Non-Invasive Medical Tool to Estimate Anemia Based on the Concept of Digital Data

Saurabh Mitra[1], Dr. Shanti Rathore[2], Dr. Sanjeev Kumar Gupta[3]

Ph.D Research Scholar, Dept. of ECE, Dr. C. V. Raman University[1]

Associate Professor, Dept. of ECE, Dr. C. V. Raman University[2]

Dean Academic, Rabindranath Tagore University[3]

Abstract: This assessment intends to execute an image planning figuring for area of both red and blue recolored platelets to help in examination of iron need shortcoming in an inexorably feasible and viable manner. Our philosophy empowers us to secure the precise number of each recolored platelets. The estimation in like manner finds out the degree of blue and red recolored cells in the given model picture test. This information is pivotal in distinguishing the disease and choosing its earnestness. In spite of the way that the estimation is organized in such a manner to give versatility with respect to the decision of either a particular region or a whole given picture test, the figurings are practiced for the perfect region figuratively speaking. Pictures of villi cells taken from the little stomach related arrangement of individuals were used.

Keywords: Anemia, Invasive, Cells, Hemoglobin

I. INTRODUCTION

A New Method and a Non-Invasive Device to Estimate Anemia Based on Digital Images of the Conjunctiva Anemia is a worldwide general medical issue with significant ramifications for human wellbeing. The World Health Organization (WHO) gauges that somewhere in the range of two billion individuals are iron deficient, which is denied as Hb fixations that are beneath the suggested limits [WHO, Geneva, Switzerland 2004], [WHO, Geneva, Switzerland 2008]. Frailty is characterized as an abatement in the red platelets flowing in the blood or as a lessening in the convergence of Hb: subsequently, it is a diminished capacity of the blood to ship oxygen. It starts primarily from wholesome variables (iron inadequacy, nutrients and minerals), irresistible illnesses (jungle fever, intestinal parasites) or hereditary elements (hemoglobin opathies) [McLean. E et.al. PHN 2009] [WHO, 2001]. These variables can happen in confinement yet are as often as possible related. Iron lack Anemia is the most well-known healthful inadequacy, and it causes a large number of passings (allianceanemia.org); it is additionally liable for expanded grimness and mortality in pre-younger students and pregnant ladies. In 2002, iron insufficiency Anemia was viewed as among the most significant contributing components to the worldwide weight of malady [WHO, Geneva, Switzerland, 2002]. Iron deficiency has a moderate development: regularly, no conspicuous manifestations show up for Hb>9-10 g/dl, since the human body actualizes compensatory components, for example, expanding the measure of blood siphoned, so that the measure of oxygen discharged to the tissues remains practically unaltered. At the point when the remuneration can never again ensure a satisfactory portion of oxygen, side effects, for example, weariness, pallor, crabbiness, expanded pulse, a sleeping disorder, cerebral pain and numerous others show up. The clinical report, much of the time, is equivocal and hard to portray. Moreover, Anemia is regularly not analyzed or sufficiently treated in incessant patients for whom it is a significant hazard factor (counting mortality) and significantly affects the personal satisfaction. Despite its etiology, since an extreme level of Anemia bargains the cell oxygen accessibility and causes harm that extents from harm to indispensable organs to a conceivably perilous condition, as a rule, iron deficient patients must be transfused dependent on their Hb level, which can vary step by step. Pallor is evaluated by estimating the degree of Hb, a protein in the red platelet that is the most dependable marker of Anemia, since Hb supplies oxygen to the entirety of the cells of the body. Standard clinical strategies to analyze Anemia basically depend on the obtrusive assurance of blood Hb, which requires venepuncture performed by a medical caretaker or a doctor. Visit blood testing prompts the patient's uneasiness, and the prerequisite of setting off to a research center or calling a medical attendant includes significant cost. Truth be told, it is of incredible enthusiasm to contemplate techniques and to configuration instruments to screen the convergence of Hb in a non-obtrusive way, with diminished costs, both in the research center and at the patient's home, some of the time even every day. Numerous examinations show incredible enthusiasm for the paleness of body parts to assess Anemia. For instance,

Kalter. H et al., 1997 give the helpfulness of clinical indications in the discovery of Anemia, which recommends the practicality of adding conjunctival whiteness to the Integrated Management of Childhood Illness (IMCI), a procedure intended to decrease kid mortality and grimness in creating nations.

Tsumura. N et al., 2003 considered skin shading and surface investigation/amalgamation by separating Hb and melanin data in the skin. Also, reports thinks about on the connection among skin and Hb.

Spinelli. M.G.N et al., 2003 analyzed the examination of palmar and conjunctival whiteness to recognize Anemia: they found that there was a more prominent degree of affectability to conjunctival paleness than to palmar whiteness.

Spinelli. M.G.N et al., 2003 presume that it was still ahead of schedule to suggest the normal utilization of this method (2003); nonetheless, it could advance considerable investment funds whenever culminated.

Aggarwal. A. K et al., 2004 concentrated the legitimacy of palmar paleness for the finding of Anemia among youngsters matured 6 to 9 months.

A comparable methodology is portrayed Silva. R.M.D et al.,2010 yet the creators expressed that conjunctival paleness assessment is emphatically affected by the spectator. Without a doubt, the doctor's experience is significant in this kind of assessment.

Hasan. M.K. et al 2017 and Wang. E.J. 2016, present picture handling of a ngertip video to examine the connection between the picture pixel data and distinctive (Hb) levels. Also, for this situation, the gauge of Hb is unequivocally affected by the shade of the skin or by straightforward tanning.

For a long time, doctors in like manner practice have assessed Anemia in individuals by watching the eyelid conjunctiva. This training is as yet far reaching in many hindered territories of the earth. Watching the eyelid conjunctiva can give data to suspecting Anemia, as a few examinations proposed.

In, the nearness of conjunctival whiteness was used for Hb assurance, and the creators arrived at 95% segregation precision among sickly and non-pallid patients dependent on an assessment of conjunctival paleness, considering a cut-off of 90 g/L for the Hb focus.

The basic factor in the entirety of the refered to works is that the assessment of conjunctival paleness isn't target, and it requires direct decisions of master doctors. As of late, there has been an expanding enthusiasm for the utilization of advanced pictures of the palpebral conjunctiva to make a non-intrusive gauge of Anemia. In the following segment, we will detail related work that tends to Anemia assessment dependent on advanced picture preparing. As per an investigation led by the world wellbeing association (WHO), 24.8 level of the whole total populace was viewed as pallid between the year 1995 and 2005. The Hemoglobin fixation in the human blood is considered as the highest quality level for the identification of pallor. This is an intravenous procedure which requires specific careful gear. As of late, figure prick blood test is taken for lab testing however blood testing requires a lot of time and may open medicinal services laborers to dangers of blood borne contaminations. Assessment of the conjunctival whiteness of the eye is normally used to quickly screen for iron deficiency in numerous centers, Physicians by and large pulls down the eyelid and emotionally look at the shade of the foremost conjunctival paleness film. The clinical sign for iron deficiency discovery can demonstrate to be very helpful by and large, yet the absence of between onlooker understandings much of the time and low affectability of front conjunctival shading can undermine the credibility of the visual recognition process. Shading scale cards, which comprises of the shading range and the comparing hemoglobin focus is utilized in numerous events to mitigate the issue of between onlooker difference and human mistake to make the visual identification process progressively dependable. Hemoglobin is the essential constituent which adds to the pigmentation found in human blood. It has a predisposition in mirroring the red part of the light falling on its surface contrasted with the green segment which it transcendently ingests. This is the main purpose behind the profound ruddy appearance of hemoglobin. Thus, by looking at the red and green parts of the RGB shading range of the conjunctival paleness, it is conceivable to at a slant gauge the hemoglobin fixation in the human circulatory system. Because of absence of legitimate human services and medicinal offices in immature nations, numerous individuals are defenseless against weakness. This circumstance can be reduced if a sign of weakness can be assessed without including costly blood tests, which are inaccessible in a large number of these zones. Indeed, even the accessibility of specialists or medicinal laborers is spotty. It would be an extraordinary assistance if the nearness of iron deficiency in a patient can be distinguished utilizing non-intrusive techniques which does exclude costly tests or even the nearness of a specialist or medicinal laborer. The nearness of pallor in an individual can be a sign of different sicknesses like jaundice and absence of sustenance. The identification of iron deficiency can serve to demonstrate the nearness of different illnesses too.

II. AUDIT OF LITERATURE

Non-obtrusive methodologies are critical for patients who need visit blood tests, and ongoing enhancements in picture examination have empowered promising strategies to be created. As of late, new and fascinating ways to deal with unbiasedly connect the eyelid shading with the Hb focus dependent on advanced pictures of the palpebral conjunctiva have been proposed. For instance,

In 1989, Carrillo Sanchez et al. utilized a colorimetric device to contrast distinctive shading conceals and the conjunctiva.

Thus, they accomplished fascinating affectability and explicitness levels in screening Hb fixations.

In 2000 Rubeto. C.Di et al., This paper talks about the malarial picture preparing framework. This framework recognizes and characterizes intestinal sickness parasites in Giemsa recolored blood slides pictures. At that point after parasitaemia assessment is finished. Morphological way to deal with cell picture division is more exact than the traditional watershed-based calculation is appeared in this paper. Dark scale granulometries are associated in perspective on opening with circle formed segments, level and non-level. Non level circle shaped organizing segment improves the roundness and the red cells minimization.

In 2002 Ruberto.C.D.et al., This paper talk about a framework orders and distinguish jungle fever parasite by utilizing tiny pictures of platelets. Morphological methodology and the critical necessities in building up this structure are the best frameworks for platelet pictures division.

In 2002 Liao. Q et al., This exploration chip away at an Automated Cell Count technique is portrayed. An exact technique for division for checking white platelets naturally is displayed here. Introductory a clear thresholding approach is associated and the computation is resolved about blood spread pictures from priori data. The imprints are offset by then with a particular ultimate objective to convey important results. This strategy is progressively compelling when contrasted with customary strategies which use data of nearby setting. It can perform exact division of white platelets however they have un-sharp cutoff points.

In 2002 Starck. J.L et al., In this work creator utilizing a channel bank of a" trous wavelet channels, curvelet change executes curvelet sub-groups and uses a ridgelet change as a part step, and thought all through is that changes should be over whole, more energetically than fundamentally inspected. In this electronic changes are associated for de-noising of some standard pictures set up in dreary clamor. A mix of geometric separation and an improved separation change consolidating force inclination is utilized for the watershed step

In 2003 Lin.G. et al., According to this paper an express scientific model for attributes of cell cores like estimate and shape measures is incorporated. For each recognized core, a certainty score is processed by estimating appropriateness of core in the model.

In 2005 Fabio. , Here creator shows the support of a programmed morphological methodology to see the Acute Lymphocytic Leukemia (ALL)with the assistance of pictures of fringe blood magnifying instrument. The exhibited framework individuates the leucocytes from the others platelets, after that it picks the lymphocyte cells (the cells causes uncommon leukemia), morphological files from those cells are assessed then after and finally characterization is performed whether the nearness of the leukemia is there or not.

In 2007, Suner. S et al., investigated shading highlights of computerized pictures of the conjunctiva. They used a standard dim card with a known RGB incentive to look at pictures obtained under various lighting conditions. In their test, they used an assessment programming that ran on a Personal Digital Assistant (PDA), which considered the RGB shading model and found a moderate connection between's the Hb focus determined in situ and the Hb fixation estimated in vitro. Another exceptionally intriguing investigation is accounted for In 2016 Chen.

Y.M. et al., where the creators utilize 18 potential highlights, including a recently included entropy highlight.

In 2014 Kim. O.et al., Studied the mix of a stochastic photon proliferation model in a multi- layered human eyelid tissue and reactance spectroscopy was utilized to contemplate the unearthly reactance of palpebral conjunctiva for Hb assurance. The removed Hb levels were contrasted and in vitro estimations of Hb; the technique demonstrated 86% affectability gauges for clinically analyzed Anemia cases. Sadly, the outcomes were gotten utilizing advanced and costly clinical hardware that isn't appropriate for usage in home settings.

In 2016 Trupti. S. et al., In this work creator directs in such situation to take choice in malady conclusion. The contribution to the proposed framework is individual nail picture. The framework will process a picture of nail and concentrate highlights of nail which is utilized for malady analysis. Human nail comprise of different highlights, out of which proposed framework utilizes nail shading changes for infection analysis. Here, first preparing set information is readied utilizing Weka device from nail pictures of patients of explicit infections. A component extricated from input nail picture is contrasted with the preparation informational collection with get result. In this trial we found that utilizing shading highlight of nail picture normal 65% outcomes are accurately coordinated with preparing set information during three tests directed.

In 2016 Bevilacqua. V et al., Here it was assessed that Hb levels utilizing a computerized picture of the eyelid conjunctiva: unique in relation to Sanchez. C.I. what's more, Suner.S. et.al our methodology didn't require a relative card to decide the shade of the conjunctiva, because of the plan of a particular gadget that was made of two segments: the equipment and programming modules. The gadget comprises of a head-mounted plastic aloof watcher (like a Google cardboard) that takes care of certain issues, including the impact of encompassing light. As prove, we found a moderate relationship (0.49) between a (CIELAB part) estimation of the picture of the palpebral conjunctiva taken through the above gadget and the Hb esteems. Moreover, to anticipate the requirement for blood transfusion, we utilized a twofold more tasteful dependent on a Support Vector Machine (SVM), and the subsequent records were 84.4% (precision), 82.4% (specicity) and 100% (affectability). The outcomes were acquired with 77 patients (9 of them pale, 68 sound).

In 2016 Chen Y.M. et al., the creators, refering to Bevilacqua. V. state that ideally, such a gadget can get well known and

moderate later on'; notwithstanding, we accept that the gadget is still very unwieldy and costly for home use. The outcome was empowering, yet the analysis ought to be stretched out to a bigger number of patients to find out if that strategy can genuinely be utilized to stay away from superfluous blood transfusion or blood inspecting to recognize the present level of Anemia. Additionally in this paper, we assessed the plausibility of evaluating the Hb level through an advanced picture of the eyelid conjunctiva. Because of the plan of another gadget and new programming running on a typical cell phone, we acquired a palatable outcome that will be point by point in the following areas.

In 2016 Wu. H.S.et al., According to this paper an iterative thresholding calculation is used for division reason especially from boisterous pictures. This calculation overcomes the issue of cell extraction and division from overwhelming boisterous pictures. This calculation works over the balanced limit of pictures iteratively giving power to picture.

In 2017, Chen. Y.M. what's more, Miaou. S.G. et al., Propose a consolidated methodology that comprises of a modied Kalman channel and punishment relapse for non-intrusive Anemia discovery basing on the examination of computerized pictures of the palpebral conjunctiva, and they successfully decrease the quantity of suspect examples.

In 2018 Muthalagu. R. et al., According to this paper creator present non-obtrusive strategy, relationship of hemoglobin with conjunctiva whiteness shading scores and order utilizing neural systems. Around 200 example eye pictures were gathered from Sankara Nethralaya with various lighting conditions (LED, CFL, Tungsten, tube light, daylight, Daylight) and diverse portable and computerized cameras. Utilizing the proposed HSI model, the diverse shading score of the chose locale was evaluated and associated with research center hemoglobin esteem. Elman neural system was utilized for connecting and arranging weak and non-frail cases, out of which

91.3 rates of the forecasts were right and 8.7 rates weren't right arrangements.

In 2018 Giovanni. et al., The creator propose a non-intrusive way to deal with Hb estimation dependent on the picture investigation of a specic conjunctival locale. We will probably build up a gadget that isn't costly and easy to use for surveying the iron deficient condition; this gadget could be utilized by the doctor to choose whether to take a blood test or even by a patient at home to choose whether to advise a doctor; along these lines, we can abstain from having the patient go every now and again to the research center to take a blood test. This gadget additionally enables us to quickly screen for Anemia in countless people, for instance, gatherings of young ladies who are toward the start of the menses.

In 2018 Bhavya. et al., In this work creator the point of convergence of our examination is on restorative pictures However, finding, recognizing and checking of red platelets physically are monotonous and dull that could be rearranged by methods for programmed investigation, in which division is a significant advance. In this paper, we demonstrate an approach to manage programmed division and including of red platelets in minute platelet pictures utilizing Hough Transform and SURF.

III. BALANCED OF THE STUDY

As we probably am aware we are living in the time of 3D medicinal science where we have loads of Tools which can recognize the infection. In present time we have bunches of innovation however there is absence of therapeutic apparatuses which can discover paleness with any non obtrusive procedure. At present we need to take the blood tests and through that we can discover the pallor. As of now there is loads of research who are chipping away at Non intrusive procedure where they are utilizing the idea of picture handling. Here they are utilizing the methodologies like eye side or nails. So according to the ebb and flow search there is heaps of research holes are there which is truly should be explained and those are followings:

• Lack of Real Time: All present methodology are require pre characterize pictures of eye side or nails, so for that approach we need to catch great quality picture through eye side scanner or top of the line camera.

• Accuracy: All present methodologies are not ready to make appropriate outcome as they are center around one single methodology like SPO2 based, EYE side dependent on nails based so there is no any cross check technique is accessible which give surety of paleness.

• Long Process: according to scanner approach all past existing devices are require aches time

• Time Issue: All present calculations rush to give legitimate outcome in time.

• Quality Issue: This is a major risk which is truly should have been unraveled there is no any methodology which can get quality level report from the information parameters.

IV. DESTINATIONS

According to the past existing in inquire about hole there are followings goals which we will cover in this work and they are followings:

• Real Time Analysis

• High Accuracy:

- No all the more Long Process
- Reduction in Time Complexity
- Improvement in Quality Issue

V. ANTICIPATED OUTCOME

In this work we are center around the advancement of Non-Invasive Medical Tool to Estimate Anemia dependent on the Concept of Digital Data through continuous Analysis , so according to our desire we will ready to improve the followings parameters through our novel calculation:

1. Able to make equity with time parameter.
2. Here we will attempt to lessen the time multifaceted nature with 10-20%.
3. Here we will attempt to improve the quality unpredictability with 10-20%.
4. Here we will attempt to make increasingly exact framework we will improve the precision by the 30-40% when contrasted with past approaches.
5. We will make an ongoing framework which can discover flaw on live camera.

REFERENCES

[1]. Aggarwal A.K., 2014``Validity of palmar pallor for diagnosis of anemia among children aged 6 to 9 months in North India," Anemia, vol. 2014, Art.no. 543860. [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4241719/

[2]. Angelopoulou. E, 2001 ``Understanding the color of human skin," Proc. SPIE, vol. 4299, PP 243-251.

[3]. Anand, Bhavya, Goel Yukta, and Goel Amita. 2018 "RED BLOOD CELL DETECTION USING HAUGH TRANSFORM AND SURF TECHNIQUE." RED 7.3.

[4]. Bevilacqua. V. et al.,2016 ``A novel approach to evaluate blood parameters using computer vision techniques," in Proc. IEEE Int. Symp. Med. Meas. Appl. (MeMeA), Benevento, Italy, PP 16, doi: 10.1109/MeMeA.2016.7533760.

[5]. Bhanushali, Akshay, et al. 2016"Automated Disease Diagnosis Using Image Microscopy."

[6]. Bhatia, Komal, and Mandeep Singh. "Non-Invasive Techniques for Detection of Haemoglobin in Blood: A Review."

[7]. Collings, Shaun, et al. 2016 "Non-invasive detection of anaemia using digital photographs of the conjunctiva." PloS one 11.4 : e0153286.

[8]. Chen. Y. M, Miaou. S.G. and Bian. H,2016 ``Examining palpebral conjunctiva for anemia assessment with image processing methods," Comput. Meth- ods Programs Biomed., vol. 137, pp. 125135, doi: 10.1016/ j.cmpb.2016.08.025.

[9]. Chen. Y. M and Miaou. S.G., 2017 ``A Kalman filtering and nonlinear penalty regression approach for noninvasive anemia detection with palpebral conjunctiva images," J. Healthcare Eng., vol. 2017, Jul. 2017, Art. no. 9580385. [Online]. Available: https://www.hindawi.com/ journals/jhe9580385/cta/, doi: 10.1155/2017/9580385.

[10]. Dimauro, Giovanni, Caivano Danilo and Girardi Francesco 2018. "A New Method and a Non-Invasive Device to Estimate Anemia Based on Digital Images of the Conjunctiva." IEEE Access 6 46968-46975.

[11]. Fabio Scotti University of Milan 2005, Department of Information Technologies, via Bramante 65, 26013 "Automatic Morphological Analysis for Acute Leukemia Identification in Peripheral Microscope Images" IEEE International Conferenceon Computational Intelligence For Measurement Systems and Giardini Naxos, Italy.

[12]. Hasan, Kamrul. Md. et al. 2017 "Analyzing the existing noninvasive haemoglobin measurement techniques." Ubiquitous Computing, Electronics and Mobile Communication Conference (UEMCON), 2017 IEEE 8th Annual. IEEE.

[13]. Hasan. M .K, Sakib. N, Love. R. R and Ahamed. S. I,2017 ``RGB pixel analysis of ngertip video image captured from sickle cell patient with low and high level of haemoglobin," in Proc. IEEE 8th Annu. Ubiquitous Comput., Electron. Mobile Comm. Conf. (UEMCON), PP. 499-505, doi: 10.1109/UEMCON.2017.8249004.

[14]. Indi, Trupti S. and Gunge. A. Yogesh 2016 "Early stage disease diagnosis system using human nail image processing." IJ Information Technology and Computer Science 7 PP 30-35.

[15]. Kalter. H et al.,1997 ``Evaluation of clinical signs to diagnose anaemia in uganda and Bangladesh, in areas with and without malaria," Bull. World Health Org., vol. 75, no. 1, PP 103,

[16]. Kim. O, McMurdy. J, Jay. G, Lines. C, Crawford. G and Alber. M, 2014``Combined reactance spectroscopy and stochastic modeling approach for noninvasive haemoglobin determination via palpebral conjunctiva," Physiol. Rep., vol. 2, no. 1, PP 001-92.

[17]. Lin G, Adiga U, Olson K, Guzowski J.F., Barnes C.A. and Roysam. B 2003 "A hybrid 3Dwatershed algorithm incorporating gradient cues and object models for automatic segmentation of nuclei in confocal image stacks," Cytometry Part A, vol. 56, no. 1, PP. 23–36.

[18]. Liao Q and Deng Y, 2002. "An accurate segmentation method for white blood cell images," in Proceedings of the IEEE International Symposium on Biomedical Imaging, PP 245–258.

[19]. McLean. E, Cogswell. M, Egli. I, Wojdyla. D and de Benoist. B, ``Worldwide prevalence of anaemia, WHO vitamin and mineral nutrition information system, 1993-2005," Public Health Nutrition, vol. 12, no. 4, PP 444-454, 2009.

[20]. Muthalagu, R., V. Thulasi Bai, and Sheila John 2018 "A smart (phone) solution: An effective tool for screening anaemia–correlation with conjunctiva pallor and haemoglobin levels." TAGA Journal 14 PP 2611-2621.

[21]. Rubeto C.Di, Dempster A, Khan S, and Jarra B,2002 "Segmentation of blood images using morphological operators," in Proceedings of the 15th International Conference on Pattern Recognition, vol. 3, PP 397–400.

[22]. Ruberto C.D., Dempster A, Khan S, Jarra B,. 2002 "Analysis of Infected Blood Cell Images Using Morphological Operators", Image and Vision Computing, Vol. 20, PP 133- 146

[23]. Spinelli M.G.N.,Souza J.N.P,de Souza S.B., and Sesoko. E.H.,2003 ``Reliability and validity of palmar and conjunctival pallor for anemia detection purposes," Rev. Saude Publica, vol. 37, no. 4, PP 404-408.

[24]. Sanchez-Carrillo C.I., de Jesus Ramirez-Sanchez T and Selwyn B.J.,1989 ``Test of a noninvasive instrument for measuring haemoglobin concentration," Int. J. Technol. Assessment Health Care, vol. 5, no. 4, PP 659-667.

[25]. Sheth. T.N., Choudhry N.K., Bowes. M and Detsky A.S., 1997``The relation of conjunctival pallor to the presence of anemia," J. Gen. Internal Med., vol. 12, no. 2, PP 102-106.

[26]. Silva R.M.D and Machado C.A., 2010 ``Clinical evaluation of the paleness: Agreement between observers and comparison with haemoglobin levels,'' Rev. Brasileira Hematol. Hemoterapia, vol. 32, no. 6, PP 44-48.

[27]. Starck J.L., Candes E.J., Donoho. D.L.,2002 "The curvelet transform for image denoising", IEEE Transaction on Image Processing 11 (6) PP 670–684.

[28]. Suner. S, Crawford. G, McMurdy. J and Jay. G, 2007 ``Non-invasive determination of haemoglobin by digital photography of palpebral conjunctiva,'' J. Emerg. Med., vol. 33, no. 2, PP 105-111.

[29]. Tyagi, Megha. 2018 "Detection of Poikilocyte Cells and Haemoglobin Using Digital Image Processing.".

[30]. Tamir, Azwad, et al. 2017 "Detection of anemia from image of the anterior conjunctiva of the eye by image processing and thresholding." Humanitarian Technology Conference (R10-HTC), 2017 IEEE Region 10. IEEE.

[31]. Tsumura. N et al., 2003 ``Image-based skin color and texture analysis/synthesis by extracting haemoglobin and melanin information in the skin,'' ACM Trans. Graph., vol. 22, no. 3, PP 770-779.

[32]. Wang. E. J, W. Li, Hawkins. D, Gernsheimer. T, Norby-Slycord. C and Patel. S. N, 2016

[33]. ``HemaApp: Noninvasive blood screening of haemoglobin using smartphone cameras,'' in Proc. ACM Int. Joint Conf. Pervasive Ubiquitous Comput. (UbiComp), PP 593-604, doi: 10.1145/2971648.2971653.

[34]. Wang. E. J., W. Li, Zhu. J, Rana. R and Patel. S. N, 2017 ``Noninvasive haemoglobin measurement using unmodied smartphone camera and white ash,'' in Proc. 39th Annu. Int. Conf. IEEE Eng. Med. Biol. Soc. (EMBC), Seogwipo, South Korea, PP 2333-2336, doi: 10.1109/EMBC. 2017.8037323.

[35]. Wu H.S., Barba J & Gil. J, 2000 "Iterative thresholding for segmentation of cell from noisy image" Jour of Microscopy, vol.197, PP296–304

[36]. Assessing the Iron Status of Populations, World Health Org., Geneva, Switzerland, 2004.

[37]. World Health Organization, Worldwide Prevalence of Anaemia 1993- 2005: WHO Global Database on Anaemia, B. de Benoist, E. McLean, I. Egli, and M. Cogswell, Eds. Geneva, Switzerland: World Health Organization, 2008.

[38]. World Health Organization, ``Iron deciency anaemia: Assessment, prevention and controlA guide for programme managers,'' WHO Reference WHO/NHD/01.3, 2001. [Online]. Available: http://www. who.int/nutrition/topics/ida/en/

[39]. The World Health Report 2002: Reducing Risks, Promoting Healthy Life, World Health Org., Geneva, Switzerland, 2002.