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A NON-INVASIVE WAY TO DETERMINE BLOOD TYPE BASED ON ANTIGEN PROPERTY

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ABSTRACT

Rapid and accurate determination of blood types is very important during emergency situation before administering a blood transfusion. Identification of blood group plays a major role in the medical field for any treatment. The conventional method involves drawing of blood samples from human body and depending upon the antigen-antibody reaction blood group is determined. The classification of human blood supported the inherited properties of red blood cells. This method provides an easy and fast means of identification of blood groups and rhesus-factor non-invasively. The light glows from the LED, which is made to pass through the finger and the transmitted light is received by the LDR, which gives the output as resistance value. This value coded to the LCD display and the blood type is based on the resistance value.

KEYWORDS: *Blood Groups, LED, LDR, Inherited Property, Resistance Value*

Article History

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INTRODUCTION

Investigation of blood types plays a main role in the medical field. The blood types are determined by the presence or absence of certain antigens which will trigger an immune reaction if they're foreign to the body. There are four major blood groups determined by the presence or absence of two antigens-A and antigens-B on the surface of red blood cells. The A, B, and O blood groups is first identified by Austrian immunologist Landsteiner in 1901. ABO blood type of recipient and donor must be matched otherwise recipient system will produce antibodies that cause agglutination of the transfused cells and block the circulation. People with blood group AB is called as Universal Acceptor and the people with blood group O is called as Universal Donor. In addition to the A and B antigens, there's a protein called the rhesus factor, which may be either present (+) or absent (-), creating the 8 most common blood types.

During the procedure of blood transfusion any mismatch can lead to the death of person. Hence, it's preferable to identity his/her blood type. Now days, we are following a conventional method (a manual process) for blood group detection. In hospitals and blood bank they need to identify the blood group in short span of time. The conventional method is time consuming and a very slow procedure is followed to carry out. If the person is infected by any viral disease or any kind of other disease the manual process is much risky for that person. Hence, new equipment has to be deviced to eliminate all types of problems associated with manual method.

ABO and The Most Common Blood Types

The blood consists of cells and a yellow watery liquid known as plasma. The two main blood type systems are ABO antigens and Rhesus antigens (including RhD antigen). These two antigens will classify blood types. Bacteria and viruses normally carry an antigen. During an infection, their antigen marks them as something that's foreign to the body or not usually found within the body. Most red blood corpuscle antigens are protein molecules found on the surface of red blood cells. White blood cells produce antibodies as an immune defense. These antibodies will target antigens and attack the foreign object like bacteria. The ABO blood type system is employed to work out the various sorts of antigens within the red blood cells and antibodies within the plasma. This system and RhD antigen status determine which blood group or types will match for a secure red blood corpuscle transfusion.

- **GROUP A:** The surface of the red blood cells contains A antigen, and the plasma has anti-B antibody that will attack any foreign B antigen containing red blood cells.
- **GROUP B:** The surface of the red blood cells contains B antigen, and the plasma has anti-A antibody that would attack any foreign A antigen containing red blood cells.
- **GROUP AB:** The red blood cells have both A and B antigens, but the plasma does not contain contains anti-A/anti-B antibodies.
- **GROUP O:** The plasma contains both types of anti-A/anti-B antibodies, but the surface of the red blood cells does not contain any A/B antigens. Having none of those A/B antigens means they will be donated to an individual with any ABO blood group.

Antigen Property

The red blood cells contain the RhD antigen, they're RhD positive. If they do not, they are RhD negative. This means that there are eight main blood types within the ABO/RhD blood type system. [A-Positive (A Rh+), A-Negative (A Rh-), B-Positive (B Rh+), B-Negative (B Rh-), AB-Positive (AB Rh+), AB-Negative (AB Rh-), O-Positive (O Rh+), O-Negative (O Rh-)].

LITERATURESURVEY

A biopsy can determine an individual’s blood group. There are some important traditional and clinical techniques used to detect the blood group.

They are:

- Slide Method
- Tube Method
- Microplate Method
- Gel Method

A. Slide Method

This test is least sensitive method among other blood group determination. In this method, the donor or recipient blood is mixed with anti A, anti B and anti D separately on the slide. The blood clumping pattern can be visually observed from which ABO and Rh type blood is determined. The test getscompleted within 10-15 minutes and is inexpensive. It is not reliable enough for completely safe transfusion.

B. Tube Method

This test is more sensitive and reliable in comparison to slide test. In this method, both forward and reverse grouping is carried out. The forward grouping suggests the presence or absence of A and B antigens in RBCs and reverse grouping indicates the presence or absence of anti-A and anti-B in serum. The blood is added into two test tube and one droplet of each antigen (anti-A and anti-B) is added separately in these samples. These tubes are kept for centrifugation for few minutes and then shaken to view clumping of blood. The purpose of centrifugation is for proper mixing of blood with antigen.

C. Microplate Method

This method is fast with feasibility of automation for blood typing. In this technique, both antibodies in blood, plasma and antigens on RBC are often determined. The microplate consists of large number of small tubes that contain a few microliters of reagent, which are treated against the blood samples. The centrifugation and incubation the clumping can be examined by an automatic readout device.

D. Column/Gel Centrifugation Method

Column is composed of small microtubes that comprises gel medium to trap agglutinates. Blood serum or cells are mixed with Anti-A, anti-B and Anti-D reagents in microtubes under controlled incubation and centrifugation. The gel medium traps the agglutinates and non-agglutinated blood cells are allowed to pass through the column.

- Arun Kumar. B, Soundariya.K, Yuvasree.S (2019) has proposed a method of an approach towards non invasive blood group detection. The light emerges from the LED which is made to pass through the finger and the transmitted light is received by the photo detector which gives the output as voltage signals. These voltage signals are obtained and are coded to the LCD display the blood type based on the voltage ranges that certain antigens possess non-invasively. It is very useful to find the blood types of the patients very efficiently. Although some factors like finger size, colour of the skin and blood pressure should be considered prior to testing. This will serve very useful for the hospitals to detect the blood groups at times of emergencies.
- Suzanne Hodsden (2015) is a Scientist who created specialized equipment for fast, versatile and accurate detection of blood type by paper based method. Study involves those 3500 samples which resulted in high precession rate. It is easy to interpret test for classifying sample into common ABO and Rh Blood groups in less than 30 Seconds. Hong Zhang and his colleagues made use of chemical reactions between blood serum protein and bromocresol green dye. The result appeared like color changes when the antigen is present in the sample and appears brown if not. This method is done using only the paper strip and no centrifugation process is involved.

- Pramod Kakarla, Murari Yashwanth K, Srikanth Pvnk, Rishi Kumar R, Pratibha N (2014) have proposed that the light from the pulsating infrared LED is passed through the blood sample through an optical fiber cable and the transmitted light is detected, processed, conditioned and is converted into an voltage signal. The intensity variation of the received signal as a result of the absorption of blood for different blood groups is converted into corresponding voltage changes, to classify the blood types.

- Vijay A. Kanade (2013) has proposed a method to automatically determine human blood type by applying image processing algorithms to the optically captured images of superficial capillaries underlying the skin surface. The technique embeds Multi Wavelengths of Light (MWL) scattering method as light passes through the capillaries for rapidly classifying blood cells based on specific antigens on the erythrocyte (RBC) surface. The portable optical devices (camera) along with the photo detectors form the basic detector structure. Used to detect the scattered light distribution/pattern produced by the blood cells to determine the blood type without drawing the blood samples from the body.

- T.M Selvakumari, (2011) has proposed that modern electronic communication systems fiber optics based devices plays a dominant role. The optical property variations paved the way for detection of ABO blood group of human using optics. Blood transfusion process can lead to death of a person if any mismatch occurs. So, it is one of the most importances for every person to identifying their blood groups. Blood grouping in most cases is done by manual process, which is also time consuming when considering large amount of blood samples. So, in order to overcome the drawbacks, a new instrumentation method, using light pulses from LED are allowed to fall on blood samples by using optical fiber cables at one end. The other end of the optical cable is connected with a photo detector. The optical variations obtained from the sensors are used to calibrate the blood group. The voltage variations in the output of the photo detector due to optical variations of ABO blood groups. Based on this method, the blood groups can be easily identified. In hospitals, the developed instrument has been tested for various blood samples. The voltage levels of the various persons are detected and noted.

PROPOSED METHODOLOGY

In this proposed system, absorption is the only optical property that is taken into consideration for the detection of blood group. If other optical properties like scattering and reflection are taken into account, then we can also measure the other factor of the blood group and hence distinguish positive and negative blood groups.

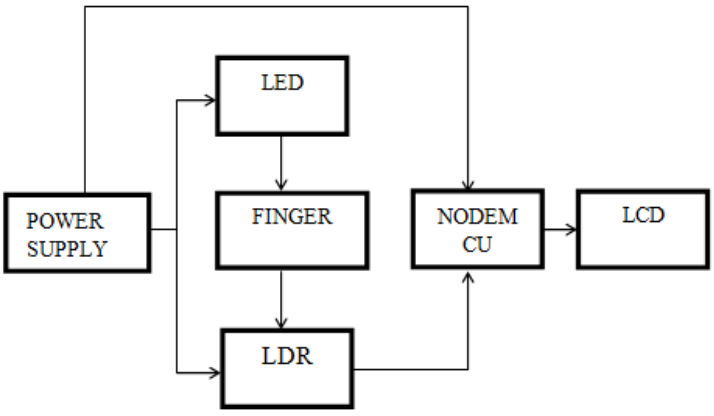

Figure 1: Block Diagram of Proposed System.

Components

LED

It is a electronic device that emits light when an electrical current is passed through it. Early LEDs produced only red light, but modern LEDs can produce several different colors, A light-emitting diode is a two lead semiconductor light source which has a p-n junction diode that emits light when energized. When a current is applied to the leads, electrons recombine with electron holes, which release in the form of photons. This effect is called electroluminescence; the energy band gap of the semiconductor determines the color of the light. LEDs are less than 1 mm in size and integrated optical components may be used to shape the radiation pattern.

LDR

A photo resistor (LDR for Light Decreasing Resistance, or Light-Dependent Resistor, or photo-conductive cell) is an active component that decreases resistance with respect to receiving luminosity (light) on the component's sensitive surface. The resistance of a photo resistor decreases with increase in incident light intensity; in other words, it exhibits photoconductivity. Photo resistors are often applied in light-sensitive detector circuits and light-activated and dark-activated switching circuits. In the dark, a photograph resistor can have a resistance as high as several mega ohms (MΩ), while within the light, a photograph resistor can have a resistance as low as a few hundred ohms. If incident light on a photograph resistor exceeds a particular frequency, photons absorbed by the semiconductor give bound electrons enough energy to leap into the conduction band. The resulting free electrons conduct electricity, thereby lowering resistance. The resistance range and sensitivity of a photograph resistor can substantially differ among dissimilar devices. Moreover, unique photo resistors may react substantially differently to photons within certain wavelength bands.

NODE MCU

It is an open source IOT platform; their hardware design is open for edit/modify/built. It includes firmware which runs on the ESP8266 Wi-Fi enabled chip. The ESP8266 is a low cost Wi-Fi chip (System on chip) from Systems, and hardware which is based on the ESP-12 module. The term Node MCU by default refers to the firmware instead of the event kits. The firmware uses the scripting language. It is based on the project, and built on the Non-OS SDK for ESP8266. The Node MCU programming model is similar to that of Node.js. It uses many open source projects. Basically electrical and mechanical equipment’s cannot connect to the internet on their own. They do not have the in built setup. To use ESP8266 setups easily connect and do operations like monitoring, controlling and analysis. The Node MCU board is compact and fits on a breadboard.

OLED Display

An Organic Light-Emitting Diode (OLED) is a light emitting diode in which the emissive electroluminescent layer is a film of organic layer is situated between two electrodes. OLEDs are used to create digital display. An OLED consists of the following parts (clear plastic, glass, foil). This display is interfaced with the Node MCU to perform the required task or function. An OLED display works without a backlight because it emits visible light. The main component in an OLED display is the OLED emitter. It is an organic material (carbon-based) material that emits light when electricity is applied. The basic structure of an OLED is an emissive layer sandwiched between a cathode and an anode. The main future of this display is work perfectly well without the need of back light, low power consumption only 0.08W and fast response time for action, rich colors, low contrast, wide viewing angle.

WORK FLOW DIAGRAM

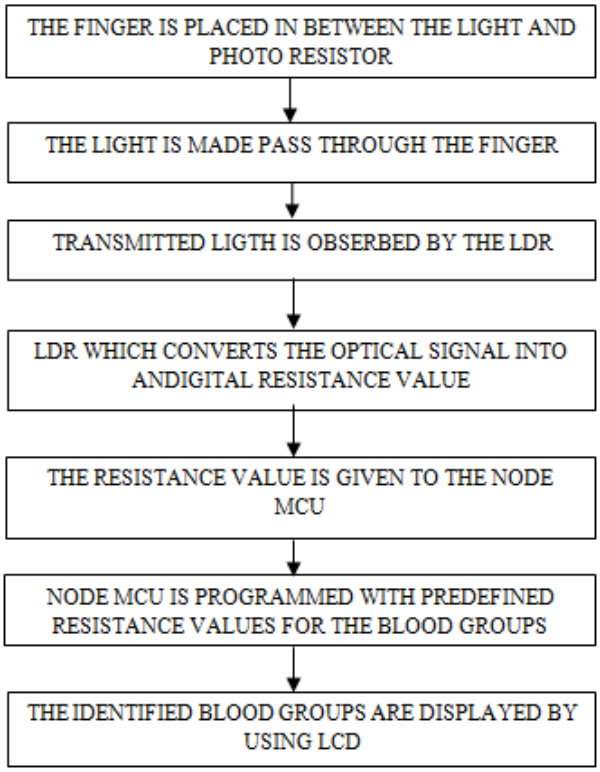

Figure 2: Project Work Flow Diagram.

RESULT

Individuals are asked to place the 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.

Table 1: Output Resistance Value for the Blood Groups

S. No.	Name	Blood Group	Resistance Value(Ω)
1.	D. Surya	O +ve	240-250
2.	S. Sivabalaji	B -ve	230-240
3.	K. Selvadurai	AB +ve	220-230

ADVANTAGES

- It is a time saving process and cost effective.
- It is user friendly.
- Easily communicate through IOT.
- This is portable equipment which can use anywhere and anytime.
- Reduce the infections happen during blood group identification.

CONCLUSIONS

The conventional methods of blood group detection involve infections, fainting time consuming and the chemical reagents are needed. The proposed system is compact in size, low cost and easily available. The blood group is identified in very less time, when compared to conventional method. There is no need of puncturing the skin, it is non-invasive way to determine the blood group. This will serve very useful for the hospitals to detect the blood groups at time of emergencies. The blood group detected by the proposed device have been compared and calibrated with that of the conventional method. The resistance values are approximate for various blood groups are given in the above table.

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