Intelligent Non-Invasive Blood Glucose Measurement

T.V.Saranya[1], M. Shalini[2], F. Fincy Mol[3]

[1]*Assistant Professor,Department of ECE,Prince Shri Venkateshwara Padmavathy Engineering College, Tamilnadu,India*

[2]*Assistant Professor,Department of ECE,Prince Shri Venkateshwara Padmavathy Engineering College, Tamilnadu,India*

[3] *Assistant Professor,Department of ECE,Prince Shri Venkateshwara Padmavathy Engineering College, Tamilnadu,India*

ABSTRACT

In this paper, we present an intelligent non-invasive medical device which is used to monitor the insulin present in our body by means of a non –invasive blood glucose concentration monitoring system. The advantages of NIR spectroscopy over MIR spectroscopy include greater penetration depths and less background interference due to water absorption diffused type IRE/IRD method. Also we would like to add few more applications like blood pressure, pulse rate, serum cholesterol, LDL cholesterol, HDL cholesterol. The entire project is designed with an embedded technology which will be easier for the patients to monitor the above said parameters without extracting even a single drop of blood. This a wireless patient monitoring system to measure the vital parameters remotely and necessary control actions can be take under risk developing situations. This system would be a reliable and efficient real time patient monitoring system that can play a vital role in providing better patient care. This method of measuring blood glucose level will be a continuous monitoring in human body.

Keywords: - Remote patient monitoring, pulse rate, blood pressure, serum cholesterol, non-invasive

1. INTRODUCTION

Diabetes has emerged as a major problem in the world. The glucose concentration changes in the blood in any direction i.e. increase or decrease in blood glucose concentration proves a fatal for the patient. The available technologies in our world today require a patient to take blood samples and measure using chemical reactions which are both painful and costly. The acceptable range of glucose concentration is from 70mg/dl to 110mg/dl. Thus, there is a need of blood glucose measuring gadget which may give keeps observing of blood glucose fixation noninvasively. Non- invasive blood glucose monitoring system can be approached by many spectroscopy techniques like polarimetry, Raman spectroscopy, Mid - infrared spectroscopy, and Near – infrared spectroscopy. In our project we are using the NIR spectroscopy in the development

2. LITERATURE SUMMARY

[1] The author presents a wirelessly powered implantable electrochemical sensor tag for continuous blood glucose monitoring. This also provides reliable accurate measurement for changing glucose levels. [2] This paper, a near infrared multi-wavelength non-invasive blood glucose monitoring system with distributed laser multi-sensors is applied to monitor human blood glucose concentration. In order to improve the monitoring accuracy, a multi-sensors information fusion model based on Back Propagation Artificial Neural Network is proposed. [3] Development of a novel method for non-invasive measurement of blood glucose concentration using smart phone Monitoring blood glucose using a smart phone application that simply uses equipment already available on smart phones will improve the lives of diabetic patients who can continuously check their blood glucose levels while avoiding the current inconvenient, unhygienic, and costly invasive glucose meters. [4] Diabetes has evolved as one of the principal health care epidemics of the modern era. At present, the widely used method of self-monitoring of blood glucose (SMBG) involves determination of blood glucose concentration with specific devices using chemical analysis of blood samples taken by puncturing the finger or the forearm. [5] The complexities and hurdles present in the life of diabetic patients will be minimized with the successful advent of a non-invasive blood glucometer. The non-invasive technology would be the wise and favourable option in the near future. [6] Much attention has been focused on the non-invasive blood glucose

monitoring for diabetics. It has been reported that diabetics' breath includes acetone with abnormal concentrations and the concentrations rise gradually with patients' blood glucose values. This paper investigates the potential of breath signals analysis as a way for blood glucose monitoring. [7] We describe further development of a novel method for non-invasive measurement of blood glucose concentration (BGL), named Pulse Glucometer, and based on differential near infrared spectrophotometer. Sequential temporal differences of infrared transmittance spectra from the radiation intensity (I^{lambda}) emerging from a fingertip containing an arterial pulse component ($DeltaI^{lambda}$) are analysed.

3. PROPOSED SYSTEM

Some new technologies to monitor blood glucose levels will not require access to blood to read the glucose level. Non-invasive technologies include Near IR detection, ultrasound and dielectric spectroscopy. These will free the person with diabetes from finger sticks to supply the drop of blood for blood glucose analysis. Most of the non-invasive methods under development are continuous glucose monitoring methods and offer the advantage of providing additional information to the subject between the conventional finger stick, blood glucose measurements and over time periods where no finger stick measurements are available (Non-invasive glucose refers levels (required by people with diabetes to the measurement of blood glucose to prevent both chronic and acute complications from the disease) without drawing blood, puncturing the skin, or causing pain or trauma. The search for a successful technique began about 1975 and has continued to the present without a clinically or commercially viable product. As of 1999, only one such product had been approved for sale by the FDA, based on a technique for electrically pulling glucose through intact skin, and it was withdrawn after a short time owing to poor performance and occasional damage to the skin of users. Hundreds of millions of dollars have been invested in companies who have sought the solution to this long-standing problem. However, most of the researchers in this field have been genuinely region),transdermal measurement (attempting to pull glucose through the skin using either chemicals, electricity or ultrasound), measuring the amount that polarized light is rotated by glucose in the front chamber of the eye (containing the "aqueous humor"), and many others. A 2012 study reviewed ten technologies: bio impedance spectroscopy, electromagnetic sensing, fluorescence technology, mid-infrared spectroscopy, near infrared spectroscopy, optical coherence tomography, optical polarimetry, Raman spectroscopy, reverse iontophoresis, and ultrasound technology, concluding with the observation that none of these had produced a commercially available, clinically reliable device and that therefore, much work remained to be done. As of 2014, non-regarding the severe shortcomings mentioned above, at least one non-invasive glucose meter was being marketed in a number of countries. Still, as the mean absolute deviation of this device was nearly 30% in clinical trials, 'further research efforts were desired to significantly improve the accuracy. The race for the next generation of painless and reliable glucose monitoring for diabetes mellitus is on. As technology advances, both diagnostic techniques and equipment improve. This review describes the main technologies currently being explored for non-invasive glucose monitoring. The principle of each technology is mentioned; its advantages and limitations are then discussed. The general description and the corresponding results for each device are illustrated, as well as the current status of the device and the manufacturer; internet references for the devices are listed where appropriate. Ten technologies and eleven potential devices are included in this review. Near infrared spectroscopy has become a promising technology, among others, for blood glucose monitoring.

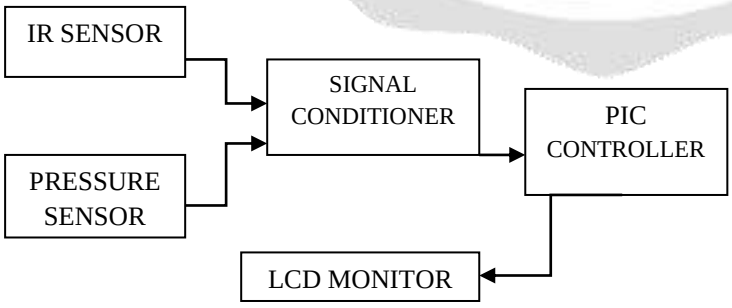

Fig.1 Overview of proposed system

This figure is the overview of our proposed system. IR Sensors work by using a specific light sensor to detect a select light wavelength in the Infra-Red (IR) spectrum. By using an LED which produces light at the

same wavelength as what the sensor is looking for, you can look at the intensity of the received light. When an object is close to the sensor, the light from the LED bounces off the object and into the light sensor.

The PIC microcontroller is used for processing the data sent by the sensor ad the corresponding values are displayed in the LCD display. The SFH 7740 is a very small reflective optical sensor for short distances with digital output. With dimensions of only 3.7x3.7x1 mm, and surface-mount solder contacts, the device may be integrated in applications where reflective sensors have previously not been considered. The part consists out of an invisible infrared light emitting diode (LED) with a wavelength of 850nm, a phototransistor, and an ASIC. For low current consumption (50µA average) the ASIC performs a measurement every 90ms and the result is latched at the output. The precise timing interval is not important for the application, as the output is never in an undefined state. The resistance transducers are commonly used for the D.C. systems. The resistance transducers like strain gauge form one or more arms of a Wheatstone bridge circuit. A separate D.C. supply is required for the bridge. The bridge is balanced using potentiometer and can be calibrated for unbalanced conditions. This is the function of Calibration and zeroing network. But the main disadvantage of D.C. system is that it suffers from the problems of drift. The low frequency spurious unwanted signals are available along with the required data signal. For overcoming this, low drift D.C. amplifiers are required. The output of D.C. amplifier is given to a low pass filter. The function of low pass filter is to eliminate unwanted high frequency components or noise from the required data signed. Thus the output of low pass filter is the required data signal. Thus the output of low pass filter is the required D.C. output from the D.C. signal conditioning system. Thus to overcome the drawbacks of invasive methods, we develop this technology with mobile application which will be easier for the patients to monitor the glucose level without extracting even a single drop of blood. Thus biomedical equipment's have a greater role in solving medical problems and enhance the quality of life. This technology is also developed for measuring the blood pressure and pulse rate of the patients. A wireless embedded technology for patient monitoring system and control action s provided to the patients.

4. ADVANTAGES

The proposed system overcomes the disadvantages of invasive blood glucose measurement technique as Non-invasive blood glucose measurement technique does not require any blood samples. Following are the points of merits of our proposed system:

- Reliable
- Cost effective
- Comfortable real time monitoring system
- Continuous monitoring of glucose levels

5. RESULTS AND DISCUSSION

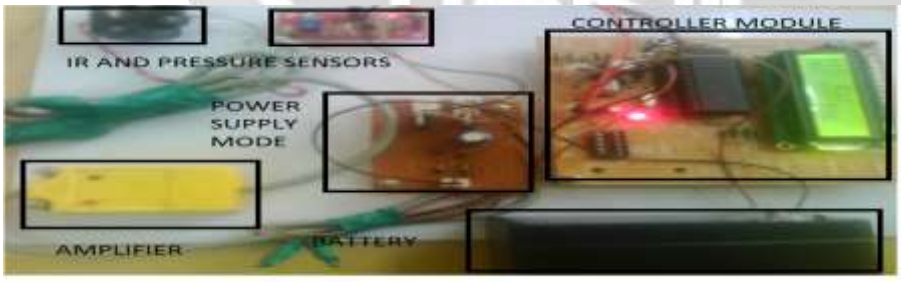

Fig 2. Experimental result

SUBJECT	AGE	NON-INVASIVE (mg/dl) M	ACCU CHECK (mg/dl) N	ERROR % (M-N)/M
S1	47	121	106	12.39%
S2	78	148	165	11.48%
S3	70	101	98	2.97%
S4	40	136	104	23.52%
S5	65	180	192	6.67%
S6	57	188	161	14.36%

Table 1: Experimental Result

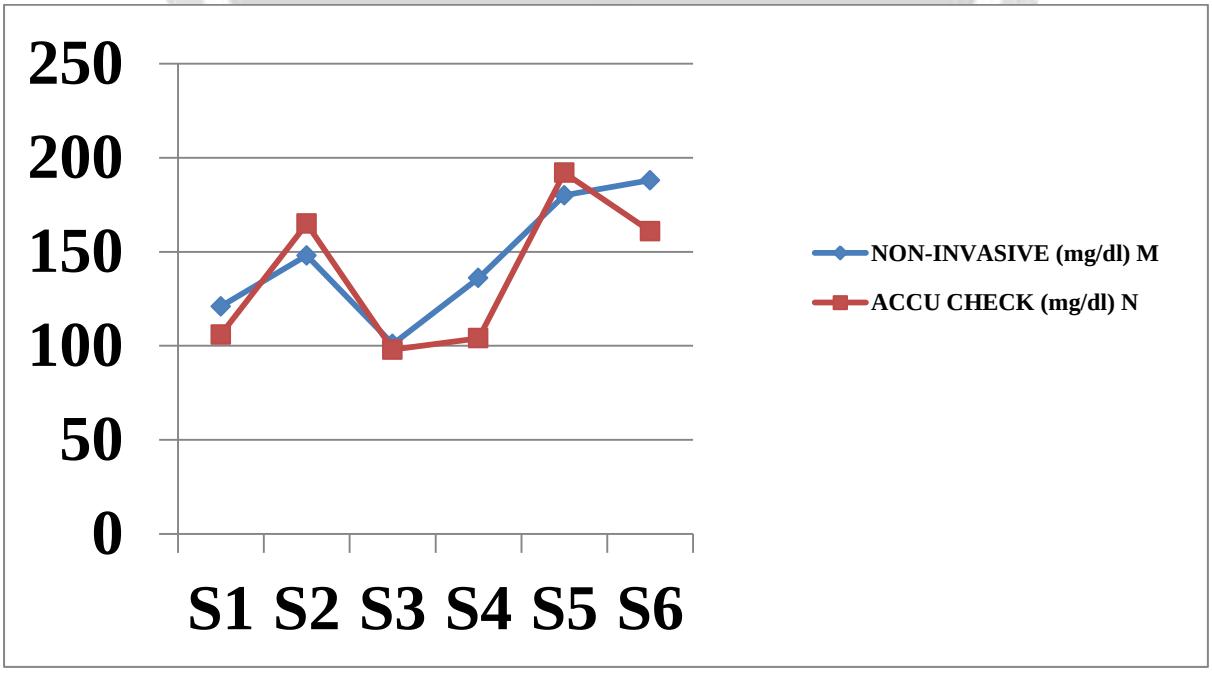

Fig 3: Glucose Concentration Graph

6. CONCLUSION

This paper has described our recent engagement with non-invasive blood glucose measurement device that can provide glucose measurements painlessly, without a blood sample or finger pricks, within a few seconds. The device can be easily adapted to provide continuous blood glucose monitoring and of these measurements. The device algorithm can also be used to measure pulse rate, blood pressure of the patient.

7. REFERENCES

[1] Zhibin Xiao, Xi Tan, Xianliang Chen, Sizheng Chen, Zijian Zhang, Hualei Zhang, Junyu Wang, Yue Huang, Peng Zhang, Lirong Zheng, and Hao Min," An Implantable RFID Sensor Tag toward Continuous Glucose Monitoring" IEEE journal of biomedical and health informatics, vol.19, No.3, MAY 2015.

[2] Bo Zeng, Wei Wang#, Na Wang, Funing Li, Fulong Zhai, Lintao Hu." Non-invasive Blood Glucose Monitoring System Based on Distributed Multi-Sensors Information Fusion of Multi-Wavelength NIR" Engineering, 2013, 5, 553-560 http://dx.doi.org/10.4236/eng.2013.510B114 Published Online October 2013 (http://www.scirp.org/journal/eng)

[3] Dantu, V. ; Univ. of North Texas, Denton, TX, USA ; Vempati, J. ; Srivilliputhur, S." Non-invasive blood glucose monitor based on spectroscopy using a smartphone" Engineering in Medicine and Biology Society (EMBC), 2014 36th Annual International Conference of the IEEE.

[4] Jaspreet Kaur, Jagdish Kumar, H K Sardana, R Bhatnagar, N S Mehla Central Scientific Instruments Organization, Chandigarh(A Lab. of Council of Scientific and Industrial Research, New Delhi) "Non-invasive blood glucose measurement using optical method : Feasibility study and design issues" ICOP 2009-International Conference on Optics and Photonics CSIO, Chandigarh, India, 30 Oct.-1 Nov. 2009.

[5] Md Koushik Chowdhury*, Anuj Srivastava, Neeraj Sharma, Shiru Sharma School of Biomedical Engineering," The influence of blood glucose level upon the transport of light in diabetic and non diabetic subjects" Vol 4, No 5 (2013).

[6] Dongmin Guo, David Zhang, Lei Zhang, Guangming Lu,"Non-invasive blood glucose monitoring for diabetics by means of breath signal analysis" doi:10.1016/j.snb.2012.06.025.

[7] Yamakoshi, Y. ; TYT Inst. of Technol. Corp., Kanazawa ; Ogawa, M. ; Yamakoshi, T. ; Satoh, M." A New Non-invasive Method for Measuring Blood Glucose Using Instantaneous Differential Near Infrared Spectrophotometry" 2009.