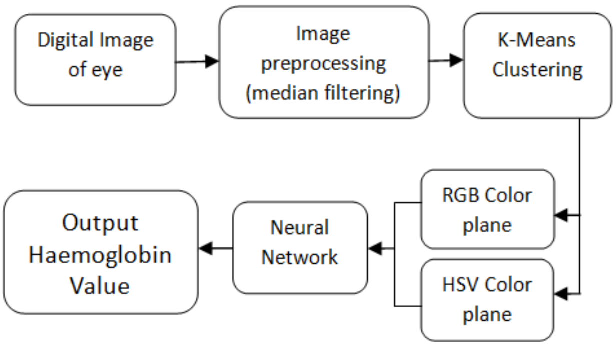

Figure: 1 Block diagram of the proposed method

K-Means Clustering Algorithm:

Image segmentation is the classification of an image into different groups. Clustering or data grouping is a key initial procedure in image processing. The algorithm works iteratively to assign each data point to one of K groups based on the features that are provided. Data points are clustered based on the feature similarity. The results of the K-means clustering algorithm include (i) The centroid of the K clusters, which can be used to label new data (ii) Labels for the training data . The figure 2 shows the result of K mean clustering of the input eye image.

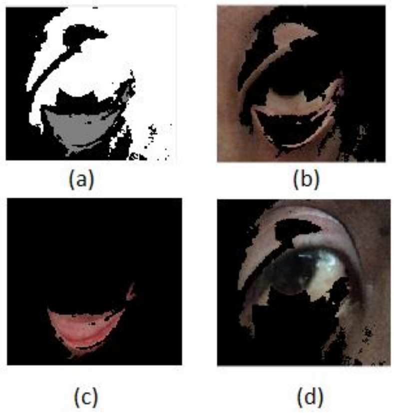

Figure 2: (a) Cluster index (b) Cluster 1 (c) Cluster 2 (d) Cluster 3

Neural Network Training :

Benchmarking process is done using Neural Network which is trained using the processed set of image data acquired from various categories of people along with their haemoglobin value. The images are acquired such that the image parameters are not so different from each other so as to minimize the possible error. The images are processed as similar to the input image and are converted into RGB and HSV color plane as shown in figure (3) and figure (4). The mean value of the individual color planes are calculated and are used to train the neural network. The network further decides the output for the given input based on the trained data.

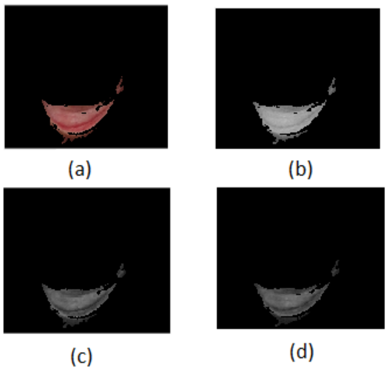

Figure (3): (a) RGB image (b) Red Channel (c) Green Channel (d) Blue Channel

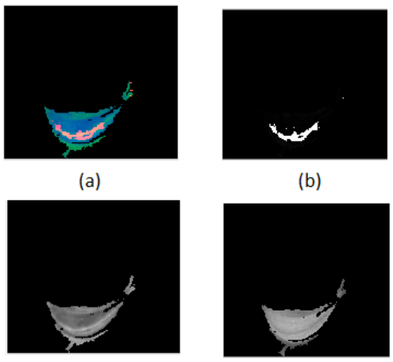

Figure (4): (a) HSV image (b) H Component (c) S Component (d) V Component

The simulation result of Neural Network is shown in figure 5. The figure 5(a) shows the performance plot. Figure 5(b) and figure 5(c) portrait the training state plot and regression plot respectively. The figure 5(d) shows the output for the haemoglobin value measured from the given input eye image.

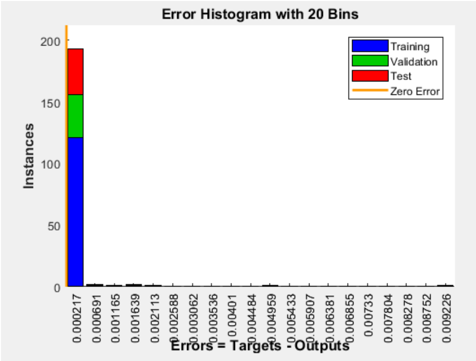

Figure 5(a) Performance plot

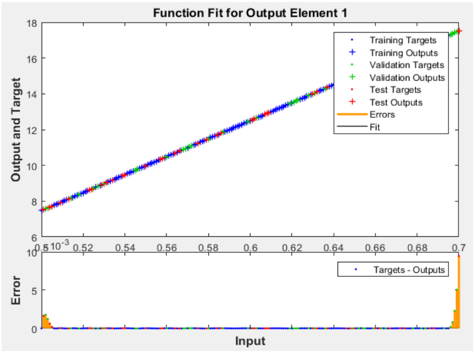

Figure 5(b) Training state plot

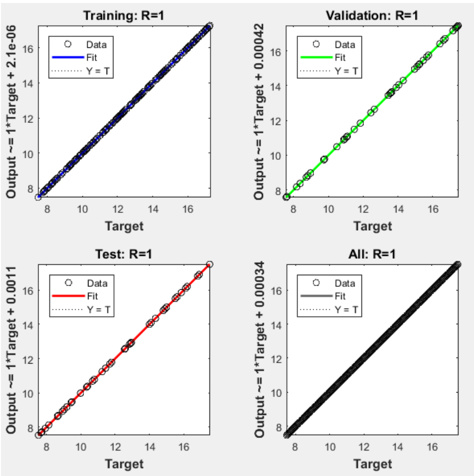

Figure 5(c) Regression plot

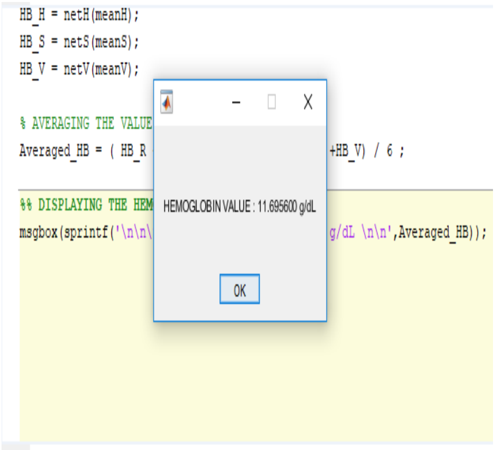

Figure 5(d) Output image

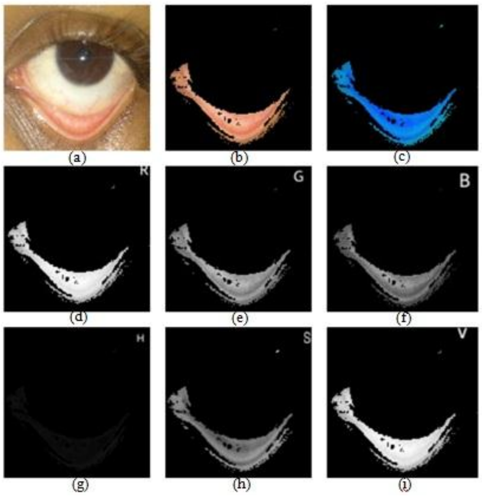

Figure 6: (a) Test image (b) Segmented image (c) HSV Image (d)R plane (e) G plane (f) B plane (g)H plane (h) S plane (i) V plane

The figure 6 shows the different steps involved throughout the proposed work including the image under test, the segmented image using K-Means clustering, HSV image, the RGB color plane and HSV color plane

IV.**CONCLUSION :**

The system is designed for feature extraction, segmentation, and training strategy for pallor classification and screening using colour parameters from pallor site images. Previous work focused only on grading the conjunctival pallor as three categories as anemic, non-anemic and pallor resembling to anemia but has similar features. For pre-clinical evaluations, the suggested approach benchmarks the severity of anemia against the actual patient haemoglobin count. Analysis is done by training a neural network using the processed set of images in predicting the future output from the input given to the model. Examining the additional data sets gathered under controlled imaging settings will be the focus of future research. The observations from the experimental study are

more generalizable yet limited in classification capabilities because the data sets under investigation in this work cover a wide range of imaging condition variabilities.

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