An Empirical Analysis of Methods & Algorithms used in Detection of Sickle Cell Disease

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Abstract:- **A collection of diseases that cause red blood cells to misform and break down. Sickle cell disease is a hereditary illness characterized by sickled red blood cells. The cells die prematurely, resulting in a lack of healthy red blood cells (sickle cell anemia) and the ability to obstruct blood flow, producing discomfort (sickle cell crisis). Treatments include medication, blood transfusions and rarely a bone-marrow transplant. Pain areas, Pain types, Whole body, Urinary and also common abnormal breakdown of red blood cells, inflamed fingers or toes, pallor, shortness of breath, or yellow skin and eyes are also called sickle cell disease. Overview of the Symptoms are treatments specialists are all devices, Medication, Narcotic, Relieves pain, dulls the senses and causes drowsiness. May become addictive, Chemotherapy, Unwanted reactions to drugs given for the purpose of killing cancer cells. Vitamin helps to promote normal body function, growth and development.**

Keywords:- *Sickle Disease, Cell, Blood, Hemoglobin.*

I. INTRODUCTION

Hemoglobin is an iron-rich protein that gives red color to the blood. Round red blood cells are indicative of health. These red -blood cells carry oxygen for every parts of the body by means of tiny blood vessels. Because blood vessels are flexible and circular, red blood cells can pass through them with ease. Anemia has 3 important reasons viz. Red-blood cell destruction, insufficient red-blood cell production, and blood loss in high rates.

"Sickle Cell disease" is an inherited illness that affects the body's Hemoglobin. This will affect the form of red blood cells, which distribute oxygen throughout the body. Owing to sickle-cell illness, the customary rounded Blood cells have transformed into sickles or crescent moons. These cells harden and thicken .and the cells shaped like sickies and crescent moons. This will lower the speed of blood flow or block the blood flow due to their atypical form, cells become lodged in small blood arteries.

II. SICKLE CELL DISEASE

Sickle disease originated from Africa and India, now it is spreading all over the world due to globalization. The highest incidents found in Sub Saharan Africa, India and Middle East. Signs of sickle disease will start from early childhood. Symptoms of sickle disease vary from person to person.
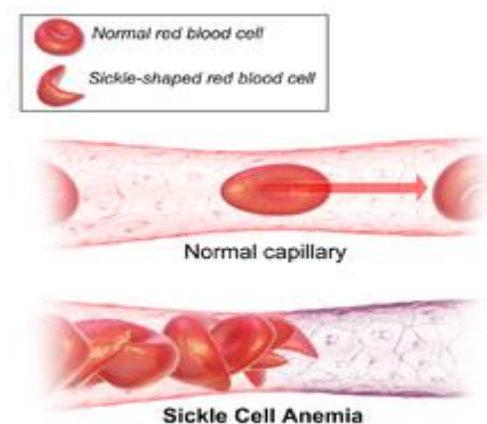

Fig1. Sickle Cell Anemia

IV. IDENTITY OF SICKLE CELL ILLNESS

Sickle cell illness is a common one and a lifelong illness that results from a beta-globin gene mutation. It causes hemoglobin S, an aberrant form of hemoglobin, to be produced. Sickle cells cause organ damage, unpredictable painful episodes. Hemolysis of blood cells and in certain cases sickle disease leads to death. For this reason. To detect sickle cell disease, various methods have been developed. This paper gives a summary of modern methods used for detection of SCD. [1]

V. METHODS

For sickle cell disease detection, certain methods are very popular viz Complete blood cell count, electrophoresis 1 segregation, and high-performance liquid chromatography (HPLC). These techniques are known as "Gold Standards" in the field of SCD diagnosis. Depending on the individual's age, there are four testing windows that coincide. viz. Prenatal and Preconception, neolapping and Prior to conception, pregnancy. [2]

TABLE 1 Testing Methods and Periods

S.no	Test	Testing Periods	Purpose	Remarks
1	Preconception Testing	Offspring would be at risk	Designed to identify asymptomatic potential parents	High Performance Liquid Chromatography [HPLC]
2	Prenatal Diagnosis	Early Childbearing	To pairs who performed well on the preconception screening	Safe and invasive Procedure
3	Neolapping	carried out at birth before the onset of symptoms	New Born Screening	Methodologies for Hb Protein Analysis
4	Post Neonatal testing	Methodologies for Hb Protein Analysis	Children	Through Neonatal screening Programs

VI. ALGORITHMS USED IN SICKLE CELL DETECTION

Average of 4,5% of Worldwide, every year, there are children born with sickle cell.as a result, more attention towards the reduction of sickle cell cases by adopting strategies and methods. An algorithm has been developed for detecting sickle cell disease using MatLab Programming language which uses digitalpicturesas input to detect the presence of Sickle-Cell Anemia.

Chinawar "et-al". developed an image processing algorithm which used sample images processed using cluster-based segmentation technique to diagnose sickle cell presence in thin blood smears automatically. The acquired pictures undergo processing by clustering-based segmentation method to recognize sickle cells and red blood cells found on microscopic slides. In addition to its restriction on overlapping red-blood cells, the method of picture acquisitions expensive in a situation where light microscopes are not available.[3]

"SaimaBala et al". [3][4]developed a technique which automatically observes red-blood cells with sickle cells by dividing of images. In their method, for the extraction of red blood cells Watershed segmentation technique was used. This technique focuses on the lack of red blood cell overlap by ignoring red blood cell overlap.

"Bharam et al."[5] suggested a procedure for the classification of sickle cells and healthy red blood cells utilizing spatiotemporal analysis- A portable, reasonably priced 3D printed shearing interferometer is used for this purpose. The method aimed to identify sickle cells through morphological analysis and mechanical properties of red blood cells. The prototype developed was made aware of the photographed blood samples that were taken to identify the sickle cells.

"Sen et al". [6] suggested a method for identifying and categorizing sickle cell anemia the red blood cells of humans using machine learning techniques. Using microscopic pictures, to analyze the form of an erythrocyte and Segmentation was carried out using thresholding. For classification blood cells in different shapes, Support vector machines, random forests, logistic regression, and naïve Bayes were applied.

Seravanan et al. [7] proposed a method which classifies blood smear images in which adaptivethresholding diagnostic techniques are employed to identify sickle cell disease.

Laith et al. [8] proposed a model using deep learning for sickle cell diagnosis by categorizing red blood cells in microscope picturesanemiadiagnosis. The research published by Taking up the training data issue using transfer learning techniques through optimizing model performance.

"Begum et al."[9] suggested a molecular analysis-based technique for determining sickle cell anemia by sugar sequencing to extract genomic DNA from the patient body. The abnormal behavior of sickle cell anemia and other complications were detected by using this method. There are intricate processes in this procedure, and experts are needed to understand the findings as well as it requires pricey gadgets.

TABLE 2 Literature Survey

Authors	Algorithms Developed	Techniques Used	Purpose	Limitations
Chintawar et al. 2022	Image Processing Algorithm	Clustering Based Segmentation Technique	To diagnose sickle cell presence in thin blood smears automatically	In some environments where access to light microscopes is restricted, the procedure of obtaining images might be expensive.
"SaimaBala et al" 2018	Method of Automatic Detection-Support vector machine classifier is used train the images	Watershed Segmentation Technique	Focus on thereby ignoring overlapping red blood cells in favor of non-overlapping red cells	-
"Bharam et al" 2005	Classification of Sickle cells and healthy red blood cells	Spatio Temporal Examination	Studying Morphology additionallymechanical Properties of Red Blood cells	It takes about two hours to process the data.Purchase Price of the Machine does not allow for blood cells to overlap
"Sen et al" 2018	Machine Learning Technique	Classification and Segmentation	Using Red Blood Cells to Diagnose and Classify Sickle Cell Anemia	Cell Shape may have an impact on the precision of the findings, cell form factor and cell thickness are overlooked. Cell Thickness and Cell Form Factor are over Looked
Begum et al 2018	Molecular Analysis	Sugar sequencing	To identify Sickle Cell Anemia	It's a complicated process, and experts are needed to interpret the results.Purchase Expensive Equipment
Lalith et al 2021	Deep Learning Model	Transfer Learning Techniques	To categorize erythrocytes in microscopic pictures	-

VII. CONCLUSION

The survey includes many methods and algorithms used for detecting sickle cells from normal blood cells in the human body. By using this study, the scholars can develop better methods and algorithms to detect and identify "sickle cell "disease for the betterment of the people. The development in today's technology will help to find the better solution for reducing "sickle cell"illness in society.

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