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Measuring Blood Sugar Level using IR Sensor

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***Abstract*—— This paper describes a non-invasive method for monitoring blood glucose levels of diabetic and non-diabetic peoples. The meaning of non-invasive is the method to measure glucose level without pricking or ejecting blood from body. A non-invasive method for glucose monitoring provides adequate control and greatly reduces the complications in diabetic patients; and consequently reduces the health care costs. Non-invasive method is advantageous as the possibilities of infections get reduced and even there is no pain of pricking the blood. The proposed method uses near infrared sensor for determination of blood glucose. Near-Infrared light is sent through the fingertip before and after blocking the blood flow. By analysing the voltage variation received after transmission through fingertip, approximate glucose level is predicted. The obtained glucose level is further transmitted to the smart android app for further analysis and storage of the data.**

I. INTRODUCTION

Diabetes is major challenge of current century. It is non-communicable disease. Currently more than 150 million peoples are suffering from this disease and are expected to increase in future to 400 million by 2035. Diabetes people check blood glucose level more than two times per day. Hence they are inconvenienced every time. They are suffering the danger of infection by pricking the finger. Also expenses associated with strips and Lancets are more because each test requires a new test-strip and Lancets. Diabetes is considered as one of the major death contributors in non-contagious diseases. The current method uses the self-monitoring glucose meter. These methods are invasive. The main disadvantage of such a method is that, it requires pricking the finger, extracting the blood from forearm and doing chemical analysis which uses test strips. Also it gives pain and discomfort due to frequent finger pricks. Non-invasive techniques are more useful and user friendly. It reduces the healthcare cost and other difficulties involved in invasive method of glucose determination. Researchers are still cannot overcome many drawbacks of non-invasive glucose monitoring method. Some problems are scanning pressure that must be applied, physiological differences such as width of tissues, correlation error, hardware sensitivity and stability. This paper describes the possible design and development for blood glucose monitoring system non invasively. The proposed technique uses a near infrared sensor for transmission and reception of rays from forearm. By analysing intensity variation in received signal by using photo-detector at another side of ear lobe, level of glucose can be predicted. Then the data can be transmitted to remote android device for further analysis.

II. LITERATURE SURVEY-

Kiseok song, et. al. (2015) have developed a multi-modal spectroscopy IC which combines impedance spectroscopy and multi-wavelength near-infrared spectroscopy. It has high precision for non-invasive glucose level estimation. It compensates glucose estimation error. IMPS circuit measure dielectric characteristics of tissues for estimation of glucose level. NIRS uses the three wavelengths, 850nm, 950nm, and 1300nm. These two results are combined for highly accurate estimation. Jyotiyadav, et. al. (2014) have introduced the glucose sensor. This sensor works based on the principle of NIR LED. They have used 940nm spectrum continues wave to analyse the glucose concentration. They have taken different concentration of glucose for experiment. The experiment is tested on human forearm and observed the reflectance spectra of blood and the result is good with greater accuracy. Nina KorlinaMadzhi et. al. (2014) have done the comparative investigation using GaAs (950nm), GaAIAs (940nm) and InGaAsP (1450nm) sensors for glucose level measurement. Firstly they proceed by using test tube which contains various percentage of glucose concentration and then same method has been used for human blood samples. There is larger voltage range for 950nm as compared to 940nm wavelength and more consistency in pattern. K A Unnikrishna Menon, et. al. (2013) have introduced voltage intensity based Non-invasive blood glucose monitoring. The proposed method makes the use of near-infrared sensor. The NIR is sent through the fingertip, before and after blocking of blood flow. By analysing the variation in voltages received after reflection, the current diabetic condition as well as approximate glucose level of individual is predicted. The obtained result is then communicated with a smart phone through Bluetooth. Matthew sidley et. al. (2011) have

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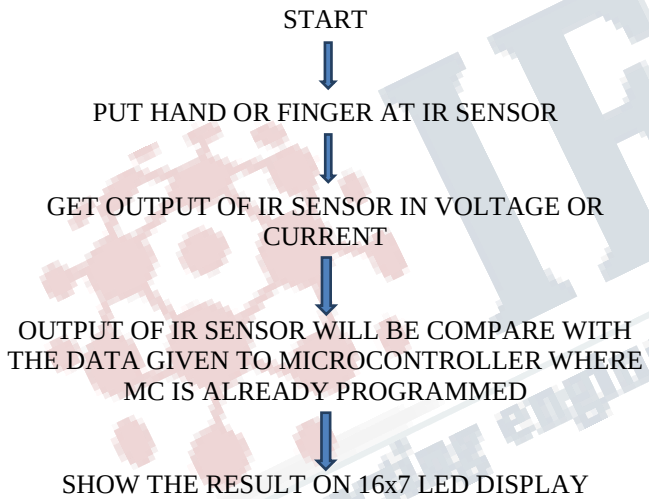
introduced the feasibility of estimating blood glucose level using a micro strip antenna strapped on patients arm. They show that antenna resonant frequency can track the changes in glucose concentration. An equivalent circuit model has been developed to measure the input impedance with changing glucose level. Jens Kraital, et. al. (2010) have introduced the non-invasive measurement of blood component. They used principle of photoplethysmography and NIR spectroscopy. They have measured the different blood component including glucose non-invasively. The blood absorbs NIR light with different absorption coefficient. This characteristic is used for measurement of blood component. This technique is also used to measure the haemoglobin and oxygen saturation in blood. For measurement of different component a range of 600nm to 1400nm wavelength is used for system.

III. METHODOLOGY AND SYSTEM ARCHITECTURE

a) Flowchart of System



The complete flowchart of system is shown in above diagram. Firstly system initializes NIR light. The attenuated light is received by the photodiode placed at other side of forearm. This received signal is amplified and filtered for noise by first and second order filtering. It is processed to determine the characteristics of signal. The determined characteristics or variable is given as input to linear regression equation obtained from data analysis in SPSS. Finally the glucose level is determined and it is displayed on LCD or other terminal.

b) Selection of Wavelength

Some peak points are there at which glucose absorption become very large. The points are 930nm,1145nm,and 1540nm.This is very useful for glucose's analysis because this band shows transparency for water. So, we choose wavelength of 930nm.Penetration depth of human tissue shows very high but water absorb high amount of light in blood.

IV. RESULT AND DISCUSSION

a) Glucose Concentration Calibration Curve

In calibration experiment , results show the output voltage of sensor rises in direct proportion with rise in concentration of glucose as relation shown in below figure.

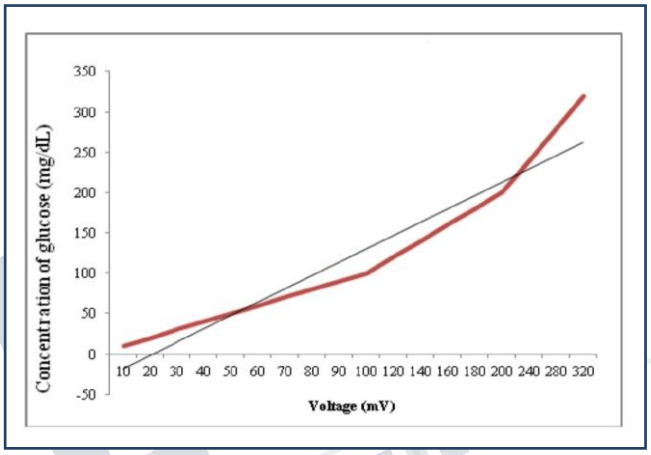


Fig:- Relationship between glucose concentration (mg/dL) and voltage (V)

b) Device Operation

We can see in above the flowchart of our model, when some put his finger near the IR sensor where it has two LED ,one is transmitter and other is photodiode which works as receiver. Transmitter transmits the infrared light that penetrates in our body and reflect back. The reflected IR rays is received by photodiode on other side.

The received light at photodiode varies according to the concentration of glucose. The variation in the light is obtained in the form of voltage.

Output voltage obtained at photodiode is provided to the microcontroller (ardiuno UNO).Where microcontroller is already programmed and have the table of voltage and concentration of glucose in blood .That data is collected from different experiments performed on different patiets of diabetes. Microcontroller compare output voltage of sensor with data given to it and output of microcontroller feed to 16x7 display in digital format.

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At the final ,glucose level of body can be seen at LED display.

V. CONCLUSION

The prepared portable device is more suitable for the detection of glucose concentration in differents glucose solutions. The prepared device has a detection sensor using IR sensor with wavelength of1540 nm and photodiode. The relationship between glucose concentration and voltage is found after many experiments. In experiment ,it's observed that there is a strong relationship between these two variables, It is observed that the output voltage of glucose solutions increase with increase the concentration of glucose solutions. This device is beneficial for diabetic patients as well as for normal people ,Normal people can daily check their diabetes to stay healthy and to control glucose in body.In future, this device can be improved to show many new features like as our daily check data of glucose will be uploaded on cloud , And device can tell our glucose level in voice and also suggest best diets for diabetes patient.

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