Wireless Transmission and Monitoring of Blood Glucose

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Abstract— Diabetes is a metabolic pathological condition which indicates the improper secretion of insulin by the human body. If not diagnosed on time, diabetes may lead to major health disorders. Further complication of diabetes may be avoided by timely monitoring of the blood glucose level which is presently brought about with the help of invasive blood glucometers. In order to overcome the difficulties faced during invasive measurements such as frequent puncturing, danger of spreading infections, high consumable cost etc. a non-invasive blood glucometer using infrared LED's has been designed. This also includes Zigbee for the wireless transmission of the blood glucose levels and GSM module for the data transfer through the registered network. Using this method continuous real time display of the blood glucose is obtained. This may help in maintenance of patient condition appropriately.

Key words: Diabetes, Non-Invasive, Real Time Monitor

I. INTRODUCTION

Diabetes mellitus is a condition in which the body does not produce sufficient insulin. Diabetes can also lead to kidney failure, blindness, and amputation. World Health Organization has estimated that in 2015 India had 69.2 million people living with diabetes (8.7%). It is predicted that in 2030 diabetes will be the 7th leading cause of death in the world [8]. The currently available means of blood glucose detection is invasive [1]. Diabetes could be controlled through timely monitoring of blood glucose level which is performed through repeated puncturing. These methods sometimes discourage the patient to take the test. This urges the need for a non-invasive means of blood glucose monitoring to be discovered. There are many approaches on designing noninvasive glucose meter. One of the designs is near infrared method using finger probe and it is safe, no direct electrical contact between the patient and the device. The concentration of glucose in the blood is calculated based on the scattering and absorption of light through the blood. The level of the concentration is displayed on the LCD [2]. Optical method is more trustworthy, cost effective and popular method for glucose measurement [3]. In addition to near infrared method, there are a variety of the optical methods for the non-invasive technique like Raman's spectroscopy, photo acoustic spectroscopy, polarization technique, polarimetry and light scattering. So, developing a non-invasive way of measuring blood glucose would be much more convenient from the end user prospective. There are also some portable means of measurement available [4]. The advantages of the non-invasive measurement over the invasive means is that the pain caused due to repeated puncturing and huge medical wastes could be reduced to great extent, hence cutting down the healthcare cost [2]. This paper introduces a sensor based wireless blood glucose monitoring system to detect blood glucose non-invasively using infrared (IR) sensors in addition to which pressure sensor has also been included as another indicating parameter, which alters in correspondence with blood glucose levels.

II. METHODOLOGY

A low cost framework for noninvasive blood glucose measurement has been designed and implemented on printed circuit board. In this prototype, wavelength of 950 nm obtained using NIR sensor and finger as a body site is used for predicting blood glucose level. Initially, the finger is placed on the IR sensor in the correct position. The IR sensor acts as the transmitter and receiver and measures the blood glucose level. This blood glucose level which has been measured will be continuously displayed on the LCD display which has been attached with the patient circuit. The signal on the other hand is transmitted through the Zigbee [5] transmitter in the patient circuit. The Zigbee receiver connected with the computer in the control center receives the signal, which helps in real time monitoring of patient's blood glucose in the absence of the physician.

When input pressure is given to the sensor [6], continuous display is made along with the blood glucose level and displayed on the LCD display. Also there is a red LED placed in order to indicate low and high blood pressures and a green LED attached to indicate normal blood pressure. These values are also transmitted and displayed on the physician monitor in addition to the blood glucose values. Whenever there occurs a drop or increase in the glucose level an alarm is sounded in the patient circuit. The alarm gets repeated twice in the patient circuit to alert the patient about the condition. If no further action has been taken, then on the third time the buzzer [7] at the physician computer sounds, as a measure to alert the physician about the patient's condition. Simultaneously, a message containing the blood glucose level and the pressure at that particular moment gets delivered to the patient's caretaker via GSM in the attempt to seek attention.

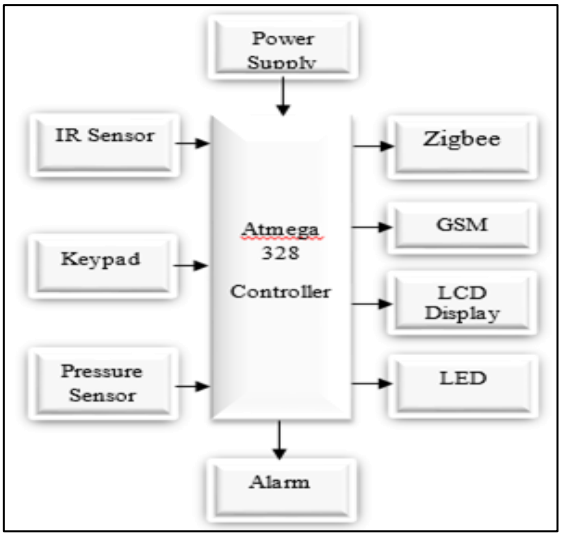

Fig. 1: Transmitter block

Flow of the process:

Fig. 2: Receiver block

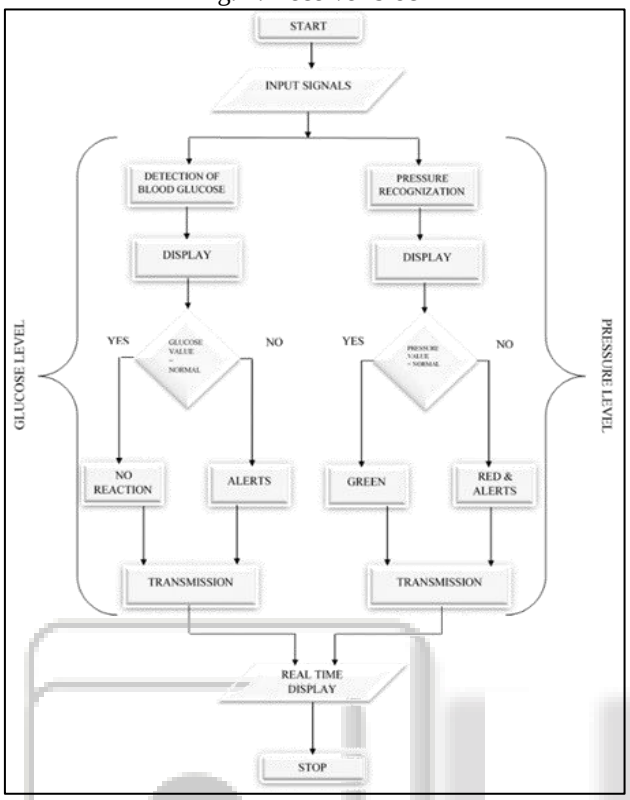

Fig. 3: Flow of the process

III. RESULT

The constructed system measures the blood glucose level and blood pressure level continuously at the patient circuit and transmits the signal via zigbee to be monitored by the physician or the care taker at the care taker table. The result obtained is displayed on the physician table using docklight software.

Patient No.	Blood Pressure (Mmhg)	Blood Glucose (After Diet) (Mg/Dl)
1.	110/70 Normal Pressure	146 High Glucose
2.	90/50 Low Pressure	117 Normal Glucose
3.	112/87 Normal Pressure	96 Normal Glucose
4.	98/72 Normal Pressure	102 Normal Glucose
5.	145/90 High Pressure	65 Low Glucose

Table. 1: Obtained blood pressure and blood glucose values

The real time display of the measured values helps the physician keep track on the patient's details even if the care taker is not available near the patient throughout the entire period of observation. This enables timely employing of insulin to the patients without fail and also alerts the patient as well as the patient's care taker if the medications has not been taken on time.

IV. CONCLUSION

A wireless means of continuous non-invasive monitoring of blood glucose using reflection spectroscopic method has been designed, which is one among the many methods used for non-invasive blood glucose monitoring. There are several advantages served by this method such as, it overcomes the need to expose the patients to sharp objects, thereby avoiding the spread of infectious micro-organisms. Another important advantage of this method is that it does not contain any side effects caused due to radiations, as this system employs IR sensor which does not emit radiations of any range. The results obtained were found to correlate greatly with those obtained through the conventional invasive means. This system may thus be adopted for monitoring of in-patients in the hospital reducing the need for employing too many caretakers. The further growth of this system may be attributed towards the development of a miniature sized system, which is capable of being used both at the hospitals and home providing better care to the patients.

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