DESIGN AND IMPLEMENTATION OF BLOOD VISCOMETER

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ABSTRACT

Blood viscosity is an important hematological parameter which is widely used for the diagnosis of atherosclerosis, thrombosis and stroke. Currently used circuit made it possible to get the value of blood viscosity within the fractions of second with a small blood sample as low as µL using disposable microcuvettes. The digital input actuates the LED. The light pulses from the LED are allowed to fall on blood samples and the light transmitted through the sample is made to fall on the LDR. Due to the optical variations from different blood samples there will be corresponding voltage variations in the output of the LDR. The output of LDR is analyzed using a micro controller to give a readable output for INR (International Normalized Value) value.

Keywords: INR, Blood Viscometer, Microcuvette.

I. INTRODUCTION

Determination of blood viscosity of a human being is a vital factor. Beside blood viscosity techniques in use today rely on subjective evaluation of reactions to determine the viscosity. The accuracy of this type of testing has proven to be a function of the person's experience who is administering the test. Coagulation is the process by which blood forms clots. Coagulation begins almost instantly after an injury to the blood vessel has damaged the endothelium lining of the vessel. . It is an important part of hemostasis, the cessation of blood loss from a damaged vessel, wherein a damaged blood vessel wall is covered by a platelet and fibrin-containing clot to stop bleeding and begin repair of the damaged vessel. Disorders of coagulation can lead to an increased risk of bleeding (hemorrhage) or obstructive clotting (thrombosis). In abnormal conditions, anti-coagulant medications which delay the formation of blood clots should be administered to prevent thrombosis and embolism. To optimize the drug dosage, the time the blood takes to clot should be monitored regularly. Hence INR (International Normalized Ratio) is used to measure the effectiveness of anti coagulant medications. Existing hand held devices for blood coagulation PST (patient self test) work by inducing a chemical reaction and consequently measuring the gradient at the electrodes coated with compounds - a technology that has not fundamentally changed in many years. In contrast, this study presents a device which uses electronics basic concept which give out an individual voltage value for the blood samples and exploits the potential to achieve high accuracy, robustness and ease of use of its disposable microcuvettes coagulation test. Although there are many methods and instruments to measure blood viscosity, most current technology, while useful in a research setting, is not optimal for day-to-day clinical use. Furthermore, recent technology development tends to use optical properties of blood to measure viscosity. We have used LED (light emitting diode) and LDR (light dependent resistor) to detect the light transmitted through the blood sample which is further analyzed and converted into the voltage. Relating this voltage value to the INR we calculate the blood viscosity.

II. HARDWARE CIRCUITRY

A circuit using basic electronics is designed which gives a voltage output to determine and calculate blood viscosity. The circuit is composed of an analog to digital converter IC ADC0804; it converts the analog signal to digital and gives it to the microcontroller. LED is used as a light source; it emits light and makes it to fall on the LDR whose resistance changes with the change in the intensity of the light falling on it. When we place different blood samples between the two than the amount of light falling on the LDR changes and a variation in the output voltage is obtained. The varied voltage so obtained due to the variation of the resistance of the LDR is given on the non-inverting end i.e., 6^{th} pin of the ADC0804. The output of the ADC0804 is given to the ATMEL 89551 microcontroller which is programmed so that it displays the obtained INR value and the light percentage falling on the LDR. The voltage so obtained when the blood clots gives the INR of the blood sample.

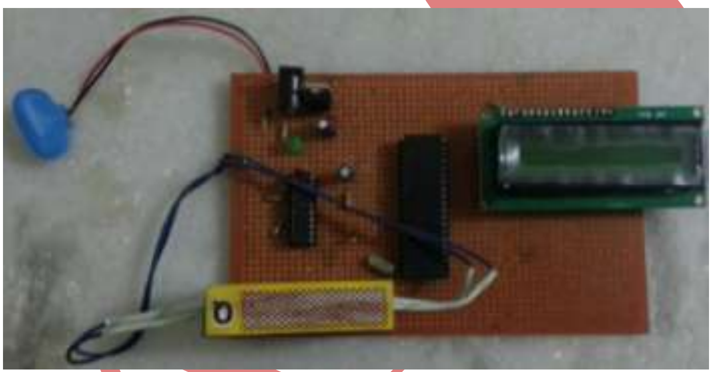

Fig.1 Circuit

III. RESULTS

The circuit was implemented and tested for blood samples obtained from normal persons. The blood samples collected in the microcuvettes were placed in between light source (LED) and light detector (LDR). The light from the LED fall on the blood sample and on the basis of density of blood, few amounts of light gets absorbed and the rest is transmitted. The transmitted light is detected by the LDR kept below the microcuvettes and on the basis of the intensity of light received the resistance of LDR varies causing the variation in the output voltage produced. The output voltage is given to the analog to digital convertor to convert the obtained voltage to digital and give it to the microcontroller which is programmed in such a way that the INR so obtained is displayed on the LCD screen. The circuit was tested on the blood samples from normal persons. The output voltage ranged between 0.80-0.87 mV.

3.1 Relation Between Voltage And INR

The normal value of INR is 1. When we measure the voltage of blood samples with normal viscosity and having INR value 1 than we get an average voltage of all the samples. When we place a blood sample with high viscosity having INR value more than 1 there is a decrease in the voltage level. Similarly, if we take blood sample with low viscosity having INR value less than 1 the voltage increases. This gives us a relation between INR and the output voltage i.e., INR is inversely proportional to voltage.

V. CONCLUSION

The developed instrument was tested for various blood samples. The circuit has shown promising results in a fairly small package. The voltage levels that were shown for various persons are noted. The INR detected by the instrument was compared with that of the conventional method. The LED and LDR pairs were successful in detecting the light transmitted and gave voltage output. The alignment of the beam and placement of the LDR in the forward scattering direction proved to be the most important factors when determining INR.

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