

Blood Group Measurement using Light Emitting Diode

Jaya Rubi, A.Keerthana, G.Srividhya, R.J. Hemalatha



Abstract: Blood grouping is basically the categorization of blood based on the presence or absence of antigens and antibodies present on the surface of the Red Blood Cells (RBC's). The most common and most important type of blood type classification system is ABO system and the Rh system. The ABO system includes blood types like A, B, AB, and O group. This identification system plays a major role during transmission and transfusion of blood. The major risk involved in blood transfusion is getting the wrong blood type by accident. A recent survey shows that for every 1 million units of blood transfused, getting the wrong blood type happens, at the most, 4 times. Transfusion with the wrong blood type can lead to a severe reaction that may be life-threatening. The existing method involves a standard procedure in which blood is drawn from the patient's body by pricking the finger with a needle or by using a syringe. The shortcomings of this method are addition of chemical reagents, hassle for patients and time of operation is more. The present proposal involves a prickless technique for blood group detection. This proposal presents a novel method for non invasive and instantaneous blood group measurement using the transmittance and reflectance property of light emitting diode. The proposed method aims to design a small and compact prototype which would be efficient and effective than the existing methods. Moreover it would be designed at a very low cost and provide comfort to the patients as well.

Keywords : Arduino Uno, Blood group, laser diode, Prickless

I. INTRODUCTION

This The ABO blood group system is used to determine the different types of antigens in the red blood cells and antibodies in the plasma. Having none of these A/B antigens means that they can be donated to a person with any ABO blood type. Some of the red blood cells have Rh factor, which is also called RhD antigen. There are four main blood groups defined by ABO system.

1)Blood group A-has antigen A on the RBC and anti-B

antibodies in the plasma

2)Blood group B-has antigen B on the RBC and anti-A antibodies in the plasma

3)Blood group O-has no antigens ,but it has both A and B antibodies in the plasma

4)Blood group AB-has both A and B antigens ,but no antibodies

The blood group O are called 'UNIVERSAL DONORS' because it is compatible with any blood type. The blood group AB are called 'UNIVERSAL ACCEPTOR' since it has no antibody in the plasma to attack the antigens on the red blood cell of donor. most Existing blood group methods are tube, slide, gel, microplate methods etc. in those methods the blood sample of the person where taken and tend to mixed with antibody solution after sometime agglutination may or may not occur. thus blood group can be determined after the formation of agglutination snag of this method are more chances of human error are possible therefore mismatching of blood group may occur. Gel method is an automated handling system is designed specifically for use with current gel technology. It was found to be reliable easy to use and fully alarmed making it a 'walk-away instrument. tube method in this both forward(cell), a well as reverse(serum) grouping is carried out. In forward grouping blood cells are placed in two test tubes along with saline as a diluent media, and then one drop- of each anti-A and anti-B is added separately in the samples. Microplate method is ideal for large number of blood samples those microplate can ne incubated and centrifuge. It results can be photographed for archival storage.

II. LITERATURE REVIEW

[1]T.M Selvakumari proposed that modern Electronic Communication System fibre optics based devices plays a dominant role. The Optical property variations gave the way for detection of ABO Blood group of human using Optics. Based on this method blood group can be easily identified.. The light pulses from the LED are allowed to fall on blood samples by using optical fiber cables. The other end of the optical cable is coupled to a pin-photo diode, which acts as a photo detector. The analog input actuates an LED. The optical variations obtained from the sensors are used to calibrate the blood group. The transmitter generates pulses of frequency 10 KHz. These pulses were fed and amplified to the LED, which converts the electrical variations into optical variations. The instrument detected blood group is compared with the conventional method. In the many modern medical electronic fields like endoscopy devices the principle of fibre optics is also used. [2]

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Blood Group Measurement using Light Emitting Diode

Soumil Chugh et al proposed a non-invasive hemoglobin monitoring device that measures hemoglobin concentration of a person without utilizing a drop of blood. The principle of photoplethysmography is the method used in this paper and also to measure the hemoglobin levels in blood the Beer Lambert law is used.

Shining lights corresponding to Red and IR wavelengths on the fingertip of a person and absorbance levels are computed is obtained by two PPG signals. The refractive index of hemoglobin and the physical distance between source and detector are determined using the path length travelled by light. Data from 10 volunteers of different ages and with varying Hb levels is acquired using the optical sensor built. Two PPG signals sampled at 100 Hz are obtained each for duration of 30 seconds. This method affects the amount of absorbance by the finger.

^[3] Jens Kraitl et al proposed a noninvasive multi-spectral measurement method that was tested with prototype-devices based on by using light emitting diodes (LED) through an area of skin on the finger and radiation of monochromatic light emitted by laser diodes. The sensors assembled in this investigation are fully integrated into wearable finger clips. In this paper a multi-wavelength photometric measurement method that provides non-invasive in-vivo spectral measurements in human blood and tissue as well as the monitoring of heart circulation patterns has been described. A newly developed laser based PMD I and a LED based PMD II device has been introduced that is able to measure PPG signals continuously at different wavelengths from 600 nm up to 1400 nm. For a measurement of blood components the Photo plethysmography (PPG) and NIR-spectroscopy are used. The arterial oxygen saturation (SpO₂) and the optical absorbability characteristics of blood which is yielding information about blood components like hemoglobin (Hb) are used to calculate by this facts. ^[4] Gayathri T et al From the study, it is noted that non-invasive techniques for the estimation of Haemoglobin level, Glucose level and WBC structures are involved. Our proposed idea is a non-invasive method for identifying the blood group without puncturing the skin. Light act as a source for optical signals which is allowed to pass through the finger and detector detects the varying voltage. Based on the optical properties of blood group, the voltage value from the detector gets varied. Thus the voltage variations determine ABO blood typing. designed prototype 100 person's blood group data base was created. Individuals are asked to place the middle finger into the set up in order to provide them with comfort positioning. Two trials was undertaken for each individuals and for each trial both left and right hand middle finger was examined for acquiring the varying output voltage range for ABO Blood group. Depending upon the data collected for 100 samples approximate reference voltage values for the ABO blood group was determined without pricking the blood from the person. Bio-Optics method for blood typing are discussed in this paper. The article also presents non invasive method for glucose level detection and haemoglobin count. In future blood group detection using optics can also be performed. ^[5] Gaurav S. Mehare et al In this paper, the proposed idea is a non-invasive method for the identification of blood group of a patient without breaking the skin of patient. At present the

method based on image processing technology to determine blood type has been widely used in the automated blood analyzer. By using the scattered/reflected light from RBC the corresponding patient's blood group can be identified.

The Steps involved in this process are

1) The 1st step is placing the patient's thumb on the hole, present on the top of the box. Box contains camera and Laser light and the Device is turned on to fire laser light onto the skin surface.

2) Light is absorbed by the hemoglobin in the red cells, and light gets scattered after hitting on the edges of the antigenic determinants having specific structure/shape when illuminating at certain frequencies,

3) By keeping the optical device ON for certain specified time the pattern of this light scattering is captured and also to capture the aftereffects of scattering –the Multiple images are taken by this device in a succession to track or trace scattered light.

4) The recorded pattern gives an estimate of the type of antigens in the blood cells –which also gives an rough calculation of the blood type. The main advantages of this system are lower in cost, small in size, no side effects, since it does not make use of blood sample it overcomes the present difficulties of manual process and also no problem of bleeding, less time consumption.

^[6] Rajashree Doshi et al. The non-invasive sensor systems is based on pulse photometric measurement methods Which allows a continuous measurement of the hemoglobin concentration. LED is in the range from 600nm -1400nm which describe the absorption spectra for Oxyhemoglobin and deoxyhemoglobin. The light is allowed to pass through the finger and transmitted light is detected by photo diode. the principle of measurement is depend on the notable absorption and transmission difference of light in near infrared /red region between oxygenated [HbO₂] and reduced hemoglobin [HHb]. Furtherly it uses Beer Lamberts Law .

^[7] U. Timm et al. developed an non invasive sensor system for the haemoglobin measurement ,pulse and oxygen saturation which is depend on multispectral measurement method .It is based on the radiation of monochromatic light emitted by LED in the range of 600 to 1100nm

^[8] Nishtha Nagar et al. proposed an invasive method for blood detection within a short span of time. The fibre optic cables play a dominant role in this method. The transmitter(light) is coupled into the fibre with a connector and it is carried through the fibre optic cable plant which is transmit across a blood sample where a detector receives and converts the optical into electrical signal. Thus the result of different blood grouping was vary in voltage.

^[9] Edward Jay Wang et al. It is also a prickles technique for blood screening of hemoglobin using Smart phone cameras. It estimates the hemoglobin concentration by using smart phone application called 'HemaApp', the source for estimation for users Hb count are smart phone LED flash and Incandescent bulb as illuminating source. By scanning your fingers on the mobile camera using hemaapp you can obtain a hemoglobin count. ^[10]

Kumar.R et al. proposed a technique for Hemoglobin count using non invasive method. In this, a wavelength of (740nm and 805nm) are derived into the finger where it is photonically least resistant and the transmitted photons from the Hb content of the blood are detected by photo detector which converts them into electrical signal.

III. PROPOSED METHODOLOGY

The main requirement of the proposed methodology is to classify the various group of blood. This classification purely depends on presence or absence of antibodies and antigens that are present on the surface of red blood cells. The basic criteria used for determining the blood group is the agglutination that is formed when antigen and antibody reacts. This manual blood grouping technology has several drawbacks as it solely depends upon the person handling the test. When there is no interaction between the antigen and antibody agglutination does not occur.

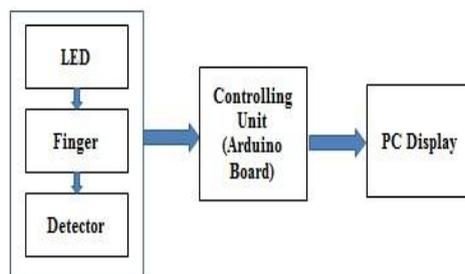


Fig1: Block Diagram

HARDWARE COMPONENTS:

Light Emitting Diode:

A light-emitting diode is used which has a semiconductor light source. Once it is energized the junction diode plays a major role in emitting the light. There a special effect called electroluminescence effect which produces photons when electrons combine with electron holes.

Optical Detector:

The OPT101 is an optical detector which is very small and easy to use. The photodiode collects the light and this helps us to achieve high sensitivity measurement. It is basically a light to voltage converter device that is integrated with an operational amplifier. The photodiode can detect a range from 300nm to 1100nm. The power supply required ranges from 2.7V to 36V.

Arduino:

Arduino boards are very useful as they are available as a variety of microprocessors and controllers. The Arduino board consists of a set of digital and analog input output pins that can be interfaced with other circuits. The boards also feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are specifically programmed using the programming languages C and C++. The Arduino project provides an integrated development environment (IDE) based on the Processing language project.

Our proposed idea is to determine the blood group using a non invasive method with the help of LED. The procedure involved is very simple and can be used very efficiently. The selection of an LED of suitable range and wavelength is the most important criteria as it allows the light source to fall on the finger. Further the optical detector helps us to obtain the optical signals which is acquired from the finger.

IV. RESULT AND DISCUSSION

The existing non-invasive techniques are studied and the and the proposed technique was carried out using some subjects. It has been concluded that it more or less uses a same principle of photo plethysmography. To detect blood grouping our proposed proposal is about usage of Light emitting diode to avoid scattering of light. This method would give comparatively more accuracy than other techniques. It is also a painless technique and would provide minimum discomfort to the patient. Based on the optical properties of blood group, the voltage value from the detector gets varied. Thus the voltage variations determine ABO blood typing. With the help of designed prototype.

Individuals were asked to place the middle finger into the set up. Several trials were undertaken for each individual for acquiring the varying output voltage range for ABO Blood group. Thus in this manner data was noted, according to the data collected the varying voltage range for ABO blood group was determined.

BLOOD GROUP	VOLTAGE
A	0.55-0.58
B	0.59-0.60
AB	0.61-0.62
O	0.52-0.54

Depending upon the data collected for 100 samples the approximate reference voltage values for ABO blood group was determined using a non- invasive method.

V. CONCLUSION

The Conventional methods that are used to determine the blood group involves the risk of infection. Another major drawback is time consumption. Several Non- invasive and Invasive technique including Image Processing for blood typing are discussed in this paper. In future blood group detection using optics and laser technology can also be performed.

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