A Simulation of Measurement of WBC using MEMS

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Abstract- **Measurement of specific gravity of blood can provide important information about the status of the platelet count. Patients suffering from leukemia require measurements of white blood cell count linked to platelet count on a routine basis. Almost in all types of Leukemia the body immunity gradually falls due to the decrement of white blood cell count. White blood cells, which are involved in fighting pathogens, may be suppressed or dysfunctional due to leukemia. Platelet count can be done through measurement of specific gravity of blood serum. The specific gravity of blood serum can be measured through MEMS (Micro Electro Mechanical System). And this measurement of specific gravity of serum is very precise, automatic and can be implemented for remote patients.**

Keywords: MEMS, Specific Gravity of blood serum, Platelet Count, Leukemia.

Introduction

Leukemia is Cancer that starts in blood-forming tissue such as the bone marrow and causes large numbers of blood cells to be produced and enter the bloodstream [1].The word leukocytes which means 'white blood' causes the patient's immune system to be unable to fight off a simple infection [2]. Because leukemia prevents the immune system from working normally, some patients experience frequent infection, ranging from infected tonsils, sores in the mouth, or diarrhea to life-threatening pneumonia or opportunistic infections [3]. The platelet count along with white blood cell count decreases with leukemia [4, 5]. A routine wise measurement of blood cell count is required. The cell count can be co related with the specific gravity of blood serum [6]. The relation between specific gravity of blood serum and red blood cell is shown in the fig1. Red blood cell count in the blood is directly related with the hemoglobin of the blood [7].
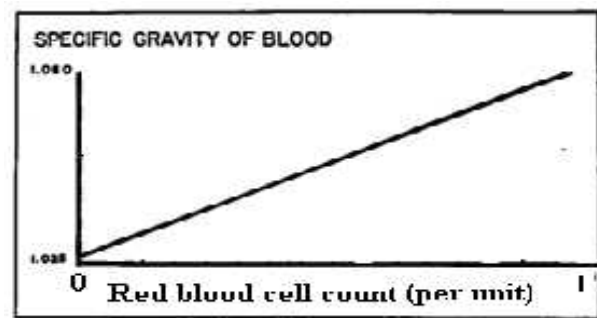

Fig: 1 Relation between specific gravity of blood and red blood cell

1 per unit of red blood cell count corresponds to 15 unit of hemoglobin

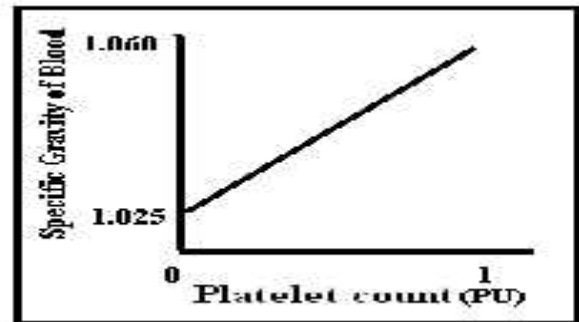The platelet is also related to specific gravity of blood. The relation between them is shown in fig2.

Fig: 2 Relation between specific gravity of blood and Platelet

1 per unit = 2 lakhs per microliter of blood

From this relation the platelet count can be evaluated with the measurement of specific gravity of blood.

Proposed system

The proposed system is an automatic system which computes and takes decision automatically. Two sets of data have been made. One set of data has been used to train the system. After the system is trained then the system is tested with the other set of data. Later the system can take decision for any unknown data automatically [8, 9].

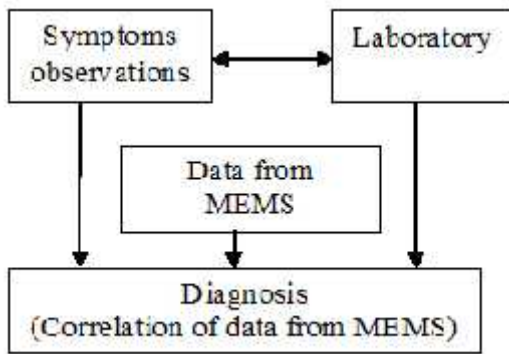The block diagram of the system is shown in fig.3.

Figure 3: Basic block diagram of proposed system
Advantages of Proposed system
1. Model produces reliable correlation of the results in respect of specific gravity.
2. Allow to apply models to unseen patients.

Density or specific gravity measurement methodology is simple in MEMS device. For minimum specific gravity, the electrodes of MEMS will vibrate with maximum amplitude and thus the amplitude of the vibration of electrode is functionally related to specific gravity which is the underlying principle of MEMS. Moreover the reliability of measurement of frequency in MEMS is very high because the frequency can be measured with very high accuracy. The density or specific gravity sensor employs a chip level, vacuum packaged, and resonating silicon tube. While filled with a fluid, the tube is driven into resonance electrostatically and its motion sensed capacitively [10, 11].

MEMS
MEMS are micro electro mechanical device which is the heart of the proposed system. This is an effective and accurate tool for the measurement of the specific gravity of the liquid [10, 12]. At the core of this sensor is a resonating silicon microtube.

Simulation Of Measurement Of Specific Gravity Of Blood Serum Using Mems In Matlab
The phenomenon for measurement of blood serum has been simulated by MATLAB 7.0. Different curves of various resonant frequencies representing different blood samples have been simulated in MATLAB [13]. The basic block diagram of MATLAB simulation is shown in fig4.
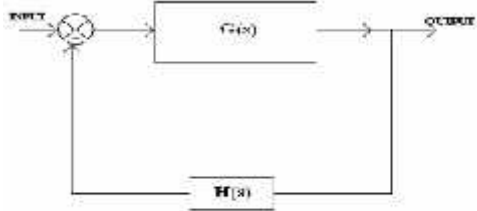

Figure 4: Basic block diagram of Matlab simulation
A MATLAB based concentration measurement algorithm is used for measurement of blood serum coming in contact. Different curves of various resonant frequencies

representing different blood samples have been simulated in MATLAB. Data obtained from MATLAB are decoded so that it can be fed to software for further analysis and correlation with the data of blood sample obtained from laboratory corresponding to the status of the subject [11]. The model using the close loop transfer function in MATLAB simulation is shown in the block diagram in fig 5.
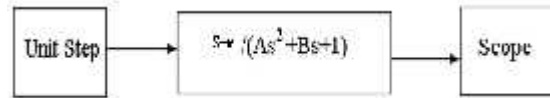

Figure 5: Sample closed loop transfer function of simulation of MEMS

Simulation Of Measurement Of Specific Gravity Of Blood Serum Using Mems In Multisim
Silicon micro tube technology has been developed to measure the density of extremely small fluid volumes. The density or specific gravity sensor employs a chip level, vacuum packaged, and resonating silicon tube. Resonating part of the silicon tube is a high impedance device and its electrical representation is parallel resonator. R and C represent the energy status of the resonating tube consequent with compression and relaxation. The electrical equivalent circuit of the vibrating part of the resonating silicon tube is as shown in fig6.
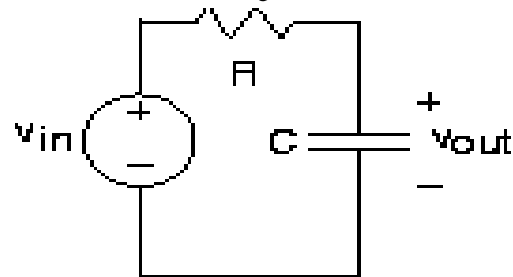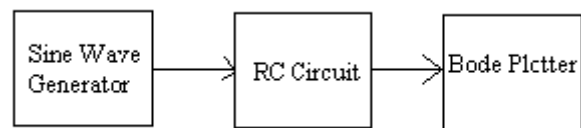

Fig 6: A simple *RC* circuit.

Fig 7: Basic Block Diagram of Multisim implementation
The concentration of blood serum is represented by the circuit shown in fig 6. The different concentration of blood corresponding to different circuit values has been implemented [14]. The basic block diagram of multisim implementation of the work is shown in fig 7.The electrical property of the blood has been considered and correlated with the results of Matlab.

Result
The result of Matlab 7.0 simulation and that of Multisim are closely co related as shown in the fig 8 in respect of concentration of the fluid and the resonant frequency of the silicon resonator.
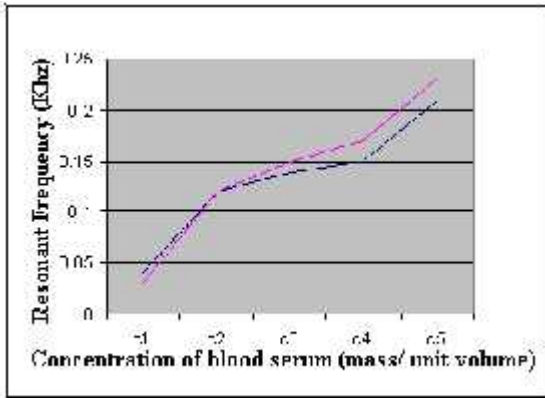
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Fig 8: Co relation of Matlab and Multisim

Conclusion

In MEMS concentration of mass in a fluid is measured against the frequency and since the reliability of measurement of frequency is very high, measurement of specific gravity is very precise. In the present paper important parameters namely red blood cell count and platelet count is measured with MEMS in order to monitor the status of the patient suffering from leukemia. It is well known that blood transfusion is a routine program depending on the status of this blood parameter.

Acknowledgement

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