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# Hemoglobin Measurement Using Non Invasive Technique

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**Abstract: Hemoglobin is the protein molecule in red blood cells that carries oxygen from the lungs to the body's tissues and returns carbon dioxide from the tissues back to the lungs. Hemoglobin is made up of four protein molecules (globulin chains) that are connected together. The normal adult hemoglobin (Hbg) molecule contains two alpha-globulin chains and two beta-globulin chains. Hemoglobin is usually measured as a part of the complete blood count (CBC) test from a blood sample. There are several invasive methods for determining Hb concentration. Invasive methods include clinical examination and referencing the colour of a drop of blood on filter paper to a standardized colour comparison chart. Here is an attempt to design a system for non-invasive hemoglobin monitoring . A total description of setup for non-invasive hemoglobin monitoring using near infrared is presented. It includes projection of near infrared radiation on a figure of subject and sensing the resultant radiation after absorbance by hemoglobin .Here the hemoglobin count is attributed to the voltage level which are standardized through a series of experiment and analysis**

## INTRODUCTION

According to World Health Organisation the normanl range for Hb Is For men : 13.5 g/dl to 17.5 g/dl and For women : 12.0 g/dl to 15.5 g/dl Hb values can be lower or higher than the normal range resulting in di_erent types of diseases.If Hb concentration is lower than normal levels then it is termed as anaemia whereas high hb levels is termed as polycythemia. There are various methods of Hb monitoring , but so far only the invasive methods are prevalent , as they are the only one which are accurate significantly. But these methods involve extraction of blood which may cause excessive bleeding or infection. Due to these problems with invasive methods of Hb monitoring , it is becoming important to find an efficient non-invasive method for the same.

## II. MANUSCRIPTS

### A. Hemoglobin

Hemoglobin is found in the red blood cells of the body. Absorption of light by oxiginated and deoxiginated hemoglobim is mearused at two wavelengths 940nm and 660nm respectively.

Each red blood cell (RBC) contains approximately 280 million hemoglobin molecules.

The main function of hemoglobin is to transport oxygen from the lungs to the tissues and then transport CO2 back from the tissues to the lungs. One hemoglobin molecule has the ability to transport up to 4 oxygen molecules. There are two main forms of hemoglobin: oxyhemoglobin, which is saturated with oxygen molecules and deoxyhemoglobin (also is called reduced hemoglobin), which is desaturated with oxygen molecules. Oxyhemoglobin has a higher a_nity for oxygen than deoxyhemoglobin, and deoxyhemoglobin has a higher a_nity for CO2 than oxyhemoglobin. Therefore, oxygen binds to oxyhemoglobin in the lungs and is then transported through the blood stream until it reaches the tissues. There, the oxygen is released to myoglobin, which then transports it to the mitochondria where it is used for aerobic respiration. In exchange, deoxyhemoglobin picks up 2 protons and 2 molecules of CO2 and returns to the lungs, where the CO2 is released through exhalation.

### B. Hemoglobin Monitoring (Invasive Techniques)

In the present days most commenly used method for Hb measurement is by collecting
blood by pricking the _ngure and trans_ering it to a cuvette which is then put in a analyser and the Hb is measured spectrophotometrically.

### C. Advantages of Non-Invasive Techniques

- Needle free, painless testing system.
- Eliminates possible infections.
- Advantageous to the hemophobic and diabetic patients.
- No need of expertise
- Devics is portable
- Cost effective
- Real time monitoring system

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### D .Description of Block diagram

The block diagram of proposed work is shown below

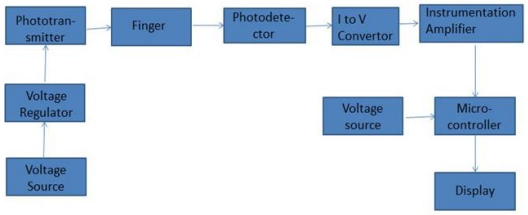


**Figure 1: Block diagram**

### E. Hardware analysis

**Table 1: Obtained voltage levels for Hb count**

| Sr.No. | Hb Count(mg/dL) | O1(mV) | O2(mV) | O3(mV) | Avg.Output(mV) |
|---|---|---|---|---|---|
| 1 | 17.7 | 4.8 | 4.7 | 4.8 | 4.8 |
| 2 | 15.8 | 5.4 | 5.2 | 5.2 | 5.3 |
| 3 | 11.5 | 7.1 | 7.3 | 7.3 | 7.3 |
| 4 | 16.9 | 4.7 | 5.3 | 5 | 5 |
| 5 | 5.5 | 5.4 | 5.4 | 5.3 | 5.4 |
| 6 | 8.6 | 9.6 | 10 | 9.8 | 9.8 |
| 7 | 9.5 | 8.8 | 9 | 9 | 9 |
| 8 | 14.4 | 6 | 5.8 | 5.9 | 5.9 |
| 9 | 12.2 | 6.7 | 7 | 7 | 6.9 |
| 10 | 12.5 | 6.8 | 6.7 | 6.7 | 6.7 |
| 11 | 10.1 | 8.5 | 8.3 | 8.4 | 8.4 |
| 12 | 13.2 | 6.4 | 6.5 | 6.4 | 6.4 |
| 13 | 11.8 | 7 | 7.2 | 7.2 | 7.2 |
| 14 | 18.2 | 4.5 | 4.4 | 4.5 | 4.5 |
| 15 | 9.9 | 8.6 | 8.7 | 8.7 | 8.7 |
| 16 | 13.3 | 6.2 | 6 | 6.4 | 6.2 |
| 17 | 10.7 | 7.9 | 8 | 7.9 | 7.9 |
| 18 | 13.3 | 6.4 | 6.3 | 6.4 | 6.4 |
| 19 | 17.4 | 4.7 | 4.8 | 4.9 | 4.8 |
| 20 | 14.5 | 6 | 5.7 | 5.8 | 5.8 |
| 21 | 9.5 | 8.8 | 8.9 | 9 | 8.9 |
| 22 | 18.2 | 4.7 | 4.6 | 4.6 | 4.6 |
| 23 | 17 | 4.8 | 4.9 | 4.9 | 4.9 |
| 24 | 14.1 | 6 | 6 | 6.1 | 6 |
| 25 | 15.6 | 5.3 | 5.4 | 5.4 | 5.4 |
| 26 | 16.9 | 4.7 | 4.9 | 5.1 | 4.9 |
| 27 | 14.8 | 5.8 | 5.8 | 5.6 | 5.7 |
| 28 | 12.5 | 6.8 | 6.7 | 6.8 | 6.8 |
| 29 | 13.5 | 6.3 | 6.3 | 6.2 | 6.3 |
| 30 | 11.3 | 7.3 | 7.3 | 7.2 | 7.3 |

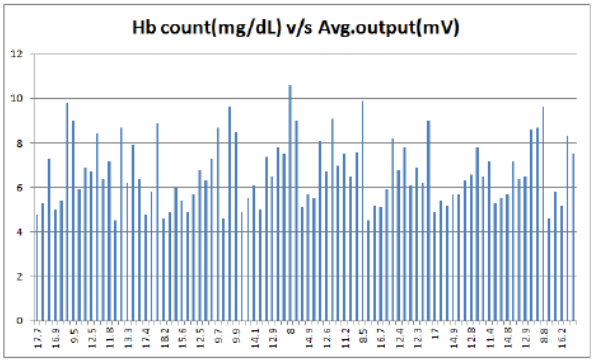


**Figure2: Hb count (mg/dL) v/s Avg Output (mV)**

### F. Result

**Table 2 calibration**

| Hb Count Range | Obtained Voltage Range |
|---|---|
| 8-9 | 9.6-10.6 |
| 9-10 | 8.5-9.1 |
| 10-11 | 7.8-8.4 |
| 11-12 | 7.2-7.5 |
| 12-13 | 6.5-7.0 |
| 13-14 | 6.1-6.5 |
| 14-15 | 5.7-6.0 |
| 15-16 | 5.3-5.5 |
| 16-17 | 5.0-5.3 |
| 17-18 | 4.7-4.9 |
| 18-19 | 4.5-4.6 |

### G. Result discussion

- For women output voltage above 7.0mV resembles that she is anaemic and below 5.4mV resembles that she is polycythemic.
- For men output voltage above 6.5mV resembles that he is anaemic and below 4.8mV resembles that he is polycythemic.
- It is observered that change in output voltage with change in Hb level did not follow a particular pattern.
- It is observed that subjects which had equal Hb level gave approximately equal output voltage.

## III. CONCLUSION

### A. General conclusion

As the hemoglobin increases output voltage proportionaly decreases and viceversa. More the hemoglobin count more will be the IR absorption,less will be the output of photodetector and hence less output voltage.Interference of ambient light with the readings was observed.

### B. Future scope

In the whole experimentation and analysis done, we did obtain some correlation between different concentrations of Hemoglobin and the output voltage. But as there are few readings we could not determine the exact relation thus more number of readings are needed to be taken so that we can get an exact relation to determine the hemoglobin count more accurately.

In our experiment we have made use of a _nger clip to measure voltages. This can give rise to human errors due to shaking and trembling. Also position and the area of

the _nger exposed to sensors can vary each time of an individual takes the reading. Thus, it takes time for the readings to stabilized.

By using micro-controller the voltages can be converted to the actual haemoglobin levels and hence can be displayed on LCD.

By using fuzzy logic the device can be used to prescribe the medications for anaemic and polycythemic subjects.

Same principle can be used for monitoring cholestrol and glucose level.

**REFERENCES**

1. Sandeep Patil HG,Dr. Ram Kumar PS,Dr.G.K.Prabhu,Dr.AGIT N. Babu, "Methods and devices to determine Hb non-invasively; a review, july 2014
2. Rajashree Doshi, Anagha Pandit Rao,Optical sensor system for Hemoglobin Measurement.