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A Different Way for Detecting Anaemia Disease using Bioelectronics Circuit

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All in all, clinical science characterizes anaemia disease as less tally of a red platelet. This illness is exceptionally successive in India and a few pieces of the entire world. This isn't straightforwardly influencing illness however the maker and initiator of numerous other blood-related issues. Biomedical has effectively built up a testing technique for the recognizable proof of such infection and sorted out the strategy for computing the quantity of check or scope of red platelets in human bodies. In view of a correlation of such information with ordinary human blood attributes specialists can distinguish the level of the pallor and its connected stage. This requires time like conventional blood revealing just as the precision of testing philosophy. With the help of this article, another method of recognizing similar information inside a brief timeframe is introduced. By processing the ordinary human platelet check with anaemia influenced blood through the bioelectronics circuit, it will be useful to sort out the presence of the illness. Rather than utilizing genuine blood, a substance blend comparable to human blood serum has been thought of and for sickness, synthetic creation has been modified. This may change results for genuine human blood however then circuit changes may assist us with improving the outcomes. The sugar meter and heart meter are as of now utilized in everyday life by normal individuals without the assistance of specialists. These commonsense outcomes may lead such instrument makers for building up the gadget for sickliness identification.

Keywords: amplifier; biology; biomedical; bioelectronics; human blood serum

I. INTRODUCTION

Once can represent Bioelectronics as summation of biology (science) and electronics (engineering). The combination of two totally various regions, science and engineering is a field of bioelectronics which has loads of extension for scientists. There is anything but an exceptional and careful definition for "Bioelectronics" was presented at the main Conference of European Churches (C.E.C.), The workshop in Brussels in November 1991, bioelectronics was characterized as "the utilization of organic materials and natural structures for data preparing frameworks and new gadgets" (Nicolini, C 1995). Bioelectronics, expressly bio-sub-nuclear equipment, was portrayed as the creative work of bio-impelled (for instance self-get-together) inorganic and normal materials and bio-moved (for instance gigantic parallelism) hardware models for the utilization of new information dealing with structures, sensors and actuators, and sub-nuclear collecting down to the atomic scale. Equipment development has been applied to science and prescription since the pacemaker was made and with the clinical imaging industry (Walker GM, Feb. 2009; Department of Electrical and Computer Engineering, NC State University, 2020).

A. Anemia: Lack of Blood

Here in this article, we have discussed a very common and very frequently affected disease called anaemia. Sometimes it is also referred to as lacking blood condition. From an engineering point of view, a few basic details of this disease have been explained here. Anaemia results from a lack of red blood cells or dysfunctional red blood cells in the body. This leads to reduced oxygen flow to the body's organs. Symptoms

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may include fatigue, skin pallor, and shortness of breath, light-headedness, dizziness, or a fast heartbeat (Mayo Clinic, 2019). Treatment depends on the underlying diagnosis. Iron supplements can be used for iron deficiency. Vitamin B supplements may be used for low vitamin levels. Blood transfusions can be used for blood loss. Medication to induce blood formation may be used if the body's blood production is reduced. Anaemia is a condition that develops when your blood lacks enough healthy red blood cells or haemoglobin. Haemoglobin is the main part of red blood cells and binds oxygen. If you have too few or abnormal red blood cells, or your haemoglobin is abnormal or low, the cells in your body will not get enough oxygen. There are more than 400 types of anaemia, which are divided into three groups: (1) Anemia caused by blood loss, (2) Anemia caused by decreased or faulty red blood cell production, and (3) Anemia caused by the destruction of red blood cells (Web MD, April 2020).

B. Existing Anemia Test Description

Generally based on routine symptoms of a patient, doctors advised going through a basic test which helps to diagnose anaemia as well as to determine its cause. Several routine laboratory tests may be used to help diagnose anaemia as well as help to determine the underlying cause like Complete blood count (CBC). Depending on the results of these, the medical history of the person, and signs and symptoms, other tests may be done as follow up to help diagnose the cause of anaemia and to help guide treatment (Trend MD, May 2020).

II. MATERIALS AND METHOD

A human blood serum-based transistor amplifier in discrete form and together in Integrated Circuit (IC) type configuration already tested and published in the reputed journal (Kosta SP *et al.,* 2013). Using LCRQ meter an innovative methodology for human blood group identification has also been under research (Manavadaria MS *et al.,* 2018). In addition to this author has also presented the concept of liquid state electronics as well as bioelectronics filter based disease detection technique innovative methods in the conference and reputed journals (Manavadaria MS *et. al.,* 2017; Dave S & Manavadaria M, 2016). The common significance from this, each serum contains a different form of ion concentration which plays a vital role in an electronic circuit. So a normal healthy human body's blood serum has vast difference compared to a person seeking from anaemia. As the various test indicate the specific CBC count, which may be directed by a range of characteristics.

Table 1. Serum sample composition for normal case (A) and anaemia case (B)

Serum Sample Content	Molecular Wight (gm/mol)	Normal Serum Proportional level (A)	Normal Serum mol. wt. (g/mol) (A)	Anemia Serum Proportional level -(B)	Anemia Serum mol. wt. (g/mol) (B)
NaCl	58.44	0.5	29.22	0.1	5.844
KCl	74.55	0.1	7.455	0.05	3.7275
CaCl2	110.98	0.1	11.098	0.05	5.549
MgSO4	120.36	0.1	12.036	0.05	6.018
NaHCO3	84.007	0.1	8.4007	0.05	4.20035
Na2HPO4	141.96	0.1	14.196	0.05	7.098

For this experiment two sample of human blood serum has been developed using require chemicals in a specific proportion, refer Table 1. One sample represents the healthy condition which we will treat as Normal serum and another one which has been affected by anaemia which will be considered as Anemia Serum as indicated in Figure 1.

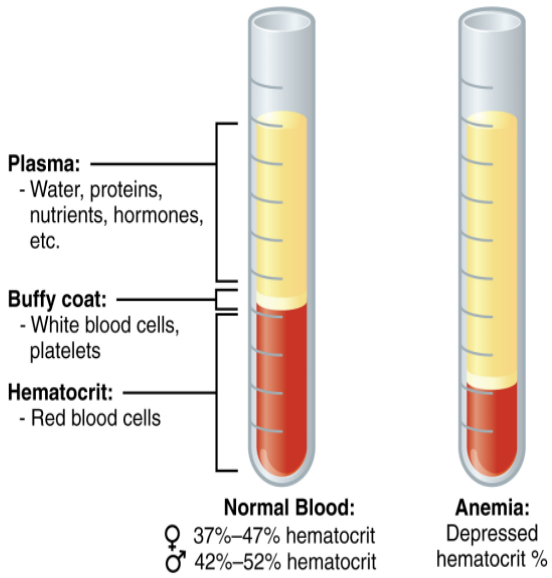

Figure 1. Level of serum in normal and anaemia affected blood sample

A common emitter (CE) amplifier is tested first with a fully electronic component to derive standard CE amplifier output characteristics. Figure 2 represents the electronic circuit with component values that are used for the experiment. The majorly gain of an amplifier is considered for comparison of disease identification. The experiment setup has been demonstrated in Figure 3. As per human blood serum electrolyte (HBSE) based amplifier circuit R1 resistor has been replaced by Normal serum and Anemia serum one after another. Input condition (Vcc=5v) and all other parameters considered as in electronics form.

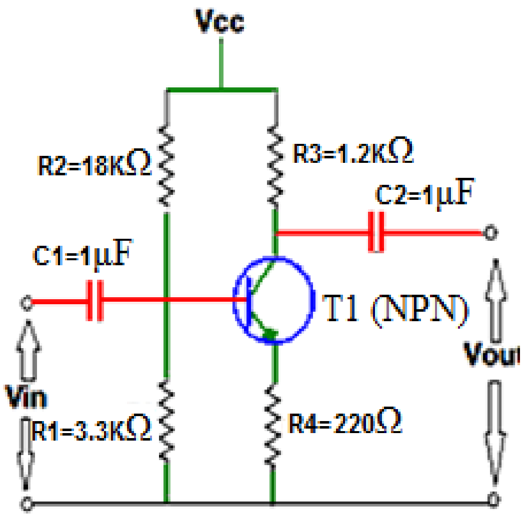

Figure 2. Transistor single stage amplifier

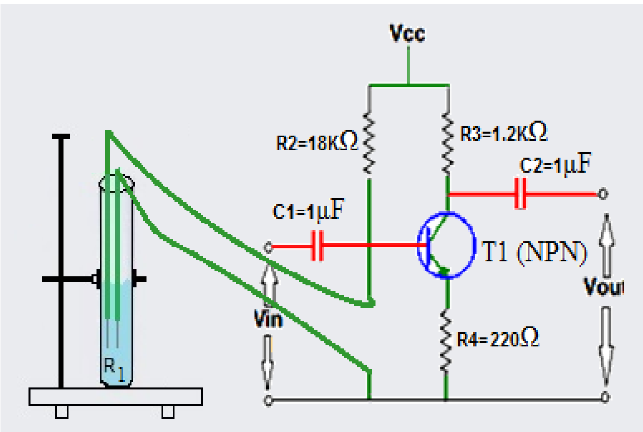

Figure 3. Experiment setup for anaemia identification

So resultant changes considered as happen due to serum effect. An input signal is taken as a sine wave ranging from 100mv, 200 mv, and 500mv with frequency vary from 100Hz to 1MHz. So many values of output voltages (Vout) have been noted down to get the characteristics of the bioelectronics circuit. The gain characteristics have been compared in graphical form with the same voltage level as well as collectively (including all frequency and voltage levels) for getting whole analysis in depth.

III. RESULT AND DISCUSSION

From an engineering point of view, the gain characteristics should be plotted as gain vs. frequency. So here for a comparison of the experiment's results graph has been given in Figure 4 to Figure 7. Corresponding to supply voltage 100 mv, 200 mv, and 500 mv, the gain is plotted for normal blood serum sample and anaemia serum sample respectively in Figure 4, Figure 5 and Figure 6. For a more conclusive remark, all the characteristics have been plotted and represented together in Figure 7.

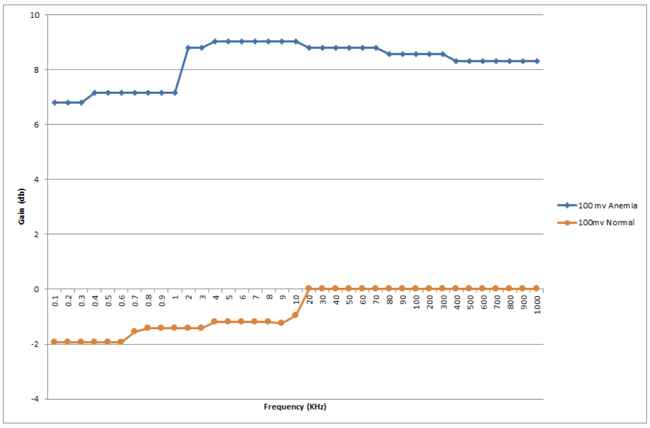

Figure 4. Anaemia identification result at 100 mV

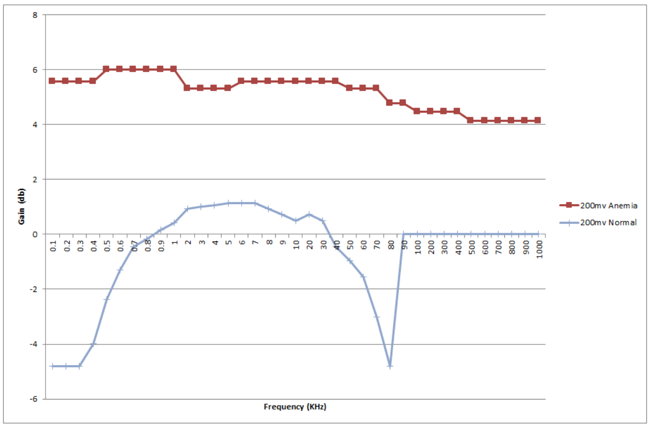

Figure 5. Anaemia identification result at 200 mV

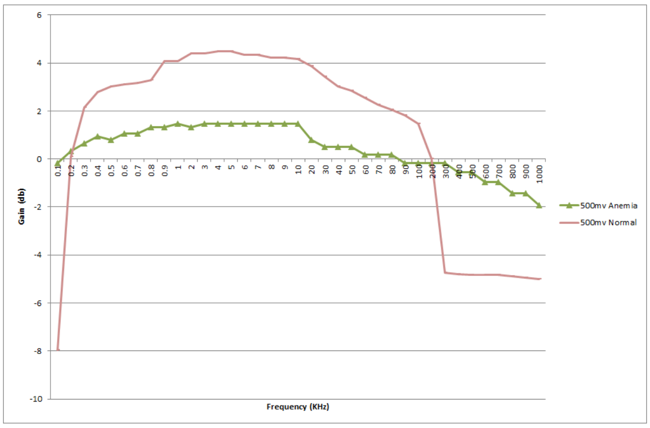

Figure 6. Anaemia identification result at 500 mV

Results are very much similar to assumption that a normal human body response must differ from an anaemia infected human body. In case of 100 mv, the applied signal is very much near to noise level. In fact, an amplitude level is negligible compare to a voltage range. The Figure 5 graph represent that, there is clearly 5 dB difference in gain of amplifier at any point of applied frequency. This can be consider like that, a sample with anaemia infection has much more connectivity (electronically), so it is allowing more no of charges to pass the input signal toward the output side. Due to this changes, an output voltage level is comparatively higher than output voltage of without this change of concentration. It is very similar that when human body blood has any change then it will be diagnosed in various clinical testing. The same pattern is also available when voltages are 200 mv or 500 mv. In these two cases difference of gain is reduced compare to 100 mv. Sometimes the gain characteristics cross between normal and disease infected readings.

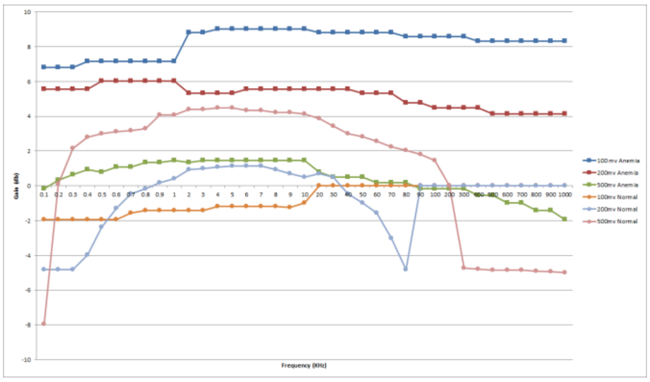

Figure 7. Anaemia identification result comparison

Secondly, in all three results anaemia infect gain range is near about 3 dB to 4 dB. This helps us to identify the frequency based variation in detection mechanism. It is interesting to note that for normal human body response the gain characteristics is also same but at other reference points. Such two difference range are sufficient to get the idea of anaemia infection level in particular sample. Compare to 500 mv characteristics, other two characteristics are very separate from each other, which indicate the importance of applying the low voltage level input signal. Overall, with consideration of voltage and frequency value, the gain response is straightforward indicative to diagnose the anemia in the human body blood sample.

IV. CONCLUSION

The result is close to visualization. As predicted due to concentration changes the response has been changing for all anaemia samples at any input voltages. It is very much interesting to observe the individual input graph representation which gives the difference between a patient and a healthy person. Here in this section, all the curves have combined to identify the ranges of anaemia and normal serum characteristics concerning the input voltage signal. At present moment it is difficult to predict exact range, but approximate for very low voltages (mv) anaemia gain lies in between 2 db to 5 db whereas for normal serum it is -5db to 5db. Again all these depend on applied frequency value which also affects output stability. This realization may open the gate of bioelectronics for new disease detection methodology.

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VI. REFERENCES

Bright Hub Engineering 2010, What is bioelectronics?, viewed March 2020, <https://www.brighthubengineering.com/consumer-appliances-electronics/73831-overcoming-disability-with-bioelectronics/>.

Dave S & Manavadaria M 2016, 'Functional realization of electronic elements in liquid state: A review introducing electronic characteristics in liquid state', in Proc. of Int. Conference on Electrical, Electronics, and Optimization Techniques, 3 to 5 November 2016.

Department of Electrical and Computer Engineering, NC State University, viewed March 2020, <https://www.ece.ncsu.edu/research/bee/>.

Kosta, SP, Manavadaria, M, Pandya, K, Kosta, YP, Kosta, S, Mehta, H & Patel, J 2013, 'Human blood plasma-based electronic integrated circuit amplifier configuration', The Journal of Biomedical Research, vol. 27, no. 6, pp. 520-522.

Manavadaria, MS, Kosta, SP & Tank VP 2017, 'A review and visionary design of human tissue blood serum based low pass filter circuit for disease detection', IJET, vol. 9, no. 2, pp. 361-367.

Manavadaria, MS, et al 2018, 'A review and visionary concept of human tissue skin based electronic circuit and systems for abo blood group identification', IJARET, vol. 9, no. 4, pp. 132–138.

Mayo Clinic 2019, Anemia, viewed April 2020, <https://www.mayoclinic.org/diseases-conditions/anemia/diagnosis-treatment/drc-20351366>.

Nicolini, C 1995, 'From neural chip and engineered biomolecules to bioelectronic devices: an overview', in Biosensors and Bioelectronics, vol. 10, no 1-2, pp. 105-127.

Trend, MD 2020, Anemia, viewed May 2020, <https://labtestsonline.org/conditions/anemia>.

Walker, GM, Feb. 2009, A Framework for Bioelectronics: Discovery and Innovation, National Institute of Standards and Technology, pp. 42.

Web, MD 2020, Anemia, viewed April 2020, <https://www.webmd.com/a-to-z-guides/understanding-anemia-basics#1>.