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Non-Invasive Blood Glucose Measurement System

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Abstract - *Diabetes mellitus is one of the leading diseases in the world which is caused due to an increased glucose concentration in the blood. Currently, blood glucose level is measured using invasive techniques. These methods are sometimes painful and harmful for the patients. To overcome the difficulties caused by invasive method, we are using the non-invasive technique for measurement of blood glucose level. In this paper, a portable non-invasive blood glucose monitoring device is developed using near infrared sensors. The device will be able to detect glucose concentration in blood and the required insulin dose, corresponding to the body mass index (BMI) of the user. Hence the results show the potential of this technique in predicting the blood glucose concentration.*

Keywords— Diabetes mellitus; non-invasive; blood glucose, body mass index (BMI)

1. INTRODUCTION

Glucose levels had been measured by taking a blood sample from patients which is named invasive, then analyzed using a spectrophotometer. However, this method is less favorable for patients with serious conditions or patients with diabetes mellitus who could not do blood sampling many times. According to those conditions, a development tools of non-invasive measuring glucose levels in the blood is needed. In [1] an Ultra-wide band (UWB) microwave imaging and Artificial Intelligence (AI) are used for non-invasively detecting the blood glucose concentration level with performance analysis. The system consists of the software module for processing interface, and a pair of small UWB biomedical planar antennas, UWB transceiver as hardware and an artificial neural network (ANN) with signal acquisition. The centre frequency of 4.7 GHz was transmitted through one side of left hand in UWB signal and on the other side received the forward scattering signals. Characteristic features from received signal were extracted for pattern detection and recognition through ANN. In [2], the near infrared (NIR) sensors having various different wavelength are evaluated that could be used in measuring the glucose concentration. The different wavelengths of NIR sensor that are used are 800 nm, 940 nm and 950 nm. The linear relationship between the output voltages and glucose is presented in [2] which are significant for all NIR sensors and the wavelength of 940nm is said to be the best among all.
Based on the studies above, a portable non-invasive blood glucose monitoring device using near infrared sensors is developed. This device displays the glucose level and the required insulin dose, corresponding to the body mass index (BMI) of the user.

2. PROPOSED METHODOLOGY

2.1. Hardware Development

The non-invasive method to detect the presence of glucose in the blood level is proposed. So, there is no need to prick the finger and use the blood samples to identify the blood glucose level. This system is simple and effective way to determine the blood glucose level. It uses the NIR sensor to detect the glucose level in the blood. First, the height and weight of the individual is set by using the keypad. Then, the NIR sensor is placed in the finger. Now, the BMI is calculated by using the height and weight entered. Then the BMI is categorized into three groups like underweight (below 25), Normal (from 25 to 30) and overweight (above 30). The NIR sensed and the BMI values are used to detect the amount of glucose level in the blood and also display the level of the insulin in the LCD. Thus, this system works non-invasively to find the glucose level.

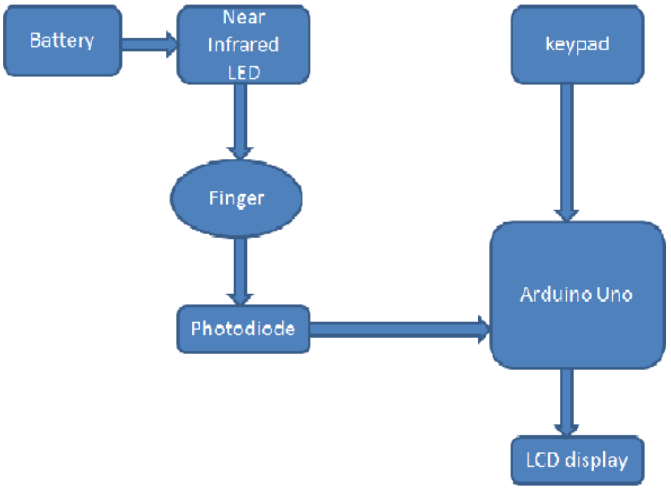

Fig – 1: Block Diagram of Glucose Measurement System

2.2. Software Development

The algorithm has been designed for the Arduino microcontroller. This is designed in such a way that it takes the height and weight of the person to calculate the BMI, corresponding to which the glucose and insulin is displayed. Figure below illustrates the flow chart of the glucose and

insulin measurement system that calculates for three different BMI groups; underweight (BMI<25), normal (25≤BMI≤30), overweight (BMI>30).

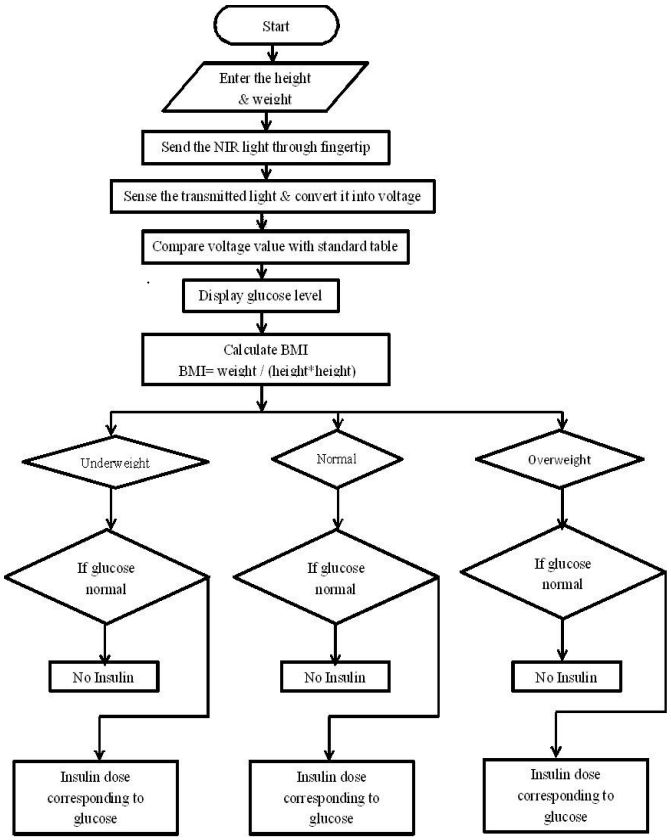

Fig - 2: Flow chart of the glucose measurement system

3. RESULTS & DISCUSSION

The main performance parameter is blood glucose level. The device requires the user to key in their height and weight using the push buttons. Once the height and weight are entered, the BMI for the user will be calculated and shown on the LCD screen. Once the glucose concentration is measured, the device will calculate the required insulin dose corresponding to the BMI and display the measured glucose concentration in mg/dL and insulin dose needed in Units as shown in the fig. 3. Although this may not provide accuracy at present but the system is efficient in cost minimization.

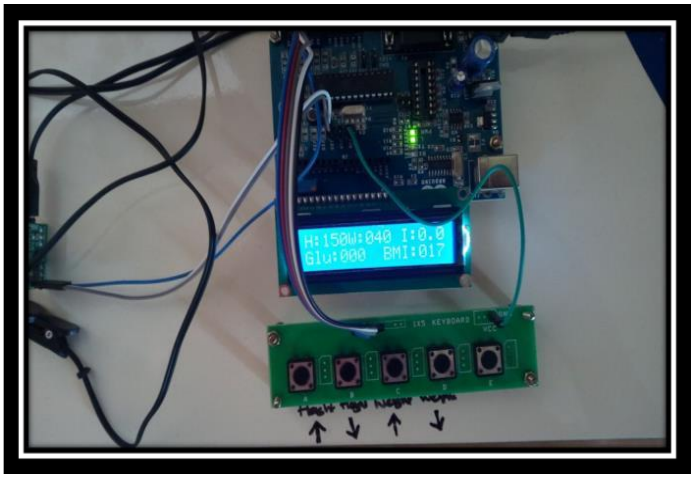

Fig – 3: Output of the device

4. CONCLUSION

Thus, the blood glucose level in an individual is identified with the help of the NIR sensor. The Body Mass Index value is calculated by giving the height and weight of that individual by entering the values in the real time. The BMI values are calculated and using this, the glucose level in the blood is determined. Since, it is a non-invasive method, there is no need to prick the finger and use blood samples to find the presence of glucose.

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