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BLOOD PHENOTYPING AND ESTIMATION OF HEMOGLOBIN CONTENT USING IMAGE PROCESSING

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Abstract - At present era, nearly 75% of the diseases are identified by analyzing blood samples. There are many parameters like RBC and Platelets present in blood, of which hemoglobin is an important parameter. It is one of the significant parameters to be estimated for medical procedures, during traumatic conditions, pregnancies and so on. This paper is based on blood phenotyping by processing of images procured during the slide test and also for the estimation of hemoglobin by image processing using MATLAB. It combines both the process in a single device and is handled easily. This reduces the time required to know the blood type and hemoglobin content. The main advantage is that there is no need of skilled personnel.

1. Introduction:

The hemoglobin (Hb) level is the most-used parameter for displaying blood donors for the presence of anemia. This work aims to find pre-transfusion tests necessary for a safe blood transfusion. This gadget likewise used to decide abo and rh blood composing and blood phenotyping. It is essential to specify that as of now these tests are performed physically or if nothing else semi-naturally, which may happen in mistakes in the testing method, the reading and interpretation of the results, being sometimes serious to the patient.

Akshaya Krishnan .et (2017) At present racing world it is a serious disadvantage to detect haemoglobin and blood group through complex lab instruments and depending of skilled personnel.[1] V. P. Kharkar et. (2013) Hb is responsible for transporting oxygen from lungs to the different parts of the body through blood. It is also responsible for transporting carbon-di-oxide from different parts of the body to the lungs. It is a serious issue that emerges in people when Haemoglobin level in their blood is lower than the standard range.[2] H. Ranganathan et (2006) Since most of the laboratories use one of the WHO mentioned methods other than cyanmethemoglobin or HemoCue methods, the results obtained have a proneness to give an wrong estimate of Haemoglobin in blood resulting in false sense of safety leading to complications, especially for pregnant women. [3] Ana Ferraz et (2013) It is important to mention that presently these tests are performed with human interpretation, which may lead to errors in the testing process, the reading and interpretation of the results, being sometimes fatal to the patient.[4] Xiaoxi Yang1 et (2014) The quantification of Hb concentration is performed frequently as a part of blood tests to analyse the O2-carrying capacity of blood. Machines presently available to lab technicians for measuring are very expensive for resource limited settings.[5] Jacob Rosenblit .et (1999) Various Researches performed on blood donors in America have resulted to the good reproducibility and accuracy of the HemoCue method. However, comparability of the Hb level measured via the HemoCue method with other, more recently available hematological equipment has not been performed.[6] Leeniyagala Gamaralalage Thamal Darshana.et (2014) WHO color scale is a semiqualitative method and over the years it has been a

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useful tool in identifying anemia in field studies. Efficiency in terms of cost, accuracy, and time makes it an important resource in primary health care settings in developing countries. At present WHO color scale is the most widely used method for detecting anemia in settings where there is no laboratory.

2. Methods and Experimental Work:

2.1. Estimation of haemoglobin and blood phenotyping:

A colour scale is used for determining hemoglobin with the process of comparing the blood sample with 10 ranges of hemoglobin. Its primary outcomes is similar to spectrophotometric readings. This scale is used for determining hemoglobin where there are no laboratories. Process for estimating hemoglobin levels by comparing a droplet of blood on a piece of filter paper towards a colour scale have been widely utilized in health centers in developing countries for the detection of anemia. The estimation of ABO and Rh type can be performed by Humans using tube, plate, micro-plates or gel centrifugation. Micro-plates and gel centrifugation tests are giving accurate result than tube or plate tests. The main drawbacks are that it needs heavy devices and also of high cost.

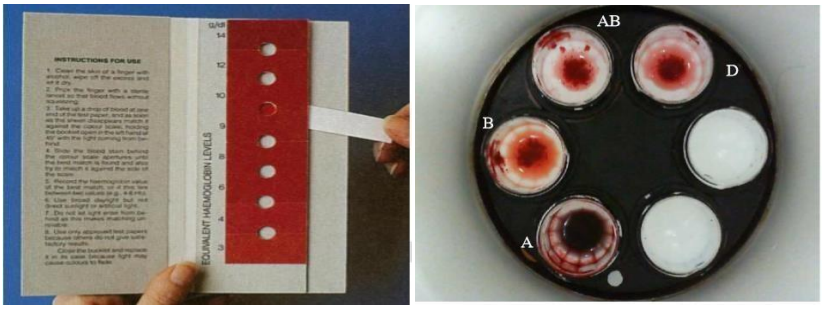

Figure 1. Estimation of Haemoglobin and Blood Phenotyping

2.2. Estimation of blood phenotype and hemoglobin using image processing:

In this technique, we use MATLAB software for image processing. The materials required are Whatman filter paper, lancet, cotton, alcohol swabs, 8MP camera, Arduino. First, apply alcohol on a finger and prick it with the assist of lancet. Draw a drop of blood at the filter out paper. Let it dry for 30-45 five seconds. Capture the picture of the dried pattern within 30-60 seconds.

S.NO.	HAEMOGLOBIN LEVELS	INTENSITY RANGE
1.	14	108-119
2.	12	120-126
3.	10	127-134
4.	8	135-142
5.	6	143-147
6.	4	148-152
7.	3	153-160

Table 2.1 Haemoglobin level corresponding to colour intensity

Pixel area were determined on MATLAB. (Table 1) shows the intensity range of hemoglobin values. For blood phenotyping (ANTI-A, ANTI-B, ANTI-AB, ANTI-D) is mixed with blood sample to produce agglutination. The occurrence of agglutination is used to determine the ABO- Rh blood type.

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It is performed with the help of change in area due to agglutination and determined using image processing.

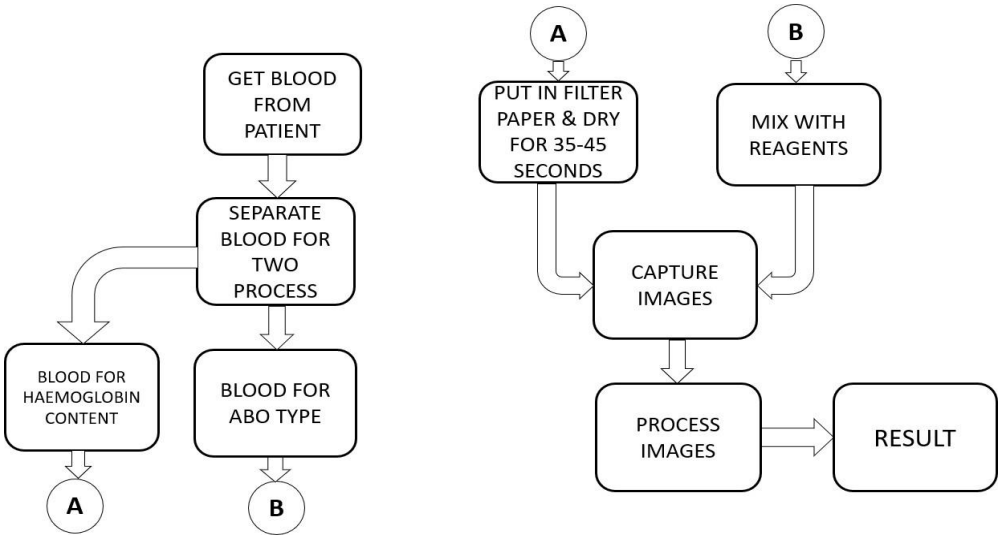
Blood Group	Forward Group			Reverse Group	
	Anti-A	Anti-B	Anti-A, B	A1-Cells	B Cells
A	+	-	+	-	+
B	-	+	+	+	-
AB	+	+	+	-	-
O	-	-	-	+	+

Positive symbol shows Coagulated blood. Negative symbol shows Non-coagulated blood.

Table 2.2. Result for blood phenotyping.

2.3. Flow process:

Figure 2. Process Flow Diagram



The process goes on like this flowchart. Initially we should get blood from the patient by safety means i.e. removing after application of alcohol on the skin surface. Then it is separated into different test-tube for different process. The two process are carried out in the same machine at the same time. The haemoglobin detection process is done by dropping a blood droplet in a watt man filter paper and let it dry for 35-45 seconds and a image is captured by OV7670 camera module and is processed by MATLAB software and the result is published. The blood phenotyping process id based on the mixing of reagents with the blood and by analyzing the changes in the test tubes i.e. coagulation of the blood by using MATLAB software we identify the blood group of the donor.

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2.4 Process Circuit diagram:

The circuit diagram is shown in the figure. The Camera Module is interfaced with the microcontroller and then the microcontroller is interfaced with the MATLAB software. And a relay is interfaced for connecting the motor for centrifuge. The connections are shown in the figure 3

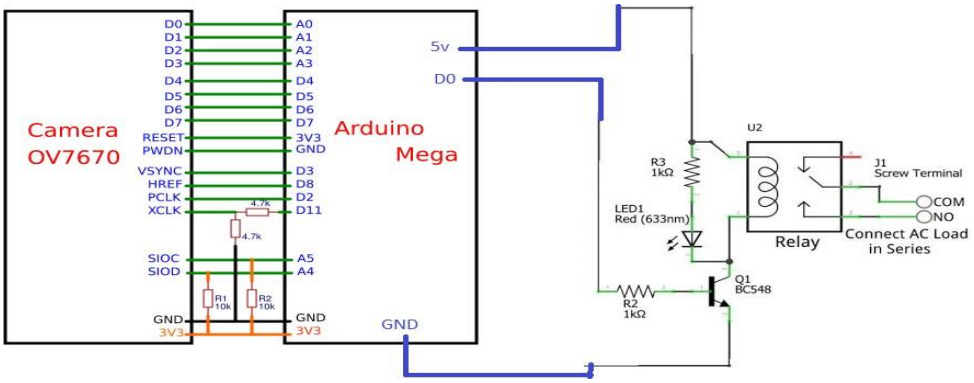

Figure 3. Circuit Diagram

2.5 Experimental Design:

The prototype is designed using NX-Cad software and is made by acrylic sheets. A dc motor of 1000 rpm is used as centrifuge. The camera module used here is OV7670. For determining the colour intensity Arduino mega 2560 is used with an interface of MATLAB. The design is shown in figure 4.

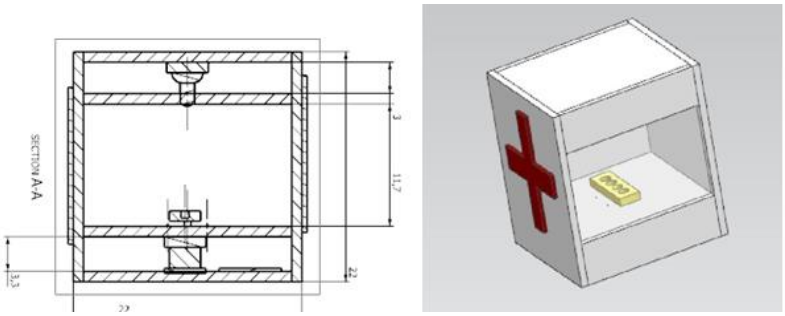

Figure 4. Design for prototype

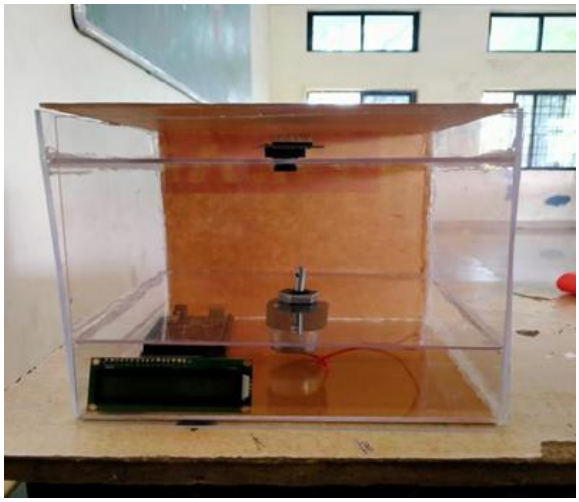

Figure 5 Prototype

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3. Conclusion:

As a result, this paper successfully decides intensity values for a specific hemoglobin level by way of the approaching the sample using image processing and also determine the phenotype of the blood by the occurrence of agglutination. It is done using image processing on MATLAB software. Major difficulty to be labored on in this method is decimal point precision and also the hemoglobin estimation is only available till 14g/dl which has to be raised to 20g/dl for the estimation of hemoglobin for nascent babies. This research also successfully determines the blood group by MATLAB software. The main advantage of this project is both the haemoglobin determination and blood group determination occurs in the same machine and at the same time.

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