



BLOOD GROUP DETECTION BY RASPBERRY PI

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ABSTRACT

Blood group determination is done before a blood transfusion in emergency situations or while checking blood group of a person for donation. It is a fast and easy way to ensure that you receive the right kind of blood during surgery or after an injury. If you are given incompatible blood, it can be fatal resulting in agglutination. Hence, before the blood transfusion it becomes necessary to perform certain tests. Determining blood group is one of the tests before transfusing the blood during emergency situations. Based on the processing of digital images acquired during the slide test, a software is developed in image processing to determine the blood group during emergency situations without any error. The images obtained are then processed, occurrence of blood clumping is checked and accordingly the blood group is determined. Thus, using image processing techniques, this developed automated method will be useful in determining the blood group.

Keywords: ABO system, agglutination, Blood samples, morphological techniques, Quantification

1. INTRODUCTION

An ABO incompatibility reaction can occur if you receive the wrong type of blood during a blood transfusion. It's a rare but serious and potentially fatal response to incompatible blood by your immune system. Human error is the most likely cause of an ABO incompatibility reaction. If your transfusion uses the wrong blood type, it could be the result of mislabelled blood, incorrectly completed forms, or a failure to check donated blood before the transfusion. There is a scope for determining blood types using image processing techniques. Image segmentation algorithm for blood type classification and various image processing parameters are analysed image quantification such as variance, mean value, variance etc. The slide test consists of the mixture of one drop of blood and one drop of reagent, being the result interpreted according to the occurrence or not of agglutination. The combination of the occurrence and non-occurrence of the agglutination determines the blood type of the patient. Thus, the software developed in image processing techniques allows, through an image captured after the procedure of the slide test detect the occurrence of agglutination and consequently the blood type of the patient by using the raspberry pi, we can show the result on LCD.

2. REVIEW OF LITERATURE

Epstein and Ottenberg in 1908 suggested that ABO blood groups were inherited, and this was confirmed by Von Dungern and Hirsfeld in 1910. The exact manner was published by Bernstein in 1924.

Attempts were made earlier to 1900, to replace blood, for example, in cases of hemorrhage, by transfusion of a donor's blood. In some instances, the therapy met with success and in some severe as well as fatal hemolytic reaction occurred. In other words, blood of some people was compatible and that of others incompatible. One could not understand the cause of this phenomenon at that time and they attributed it to some unknown immunological differences between the recipient and the donor.

In 1875, Landois noticed that if red blood cells of an animal of one species were mixed with serum from an animal of another species, clumping or agglutination of red blood cells usually occurred. The phenomenon was recognized as being similar to that which followed the mixing of bacteria with appropriate immune sera.

Landsteiner from his observations stated "if an agglutinin is present on the red blood cells of a blood, the corresponding agglutinin is absent from the plasma; if the agglutinin is absent the corresponding agglutinin must be present". This statement is popularly known as Land Steiner's law.

The Landsteiner law, however, is not always true, for example, 'Rh' negative persons need not and normally do not contain anti-Rh agglutinin but may develop the agglutinin as a result of immunological response (Sensitization). When 'Rh' positive red blood cells enter the subject's circulation during blood transfusion or maternal circulation from the 'Rh' positive fetus. Landsteiner (1901) and later workers, namely, Jansky (1907) and Moss (1907) showed that the red blood cells of all the individuals can be grouped according to the presence of two blood group substances or agglutinogens called 'A' and 'B', into four main blood groups 'A', 'B', 'AB' and 'O'.

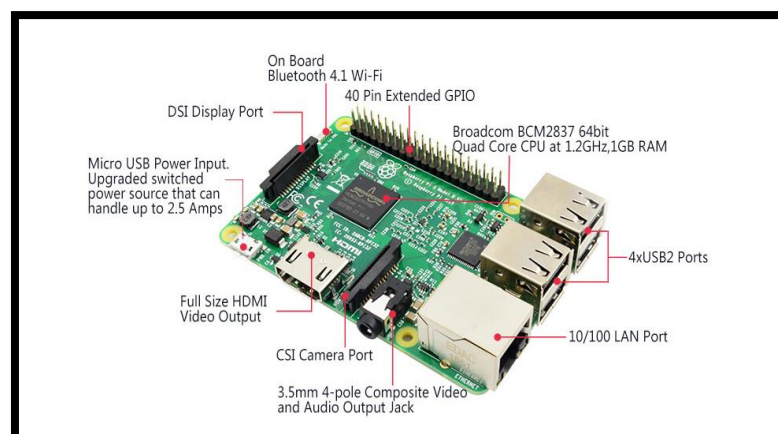
Group 'A' is further subdivided into 'A1' and 'A2'. Anti-A serum contains two antibodies anti-A and anti-A1; it is generally believed that 'A1' has two antigens, 'A' and 'A1', while 'A2' has only one 'A'. 'A2' cells react weakly with anti-A serum; hence a high titre serum is necessary while grouping; 'A2B' cell react even less readily with anti-A serum. The subgroups of A increase the number of groups from four to six; 'A1', 'A2', 'B', 'A1B', 'A2B' and 'O'. The main four groups of ABO system are inherited as Mendelian characters by three allelic genes, A, B, and O.

3. NECESSITY OF PROJECT

The accurate grouping of blood is very important when it comes to having a blood transfusion. If blood is given to a patient that has a blood type that is incompatible with the blood type of the blood that the patient receives, it can cause intravenous clumping in the patient's blood which can be fatal. The patient's body can start producing antibodies that attack the antigens on the blood cells in the blood that was given to the patient, causing reaction and rejection.

4. HARDWARE REQUIREMENT

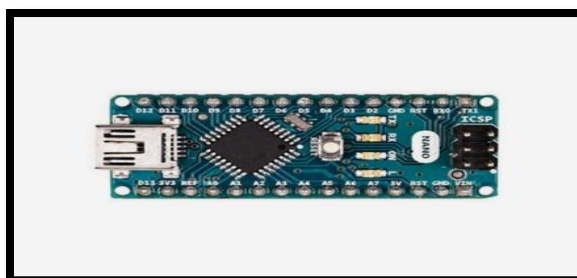
Raspberry Pi-3: Raspberry Pi board is a miniaturized fascinating computer having ample processing speed and size not bigger than credit card. Incredible things can be done by using it. Firstly, to work with raspberry pi, we need a list of things to get desired operation and functioning.



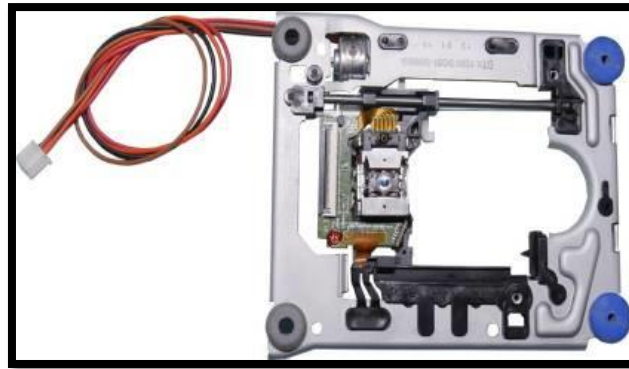
IMX179 8MP USB Camera Module - Embedded MIC - 3288x2512 resolution: In a camera, electronics have less influence on performance than the sensor itself. Some cameras can have good image resolution with weak sensitivity, with almost no thermal noise due to the sensor's weak sensitivity. Other cameras, on the other hand, will require high sensitivity to produce a visible image in low light conditions, without the resolution being exceptional, but with a high risk of thermal noise due to high sensor sensitivity. Finally, do not forget the importance of the lenses attached to the camera. Their optical quality, maximum aperture and focal length directly affect the quality of the images formed on the sensor. The price and performance of a camera are strongly linked.



Arduino Nano: The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328 (Arduino Nano 3.x). It has more or less the same functionality of the Arduino Duemilanove, but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one.



Stepper motor DVD Driver: DVD stepper motor board is used for making small CNC machine pen engraver, 3d printer, laser engraver 2 phase 4 wire stepper motor can be used with a4988 and work on 12V3d also 5-volt operating voltage can be work on Arduino bead CNC or grbl contain 2x DVD romps stepper motor board.



LCD (Liquid Crystal Display): A 16x2 lcd means it can display 16 characters per line and there are 2 such lines. In this lcd each character is displayed in 5x7 pixel matrix. jhd162a.Black text on green background. Pins are documented on the back of the lcd to assist in wiring it up. Connection port is 0.1" pitch, single row for easy breadboarding and wiring. This LCD 16 x 2 display module is perfect for Raspberry Pi and microcontrollers compatible with Arduino.



5. SOFTWARE

Raspbian OS: Every Raspberry Pi board comes with the official Raspberry Pi OS. Initially titled Raspbian, it is an Operating System made specifically for the Raspberry Pi. Although the first instances of the board weren't running this OS, the Raspberry Pi Foundation quickly created it, so any board after June 2012 was compatible with it. The initial version of the Raspbian OS was made by Mike Thompson and Peter Green as an entirely independent endeavour. The Operating System was rooted in Debian, which is a kind of Linux operating system. This puts the Raspbian OS firmly into the UNIX-Like family of operating systems. The initial versions of the Raspbian operating system were 32-bit and Debian-based. However, more recent editions of the OS have switched to being 64-bit, and have abandoned the use of Debian as their base. The Raspberry Pi OS was made specifically with the Raspberry Pi in mind, and it'll run on every single kind of Raspberry Pi board, apart from the Pico edition, due to its far smaller size and computing power. The Raspberry Pi OS uses a modified version of the Lightweight X11 Desktop Environment (or LXDE) as its desktop environment. LXDE is a desktop environment specifically made for single-chip computers and those with low resources. It uses an Open box stacking window manager together with its own unique theme to bring a cohesive and unique user experience. Each distribution of the OS will come with an algebra program called Wolfram Mathematica, as well as the Minecraft: Pi Edition game, in addition to a hyper-lightweight version of Chromium.

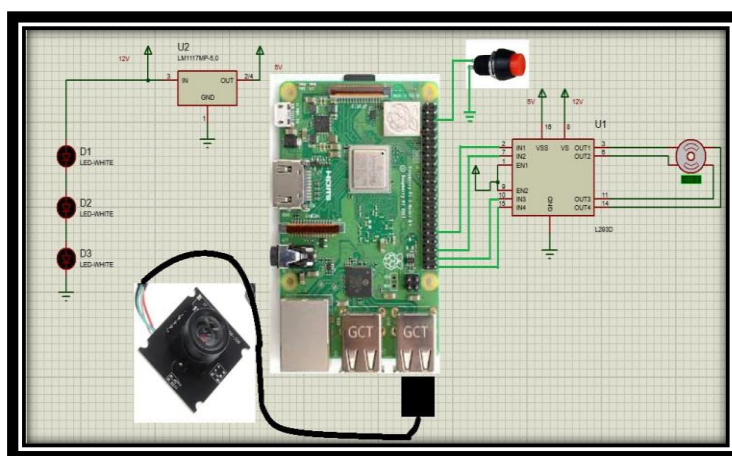


Computer Vision (Open CV): Computer vision is a field of artificial intelligence (AI) that enables computers and systems to derive meaningful information from digital images, videos and other visual inputs and take actions or make recommendations based on that information. If AI enables computers to think, computer vision enables them to see, observe and understand. Computer vision works much the same as human vision, except humans have a head start. Human sight has the advantage of lifetimes of context to train how to tell objects apart, how far away they are, whether they are moving and whether there is something wrong in an image.

Python language: For the implementation of this project program, we have used python language.

6. WORKING

Determining blood group and the software developed is by using image processing techniques. Three samples of blood are taken on a slide, each mixed with reagent anti-A, anti-B and anti-D respectively. After sometime, agglutination occurs and the result is interpreted according to the occurrence of agglutination. The agglutination reaction is the occurred reaction between the antibody and the antigen, indicating the presence of a particular antigen. The condition of the occurrence of agglutination determines the blood group of the patient. Thus, the software developed based on image processing techniques allows detection of agglutination on the slide through an image captured after mixing specific reagents and consequently the blood group of the patient is determined. Stepper motor is used for travelling of slide.



7. IMAGE PROCESING

What is Image Processing?

Image processing involves two methods, namely analog image processing and digital image processing. Analog image processing comprises the technique to process photographs, printouts, and different hard copies of images. In contrast, digital image processing involves manipulating the digital image for generating information with the help of complex algorithms.

The input for an image processing task is an image. However, it is essential to note that analog image processing always requires an image input. Still, digital image processing may include images or information associated with an image, such as features or bounding boxes, etc. Ideally, image processing is used for the following purposes.

1. Image visualization is the representation of the processed data in the form of visual output for better understanding.
2. This task is mainly done for objects that are not easy to detect in an image.
3. Improving the quality of the image by using image sharpening and restoration.
4. Image search is associated with retrieving the image source from an investigation conducted by an image search engine.
5. To perform classification to distinguish different objects and locating their position in an image.

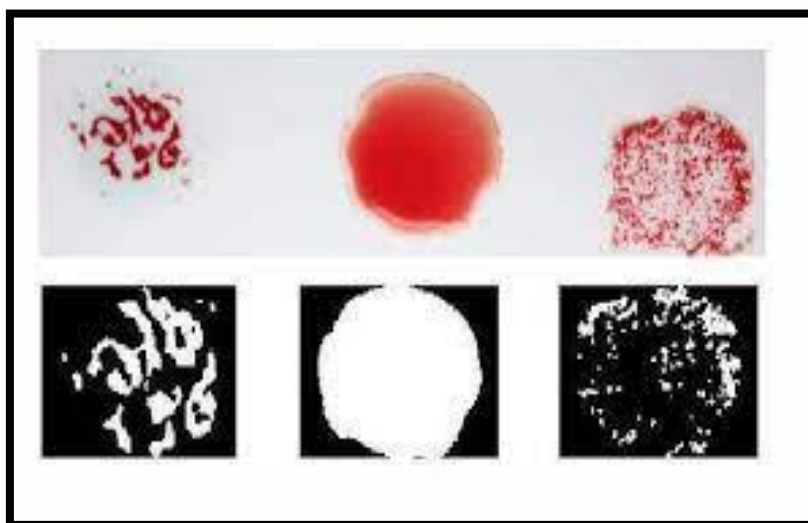
Thresholding: Thresholding is a type of image segmentation, where we change the pixels of an image to make the image easier to analyse. In thresholding, we convert an image from colour or grayscale into a binary image, i.e., one that is simply black and white.

Morphological processing: The extraction of essential components in an image describes the shape of a particular object in an image. Some of the typical morphological operations are erosion and dilation for producing image attributes.

Segmentation: Image segmentation is one of the necessary procedures under image processing that involves the partitioning of the image into multiple segments. This procedure allows to locate objects in an image and identify the boundaries of the objects. An important point to note is that the segmentation's accuracy will lead to better recognition and classification accuracy

Representation and Description: The representation is associated with displaying image output in the form of a boundary or a region. It can involve characteristics of shapes in corners or regional representations like the texture or skeletal shapes.

On the other hand, the description is most commonly known as feature selection, responsible for extracting meaningful information from an image. The information extracted can help to differentiate between classes of objects from one another accurately.



After Image Processing

8. FUTURE SCOPE

Blood group typing is the process of testing red blood cells to determine which antigens are present and which are absent. It is standard practice to test for A, B, and D (Rh) antigens and to perform tests for other antigens in selected cases. ABO blood group typing is confirmed by reverse grouping that detects expected isoagglutinin's. Unexpected antibodies can be demonstrated by antibody screening tests. For transfusion, donor units compatible with the patient are selected. Prior to transfusion, a crossmatch is performed as a final check for incompatibility. This article describes the recent and future methods of blood group typing and testing of serological compatibility. In addition, methods for blood bank automation are presented.

9. CONCLUSION

The system is developed in a robust manner so that it is unaffected by the exceptional conditions. The software developed in image processing is efficient and it effectively detects the occurrence of agglutination and consequently the blood group of the patient in a short interval of time. The system would achieve high percentage of sensitivity and specificity which will be useful in determining the blood group in emergency situations.

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