IR based Haemoglobin Measurement using Non Invasive Technique and its Classification

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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.**
Haemoglobin consist of four protein molecules (globulin chains) that are linked together. The normal adult haemoglobin (Hbg) molecule contains two alpha-globulin chains and two beta-globulin chains. Invasive method comprises of physical examination and credentialises the colour of a drop of blood on filter paper to a standardized colour comparison chart[3].
Here is an attempt to design a system for non-invasive haemoglobin monitoring and classification . A non invasive haemoglobin monitoring using infrared is showcased. It includes near infrared radiation on a index finger of your hand and sensing the resultant radiation after absorbance by haemoglobin . The haemoglobin count is measured across to the voltage level through a chain of observations and results are obtained .The results are further used for analysing the various haemoglobin related diseases prevalent in women[3].

Keywords: **N**on invasive , monitoring, fuzzy logic, classification

I. INTRODUCTION

According to World Health Organisation the normal 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 different types of diseases. If Hb concentration is lower than normal levels then it is termed as anaemia whereas high hb levels is termed as polycythaemia.

II. MANUSCRIPTS

A. Hemoglobin

Hemoglobin is present in the red blood cells of the body. Absorption of light by oxygenated and deoxygenated hemoglobim is measured by wavelengths 940nm and 660nm respectively.
Each red blood cell (RBC) contains approximately 280 million hemoglobin molecules.
The main task of hemoglobin is to carry oxygen from the lungs to the tissues and then transport CO_2 from the different tissues to the lungs. One hemoglobin molecule has the ability to carry up to 4 oxygen molecules. There are two main components of hemoglobin: oxyhemoglobin, which is saturated with oxygen molecules and deoxyhemoglobin (also is called reduced hemoglobin), which is desaturated with oxygen molecules. Oxyhemoglobin is highly associated for oxygen than deoxyhemoglobin, and deoxyhemoglobin is highly associated to CO_2 than oxyhemoglobin. Therefore, oxygen combines to oxyhemoglobin in the lungs and is then transferred through the blood stream until it reaches various tissues. There, the oxygen is released to myoglobin, which then carries it to the mitochondria, and thus used for aerobic respiration. In exchange, deoxyhemoglobin picks up 2 protons and 2 molecules of CO_2 and returns to the lungs, where the CO_2 is set out through exhalation.

B. Advantages of Non-Invasive Techniques

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

C. Description of Block diagram

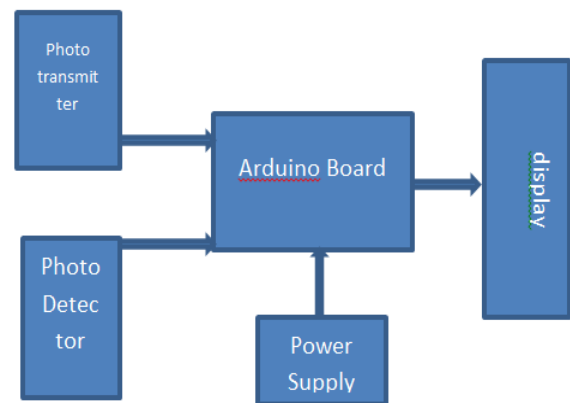The block diagram is shown below for the detection

Figure 1: Block diagram

D. Hardware analysis

Table 1: Obtained Avg voltage levels for Hb count

Sr. No	Female Age Group	Hb Count(mg/dl)	R1 in mV	R2 in mV	R 3 in mV	Reading 4 in mV	Avg output voltage in mV
1	10 – 12 yrs	16.6	5.0	5.2	5.3	5.0	
2	10 – 12 yrs	15.3	5.0	5.1	5.1	5.0	5.05
3	12 – 15 yrs	16.7	4.7	4.5	4.6	4.6	4.6
4	12 – 15 yrs	15.6	5.0	5.1	5.1	5.1	5.07

5	12 – 15 yrs	14.3	6.2	6.3	6.3	6.3	6.3
6	12 – 15 yrs	14.8	6.0	6.0	6.1	6.0	6.0
7	12 – 15 yrs	16	4.3	4.4	4.4	4.3	4.3
8	15 – 17 yrs	16.33	4.3	4.2	4.2	4.2	4.2
9	15 – 17 yrs	15.33	5.6	5.7	5.7	5.6	5.6
10	15 – 17 yrs	17.2	4.9	4.8	4.8	5.0	4.87
11	15 – 17 yrs	16.5	4.1	4.1	4.1	4.3	4.1
12	15 – 17 yrs	13.22	6.4	6.3	6.4	6.4	6.4
13	15 – 17 yrs	13.67	6.2	6.3	6.3	6.2	6.2
14	15 – 17 yrs	14.4	6.2	6.1	6.2	6.2	6.2
15	15 – 17 yrs	15.2	5.5	5.4	5.5	5.5	5.5
16	15 – 17 yrs	15.5	5.0	4.9	4.9	4.8	4.9
17	15 – 17 yrs	16.1	4.7	4.6	4.5	4.7	4.6
18	15 – 17 yrs	16.02	4.5	4.7	4.7	4.5	4.6
19	15 – 17 yrs	15.3	5.5	5.5	5.6	5.5	5.5
20	15 – 17 yrs	16.2	4.8	4.5	4.8	4.8	4.8
21	18 – 25 yrs	11	7.2	7.1	7.1	7.1	7.1
22	18 – 25 yrs	11.6	7.1	7.2	7.2	7.3	7.2
23	18 – 25 yrs	12.3	6.7	6.8	6.6	6.7	6.7
24	18 – 25 yrs	12.7	6.7	6.7	6.5	6.6	6.7
25	18 – 25 yrs	12.8	6.6	6.4	6.4	6.1	6.3
26	18 – 25 yrs	13.2	6.4	6.3	6.4	6.4	6.4
27	18 – 25 yrs	13.6	6.5	6.4	6.3	6.3	6.4
28	18 – 25 yrs	13.8	6.5	6.4	6.4	6.4	6.4
29	18 – 25 yrs	15.2	5.2	5.4	5.2	5.2	5.2
30	18 – 25 yrs	15.6	5.3	5.3	5.3	5.3	5.3
31	18 – 25 yrs	16.1	4.7	4.6	4.6	4.4	4.6
32	18 – 25 yrs	16.4	4.8	4.7	4.8	4.8	4.8
33	18 – 25 yrs	12.2	6.8	6.8	6.8	6.8	6.8
34	18 – 25 yrs	12.4	6.7	6.6	6.7	6.7	6.7
35	25 – 30 yrs	14.3	6.2	6.1	6.1	6.1	6.1
36	25 – 30 yrs	14.8	5.9	5.5	5.8	5.8	5.8
37	25 – 30 yrs	13.1	6.1	6.2	6.2	6.2	6.2
38	25 – 30 yrs	11.3	7.1	7.2	7.2	7.2	7.2
39	25 – 30 yrs	10.2	7.6	7.5	7.7	7.5	7.5
40	25 – 30 yrs	12.6	7.3	7.2	7.3	7.2	7.3

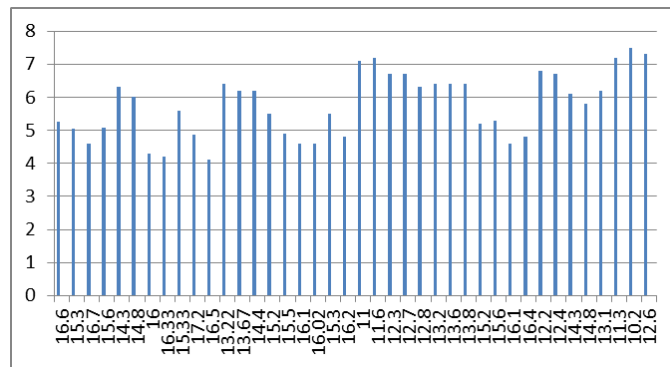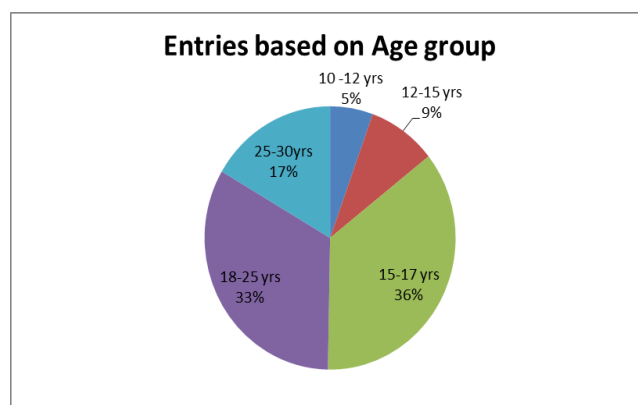
Figure2: Hb count (mg/dL) v/s Avg Output (mV)

Figure3: Entries of different age group

E. Result discussion

- For women category having haemoglobin level between 12 -15.5 grams per decilitre is considered normal. Values below 12-13 grams per decilitre is considered to be iron deficit anaemia in females

- Similarly the hemoglobin level can also be used to detect the hemoglobin related diseases during pregnancy. The value below 12 grams per decilitre will be considered iron deficit and will have voltage range between 6.8mV – 7.0mV and below 10 grams per decilitre is anaemic with voltage range between 7mV – 8mV.

- The haemoglobin level intensity can also help in finding the heart rate of a patient.

III. CONCLUSION

A. General conclusion

As the hemoglobin increases output voltage value reduces and thus inversely propotional. Higher the hemoglobin count higher will be the rate of the IR absorption,lower will be the output of photodetector and hence less output voltage. Interference of light with the samples could cause error in readings.

B. Future scope

By using fuzzy logic the device could be enhanced to describe the medications for anaemic and polycythemic subjects.

Same principle could also be used for monitoring cholesterol and glucose level [3] and also to find the heart rate of a patient.

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