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A Non-invasive Blood Glucose Monitoring Technique Using Infrared Sensor

M Akila[1], A Jahana parvin[2], S Kaviya[3], M Preethi[4], R Nithiya[5]

Bachelor of Engineering (Final year), Department of BME, Agni College of Technology, Chennai, Tamilnadu, India[1234]

Assistant Professor, Department of BME, Agni College of Technology, Chennai, Tamilnadu, India[5]

ABSTRACT: Diabetes is the most commonly occurring disease around the world; approximately 415 million people among the 7.7 billion population of the world suffer from diabetes. It is necessary to regularly monitor the blood glucose level of the diabetic patients. Therefore, we propose a non invasive method using near infrared sensor for transmission and reception of rays to and from fingertip for real-time monitoring of the glucose level and to report the abnormal conditions through message to the guardian and through voice module to the user.

KEYWORDS: non-invasive, diabetes, near infrared spectroscopy, blood glucose.

I.INTRODUCTION

The blood sugar level is the amount of glucose present in the blood. The sugar level will normally be 70-130 mg/dl. If the blood sugar level drops below the normal level the condition is called hypoglycaemia and if the blood sugar level increases above the normal the condition is called hyperglycaemia. According to World Health Organization (WHO), the number of people affected by diabetes has increased from 108 million in 1980 to 422 million in 2014. Diabetes is caused due to increase in the blood sugar concentration which may affect the heart, blood vessels, kidney and nerves. The diabetes has two types, type 1 and type 2, based on different conditions but the effects is same for both the conditions including the increasing of the blood sugar level. The monitoring of blood sugar level is very important in case of diabetes patients, since it is necessary to keep the blood sugar level in limit; if it exceeds or drops, it may lead to various other medical problems. Currently, the measurement of the blood sugar level is done only by pricking the finger which is a painful process and may cause infections.

The non-invasive procedure does not involve any pricking of the finger, hence there is no pain or chance of infections. It involves a near infrared sensor for transmission and reception of light rays through the finger. The light absorbed by the glucose molecules are calculated from the attenuated signal reach the receiver. The glucose level of the user will be monitored in real time, and the high or low level of glucose will be reported to the patient through a recorder voice module[7]. It also sends the abnormal conditions through GSM module to the registered guardians

II.RELATED WORK

The present methods are only based on invasive techniques, but now many non invasive techniques are being developed. Abhishek T K did a survey on non-invasive blood glucose monitoring using near infrared. This technique is to determine the blood glucose concentration non-invasively based on the survey they conducted. They studied the difference in the frequency shift. The difference between the normal and diabetic patient's glucose intensity were obtained in this method. Anusree L describes the various blood glucose measurements made non- invasively using near infrared spectroscopy. The complexity and the indirect measurement is still a concern in this method but it is painless and has better accuracy. R. A. Budapest experimentally proved that the non-invasive glucometer is reliable in glucose detection with 4%-16% accuracy compared to the invasive method. This method includes BMI measurements to determine the glucose level by using infrared sensor with peak wavelength of 1550nm and Arduino UNO as a microcontroller[1]. Asha Rani developed a protocol to continuously monitor the blood glucose non-invasively using

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near infrared technique. The sensor diode patch was designed by using LED and photo diode to observe the diffused reflected spectra of blood. The drawback in this method is the positioning error and it has some unwanted interference.

III.METHODOLOGY

Existing techniques to measure blood glucose level are based only on invasive finger pricking methods. Thus, non-invasive techniques are being introduced to provide convenient and pain free blood glucose testing such as Raman Spectroscopy, Dielectric Spectroscopy, Laser beam, IR Spectroscopy[3]. In this paper, we have proposed a method that continuously monitors the user's blood glucose level using NIR sensor at wavelength 940 nm[10].

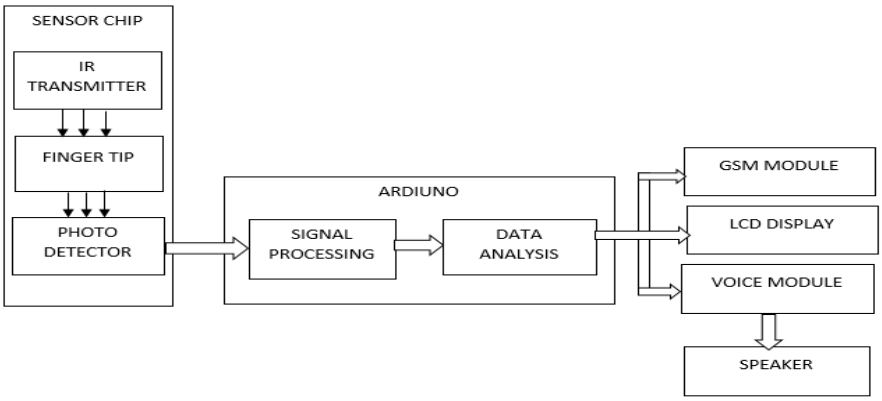

Figure 1 A Block Diagram representing the prototype

In this method, we have used NIR sensor, Arduino UNO, LCD display, voice module and GSM module. The wavelength of NIR sensor ranges from 700 nm to 1mm and it penetrates through the human tissue from 650 nm to 1350 nm[7]. The blood glucose is absorbed at various peaks of wavelength of 940 nm, 970 nm, 1197 nm, and 1408 nm. Specifically, at 940 nm wavelength the glucose molecule absorbs the NIR light more than the other blood constituents such as water, platelets, RBC etc[10]. The sensor chip consists of an NIR transmitter and a photo detector which is placed on either side of a finger. In this, the optical signal passes through the finger and reaches the photo detector where the intensity of the resultant optical signal is acquired. With this output intensity the glucose level in the blood is being calculated. A AC voltage of 12V is given to the device from the battery and the rectifier connected to it converts the AC voltage to DC in which only 5V is given to the microcontroller. Arduino UNO is a microcontroller board which has been used in this method. In microcontroller, the signal is amplified using operational amplifier which has been given high input resistance to reduce the noise. Using embedded C, the blood glucose level is being calculated from the signal. The output signal from the Arduino is received by the GSM module. Suddenly, if the user's blood glucose level rise up or falls, it will alert the guardian about the situation. A voice module is also connected to alert the user about their blood glucose level. So that the user can take their insulin medication. Using these components, a system is designed to continuously monitor the glucose concentration in blood.

IV.RESULT

The device is designed to real time monitor the blood glucose level of the patients. It clearly monitors the glucose level and checks for the hypo or hyper-glycaemia conditions and during such cases the device notifies the user through the voice module and the GSM module messages the patients guardian registered. Using this technique, we have studied the glucose level in blood for about 10 patients and compared it with the output of the glucometer. We have attained our desired and efficient result.

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