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Hemoglobinometer Based on Reflectance and Transmittance Photometry

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ABSTRACT: The aim of our project is to determine the hemoglobin content in the blood without causing any damages to the other blood cells in order to detect the anemic condition of the patient. In this paper the hemoglobin measurement is based on reflectance and transmittance photometry using a cell strip. A cell strip is designed to be disposable one and it is used to collect the standardized volume of blood instead of volumetric measurement from the finger tip. Here pre-treatment of cell is proposed since it oxidizes hemoglobin to methaemoglobin but the blood cells are not chemically treated because the organic chemicals would cause damages to the white blood cells. The advantage of this method is it is reliable, compact, cheap, easily portable and the consumption volume of the sample is less. The accuracy of the result is high and the rate of error elimination is effective.

KEY WORDS: Hemoglobin, Methaemoglobin and Standardized volume

I. INTRODUCTION

Hemoglobin content in the blood is used to determine the iron deficiency that is the different state of the anaemia. The anemic condition is most commonly seen in children that causes the slowdown in the growth and makes the children more prone to the infections. At the earlier methods the volume of consumption of the sample and the time was relatively high and the diagnostic method was painful. The first proposed method for the detection of the anaemia is the coulter counter method in which the blood is collected by puncturing the capillaries. In this method the collected blood is stored in the bottle and latter the small cuvettes are filled with the capillary blood collected the hemoglobinometer shows the sensitivity of 0.85 and specificity of 0.94 whereas only 10ml of blood only used.
In this method the experimental investigations is made to develop the hemoglobionometer based on the reflectance and transmittance photometry without the treatment of the blood cells in the chemicals. The tallqvist's paper is used for the manual analysis of the blood cells later the paper is examined in the spectrophotometry for the studies of the blood cells. It has overcome the defects that was seen in the conventional clinical method that involves the diluting the fluids and usage of the pipettes for the measurements.

II. EXPERIMENTAL INVESTIGATIONS

A. BLOOD SMAPLES

The single droplet of blood is used in this technique and the sample is collected by a single prick in the finger the process is carried out by using the sterilized lancet usually the sample is collected by the vein puncturing. The blood sample is not introduced to the anti-coagulating solution because the action is performed at once the sample is collected.

B. PHOTOMETRIC STUDIES

The photometric studies are carried out through both of the light reflection and light transmittance on the thin layer of the RBC in which the fibrin should not be damaged. A small droplet of blood is made placed on the glass slide in which laser light of wavelength 400-750 nm. In the actual practice the paper is not treated with the HCl solution because it could damage the fibers in the blood.

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III . HEMOGLOBIN MEASUREMENT

The hemoglobin content in the blood is measured in the unit of **grams per deciliter.** The normal values of the hemoglobin content in the blood varies in accordance with the ages both in the children's as well as in the adults.

TABLE 1.1: Varying values of hemoglobin in the blood depending on ages

Age category (years)	*n*	Hemoglobin (g/dl)	Anemia	Severe anemia
		Mean (SD)	*n* (%)	*n* (%)
1–2	3	12.0 (0.70)	0 (0)	0 (0)
3–5	15	12.2 (0.93)	1 (6.7)	0 (0)
6–8	19	12.3 (0.95)	4 (21.1)	0 (0)
9–11	22	12.2 (0.83)	8 (36.4)	0 (0)
12–14	19	12.4 (0.79)	3 (15.8)	0 (0)
15–19	19	12.8 (1.77)	10 (52.6)	0 (0)
20–29	32	12.6 (1.67)	21 (65.6)	1 (3.1)
30–39	24	12.1 (2.14)	14 (58.3)	3 (12.5)
40–49	8	10.2 (2.85)	6 (75)	4 (50)
50–59	2	12.5 (0.21)	1 (50)	0 (0)

IV. LANCET DEVICE (AUTOLET)

The lancet device is used for pricking at the finger tip it is specially designed to extract only a droplets of blood and helps in providing comfort, control while obtaining blood hence it would help in preventing the loss of blood. The lancet is cleaned with the sterilized solution of EDTA so that the patient is not prone to infections.

V. DESIGNING OF HEMOGLOBINOMETER

In order to eliminate the tallqvist's error the device is developed by using LDR which is known as LIGHT DEPENDENT RESISTOR and by using LED's. The laser light source is passed on the blood sample which is placed above the LDR. The intensity of LDR varies in dependence with the light.

A, ARDUINO

ARDUINO is considered to be the heart of all the sub devices that are connected with each other. It also acts like a control unit of the entire circuit. It is a inbuilt peripheral device with reprogrammable flash memory. The peripheral device helps to operate in the low power operation mode.

The UNO board used in this project is Atmega 328P microcontroller board. It has 16 digital input pins and 6 pins that are analog pins.

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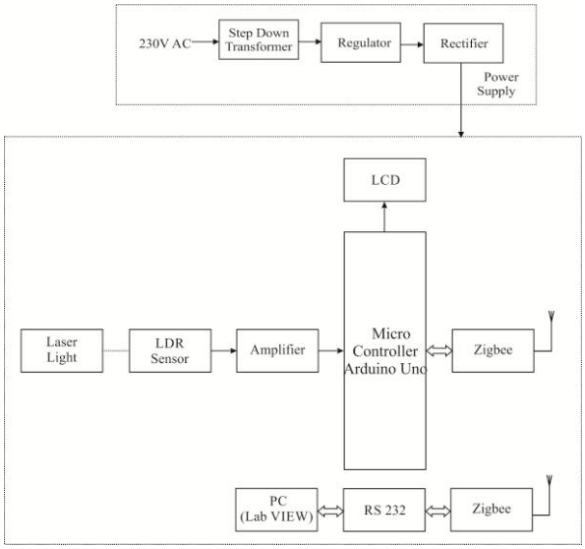

Fig 1.1: The generalized Block Diagram of Hemoglobinometer

B. ZIGBEE

Zigbee is defined as a wireless personal area networking it connects the serial devices together that is the related item with the computer for the purpose of representation of the results.

Zigbee is mostly commonly preferred than the Wifi and Bluetooth because it can transmit large rates of data, consumption of power is less and has longer battery life.But the major disadvantage in this case is that the rate of speed of data transferring is less

C. LABVIEW

Labview helps in programming instrumentation, Acquisitions of data and in the control systems. It operates in high speed hence the processing can be done at faster rate. By using Labview the designing and the implementation in the system can be done in by which there will be a reduction in development time and there will be higher productivity.

VI. HARDWARE

The development of hemoglobinometer based on reflectance and transmittance in hardware is categorized into 2 classes

- Transmitter
- Receiver

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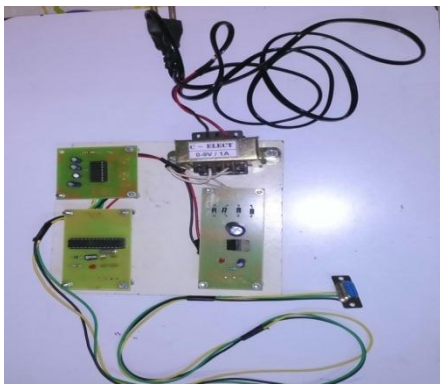

Fig 1.2: Hardware part of light transmitter.

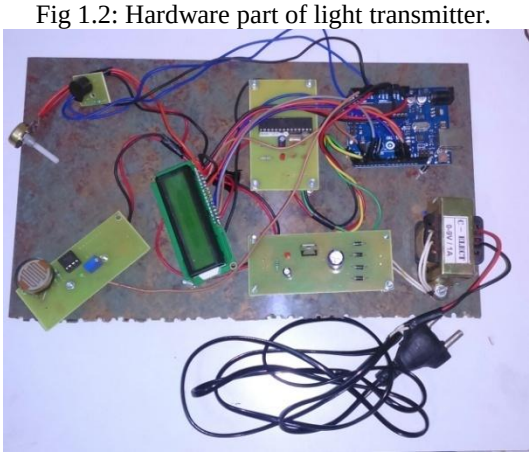

Fig 1.3: Hardware part of light receiver.

VII. CONCLUSION

From this experimental investigation a simple, compact and reliable hemoglobinometer is developed based on the reflectance and the transmittance method. Hence this method provides comfort to the patient as well as it is easier, effective and less time consumption where the results can be obtained within few seconds.
This technique is used both in clinical field as well as for the research purposes moreover this method does not cause any damages to the blood cells and to the fibers in the blood cells.

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