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EXPERIMENTAL ANALYSIS OF BLOOD GROUP IDENTIFICATION USING EMBEDDED SYSTEM

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Abstract: There is a lot of blood in the human body. Everyone knows how important this blood is. Although there are many fields in this world, the medical field is considered to be the most important field. Because it is this blood that is one of the most essential in this medical field. Blood in the human body is classified as A, B, AB, and O blood. Anyone of the above four types of blood can be present in a human. Similarly, every human being has every type of blood. Thus the type of blood varies so it is necessary to find out what type of blood the blood belongs to.

So until now, blood types have been diagnosed with ABO and Rh methods to find out what type of blood it is. And these ABO and Rh methods are still being used to diagnose blood type in hospitals and blood banks with the help of a human. The blood type thus diagnosed is sometimes more prone to errors in blood results due to the carelessness of that person.

So many studies are going on to make sure that no mistakes happen in such discoveries and to correct such mistakes. In that regard, we are going to look in detail at the research and development of a new automatic blood type diagnostic machine. The uniqueness of this automatic blood type machine is that if a test tube containing a human blood sample is fitted into the machine with the help of an embedded system, the blood type of the blood sample is displayed. The result then displayed is stored with the full details of the person belonging to the blood type. This instrument is very useful for the medical field.

Keywords: **Blood group, ABO system, Rh system, Sensors, Embedded system.**

I. INTRODUCTION

It's something we all know is that there are more red blood cells in the blood of each of us. Its job, however, is to take in the oxygen the body needs and deliver it to all the cells in the body. There will be a lot of chemicals on the surfaces in these red atoms. These chemicals are what we call antigens.

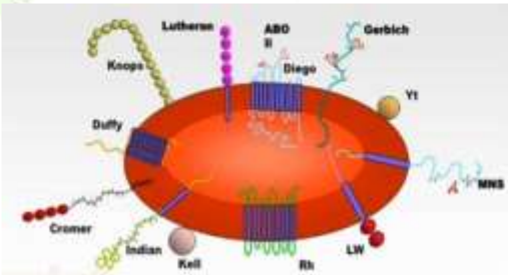

Figure 1: Blood Group on the RBC

Similarly, hundreds of different types of antigens are found on the surface of each red cell. We classify the blood types in our blood by keeping the antigens found above these red atoms. Thirty-three blood type classification systems have been identified so far. Of these thirty-three classification systems, only the following two blood type classification systems are world-famous: the A B O system and the RH system.

What is wrong with other blood types is that certain types of antigens are only available to a certain type of people, and when this type of blood is transfused to other types of people there is a risk of blood transfusion failure and thus death. That is why even though thirty-three types of blood are detected, we have two types of classification systems that are successfully run, and all other types fail.

1.1. ABO system

Carol Land Stener, a researcher in Australia, has done a lot of research on why this blood transfusion failure occurs and why the ABO system was discovered when blood was tested on a wide variety of people. What he found was that there was a kind of antigen on top of these red blood cells in the population and he named it A antigen, B antigen, O antigen. That is, we divide our blood types by these antigens. People whose blood contains the antigen A above red blood cells are said to belong to type A blood. People whose blood contains the antigen B above their red blood cells are said to belong to type B blood.

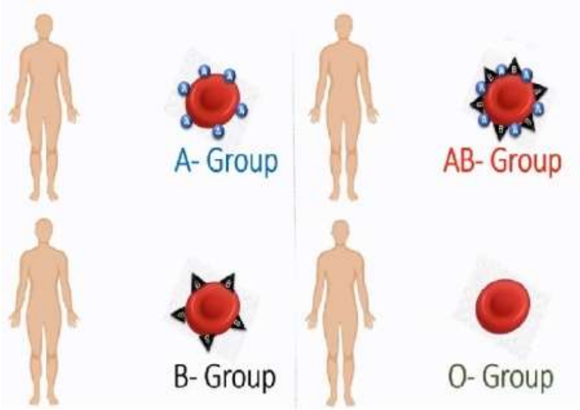

Figure 2: Blood Type Antigens

Anyone whose blood has these two types of antigens A and B above the red blood cells is said to belong to type AB blood. Anyone who does not have these two types of antigens A and B above the red cells in their blood is said to belong to type O blood. This is how we divide blood types A, B, AB, O by putting antigens on top of red blood cells.

1.2. Rh system

This is another type of structure in which the Rh antigen is found above the red blood cells, just as the A antigen, B antigen, and AB antigen are found above the red blood cells. These are called R antigen or D antigen. People whose Rh antigen is found above red blood cells are called + ve type, and those whose Rh antigen is not above red blood cells are called –ve type. This is how we call one's blood type + ve and –ve.

The Rh antigen was named Rh because the researchers took blood from a species of monkey called Rhesus macaque and found that the Rh antigen was present above its red blood cells. Similarly, this Rh antigen was found to be present in human blood. Hence the name Rh was derived from the monkey's name, Rhesus macaque.

We divide our blood into eight types based on the above ABO and Rh system. That is, A + ve, A –ve, B + ve, B –ve, AB + ve, AB –ve, O + ve, and O –ve.

Although eight types of blood are detected by the ABO and Rh the system, three antigen solutions, Anti A, Anti B, and Anti O or D, are needed to distinguish these eight blood groups from a person's blood sample. So far blood groups have been manualized by the ABO and Rh system with these antigen solutions is being identified.

Figure 3: Anti A, B & D Solutions

With these ABO and Rh systems at the forefront, research has been conducted and published in a number of articles and journals to identify this blood group in a very simple way using a number of technologies. Most of these papers are used to identify blood group using software technology called image processing. For example, blood group identification is done using [1], [2], [3] image processing technology. That is, slides of tested blood are photographed and converted to pixels by image processing technology, which compares them with images of blood groups already saved in the Lab VIEW software IMAQ vision.

[4] Blood group identification is done using fiber optics. That is, a light pulse is given by an LED from one part of the fiber optics cable and that light pulse is detected in the photodiode on the other side of the silk above the blood on the testing slide. Since optical variations vary for each blood group, different voltages are available at the output of the photodiode. Based on this, the blood group is identified in this paper. [5] The blood group is identified using a color image. That is, just like image processing, the testing blood slide takes a photo, the photo is converted to an image by preprocessing, the color of the image is changed by RGB to HSI, and finally, the blood group type is classified by SVM (support vector machine).

[6] The blood group is identified using a laser beam. That is, the laser beam is projected onto the slide containing the testing blood sample. The blood cell identifies the various outputs of the blood sample by knowing the intensity change of the laser beam according to the density of the blood sample. [7] Blood group identifies using fiber optics technology and its results are monitored on a mobile phone. [8] This blood group is also identified using microscopy. Although many software has been used to identify blood group

identifiers, I have developed an automatic blood group identification tool with an embedded system, similar to the ABO and Rh system for blood group identification.

II. EXPERIMENTAL ANALYSIS

The topic I took up for my research work was the experimental analysis of blood group identification system using embedded systems. What I am going to do here is to create an instrument with the help of mechanical and electronics with the technology of embedded systems to automatically identify the blood group to do the manual work that was used to identify the blood group before. One to five setups are put together and then processed to make this instrument complete. I.e. the first one is automatic setup, the second one is the sensing setup, the third one is the control setup, the fourth one is display setup, and the fifth and last setup is power supply setup.

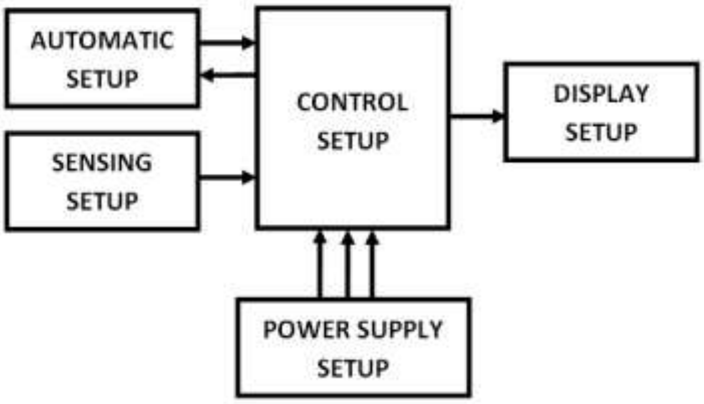

Figure 4: Main Block Diagram

2.1. Automatic Setup

Arrangements made by the mechanical setups in this automatic setup are used to identify the blood group. Only four setups are used in the automatic setup. Namely, needle setup, antigen solution setup, mixing motor setup, and cleaning motor setup. These four setups are used to convert the manual processes in the ABO and Rh systems above into automatic processes.

2.2. Sensor Setup

The three testing blood sample slides obtained by the four setups in the automatic setup are automatically processed step by step and are sensed by the three sensor pairs arranged in this sensor setup. In all three sensor pairs, a transmitter and a receiver are connected. A three testing blood sample slide is placed between these three transmitters and receivers and sensed by three sensor pairs. The blood group is thus identified based on the outputs of the three sensor pairs.

2.3. Control Setup

The outputs obtained from the automatic setup and sensing setups seen earlier are sufficient to identify the blood group. This is because the results we get from the automatic process are the same as the results we get during the manual process. However, the output results we get are automatic.

However, this control setup is used to convert our automatic output results into digital output. In addition, all the setups in this instrument are controlled by giving instructions from this control setup to make them operating as per the processes. That is, needle setup, stepper motor setup, antigen solution setup, mixing motor setup, sensor circuit board setup, LED circuit board setup and LCD display circuit board setup are all controlled by the controller board.

III. WORKING PRINCIPLE

I made a controller board with sensor pair setups interfaced as part of this automatic blood identification instrument. Then three testing slides mixed with a blood sample and antigen solutions (Anti A, Anti B, and Anti D) were placed between the sensor pair setups IR transmitter and IR receivers and the output of the controller board was checked but the output was found to be incorrect. The reason was that the output was incorrect because the sensor pairs IR transmitter and IR receiver were kept in the open place and the testing slides were checked. This means that we got the output incorrectly because all the IR receivers took the excess light sources in the open space of this IR receiver as input.

To avoid such mistakes I took the IR transmitter and IR receivers in a separate sensor pair and put them in a cardboard box. I permanently fixed the IR transmitter at the top of this box and the IR receiver at the bottom. The testing slide was then placed in the center of the carton, between the IR transmitter and the IR receiver. Thus, once the sensor pair setup is fixed, the testing slide is checked and the output is correct. Many more testing slides were checked to confirm this, and the output was correct.

The sensor pair setups that gave this correct output took the interface-made model setup and tested some of the many blood samples kept in the lab by a lab technician I know who works in private laboratories and found out what the blood group for that blood was. They also took these automatic blood identification instrument setups and obtained proper permission from the government hospital and with the help of a lab technician working in the laboratory there tested some of the various blood samples and found out what the blood group for that blood was. So I checked the testing blood sample with the newly designed automatic blood identification instrument and the output they got manually tested the testing blood sample and the output they got manually tested the blood test sample in government hospitals. Comparing the output, the two outputs were identical.

IV. RESULT AND DISCUSSION

Let's see how the blood groups of the testing blood samples can be identified experimentally using these automatic blood identification instrument setups that I have created. There are three sensor pair setups in this instrument.

There is a mixed-blood sample and Anti A solution between the first sensor pair and a mixed crimson slide, a testing blood sample, and an Anti B solution between the second sensor pair and a mixed red screen slide between the third sensor pair. Sample and Anti D solution were mixed and checked with a slide containing blood-red patches. When checking in this way, the output of the sensor pairs will be in the condition "LOW" "LOW" "HIGH".

Table I: Sensor Pair Output

SENSOR PAIR I	SENSOR PAIR II	SENSOR PAIR III
LOW	LOW	LOW
LOW	LOW	HIGH
LOW	HIGH	LOW
LOW	HIGH	HIGH
HIGH	LOW	LOW
HIGH	LOW	HIGH
HIGH	HIGH	LOW
HIGH	HIGH	HIGH

Based on the outputs of these sensor pairs, the ON and OFF condition of all three LEDs is given as input from the controller board to the LED circuit board. That is, if the LED1 is in the “OFF” condition, the LED2 is in the “OFF” condition and the LED3 is in the “ON” condition, then the blood sample we took for testing was found to be O positive. That is, the output condition of the controller is "OFF" "OFF" "ON" for the LEDs and the result is O POSITIVE.

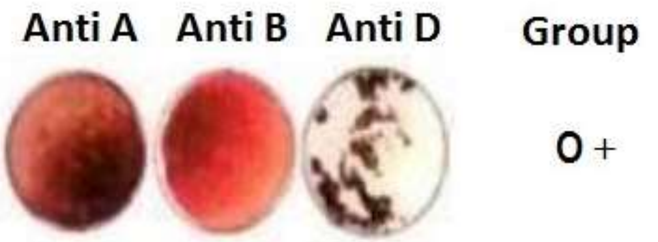

Figure 5: O Positive Blood Group

The inputs from the controller board to the LCD display board that are connected to the LCD are the same as the inputs given to this LED circuit board. That is, information is sent as binary data to the data pins of this LCD display according to the instruction as per the condition programmed by the embedded c inside the processor IC on the controller board.

That is, for the LCD display, the binary data □’s for the output of sensor pair 1, the binary data □’s for the output of sensor pair 2, and the binary data of 1’s for the output of sensor pair 3 are given from the controller board. This means that the output condition of the controller is in the condition of "001" for the LCD and the result will be O POSITIVE. Therefore, the LCD display was displayed as "Testing Blood is O Positive". With this, the blood sample taken for testing was confirmed as O positive.

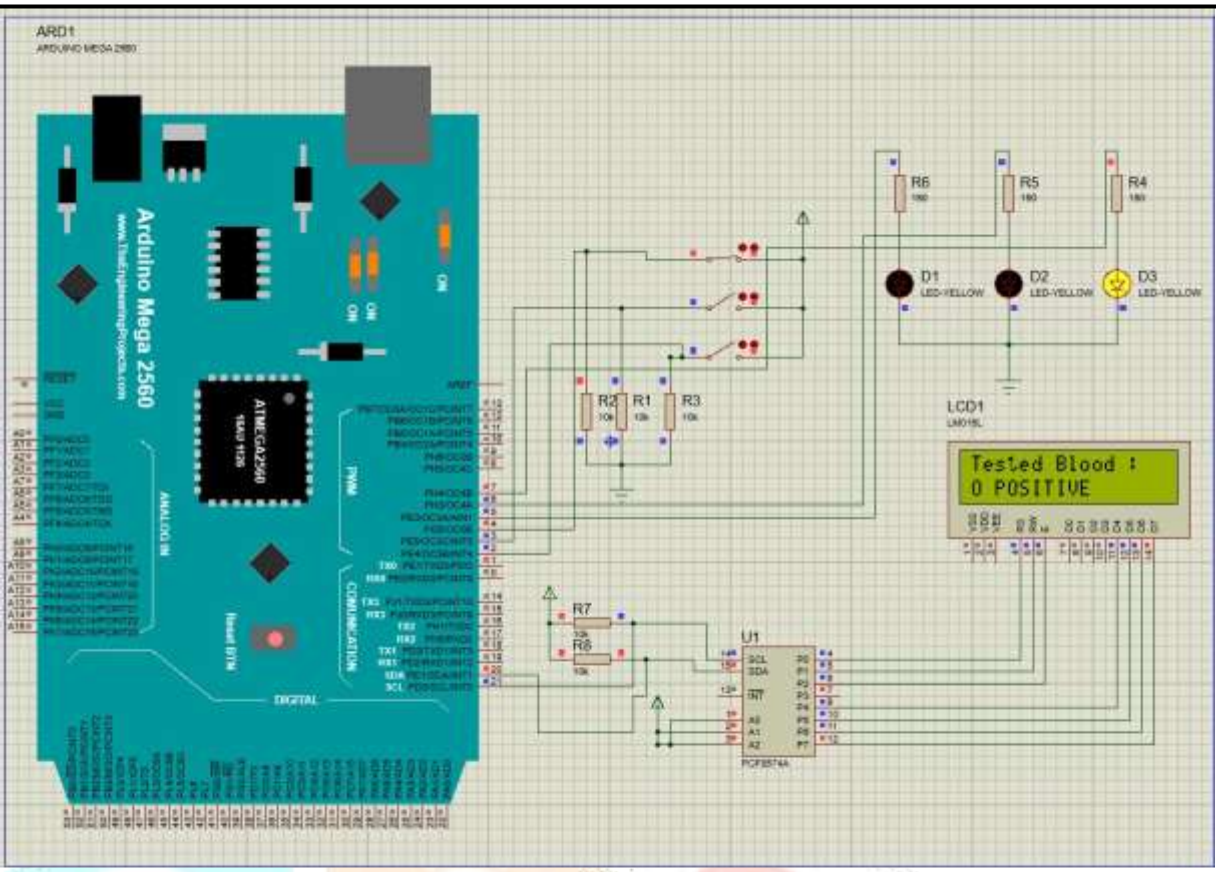

Figure 6: Output Result Diagram for LED and LCD

V. CONCLUSION

Although many technologies have been used to research blood group identification and its results have been published, the results of the blood group identifications conducted so far have been researched using the results of simulations using software and the results have been published as articles and journals. But if an automatic instrument has been developed to identify this blood group for the first time, it is "experimental analysis of blood group identification using the embedded system". This instrument is made up of readily available electronic components and mechanical and electronic components. This automatic blood group identification tool is designed to be used by everyone.

In addition, IR sensors, which are sensor pairs used in many places in this instrument, have been used to detect the blood group identifying work which is considered to be the most important work here. Although the blood group can be identified with IR sensors, which are readily available components, its output is very accurate. This is because this blood group identification system was created as an instrument after the instrument had multiple blood samples and performed many tests.

Once this experimental analysis of the blood group identification system was developed, some blood samples were tested by a lab technician in a private laboratory to determine the blood group for that blood. Similarly, in blood donation camps held in government hospitals, this instrument tested some blood samples and found out what the blood group for that blood was. The purpose of creating this blood group identification system is to make it easy for the general public to know what their blood type is by having such instruments in our government hospitals. And there is no need to pay extra for private laboratories to identify their blood group. These instruments are available in government hospitals so that blood donors can be easily identified and blood can be obtained from donors and blood bags of type of blood group can be stored in blood banks.

VI. FUTURE WORK

The current automated blood identification instrument is designed to test only one blood sample at a time. This instrument is now in this fast-paced world, and in this world of high population, in other words, the growth in all fields is growing day by day in the medical field and the number of patients and accidents is increasing day by day.

Therefore, a change in this instrument is required, so in the future, the same instrument will be designed and released to test multiple blood samples simultaneously using many more technologies. Thus the instrument used to test high blood samples can be very useful for the medical field.

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