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Non-Invasive Blood Glucometer using NIR Spectroscopy

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Abstract- *Diabetes is one of the most life-threatening disease prevalent in human beings. To control Diabetes, the blood sugar level of the individual must be checked regularly. The present methods available in the market to measure blood sugar makes use of invasive techniques, a prick is done on the finger and blood sample is taken for measurement. This process is painful and is not cost effective. In this paper, we introduce equipment that makes use of non-invasive techniques to measure blood sugar levels. We make use of Near-Infrared (NIR) Spectroscopy based on the amount of NIR light passing through the ear lobe of an individual. When the light passes through glucose molecules present in blood we are able to determine a reading.*

***Key Words*: Diabetes, Blood sugar level, Non-invasive, Spectroscopy.**

1. INTRODUCTION

1.1 Motivation and Background

Our project always aims at improving human life and making life better and easier. Over the past two years we have been involved in projects that had the primary aim of making life easier. Hence this time as well we decided to stick to our basic aim and therefore we selected the non-invasive blood glucometer using NIR light. The non-invasive blood glucometer avoids the use of the traditional invasive methods that involves pricking of the skin to obtain blood samples. Hence we use the noninvasive method that eliminates this painstaking process.

1.2 Overview

In future blood glucose measurement will be through non invasive methods that do not involve puncturing of the finger to get blood sample. Non invasive methods involve either radiation or fluid extraction. In radiation method the energy beam is applied to the body, then the beam is modified in proportion to the amount of glucose present in blood and then measured. In fluid extraction a fluid contacting glucose is extracted from the body, this fluid has same proportion of glucose as in the blood and it is then measured. The most commonly used non invasive technologies are 1) far-infrared radiation spectroscopy, 2) near infrared radiation spectroscopy, 3) optical rotation of polarized light, 4) radio wave impedance, 5) interstitial fluid harvesting, 6) fluid extraction from skin. All of these technologies have the potential to be commercially used but have some short comings.

1.3 Objective

Diabetes is one of the most life threatening diseases in the world that occurs not only among adults and elderly, but also among infants and children. Blood glucose measurements is essential for diabetes patients to determine how much insulin dose intake should be taken and regular monitoring is vital to ensure that glucose level is always within the normal range. The most widely used methods to measure glucose level in blood are invasive which are high in accuracy but are usually a bit painful and has higher risk of infections. Therefore we have introduced non-invasive method to develop pain free glucose measuring method.

1.4 Earlier available technologies

Glucose measurement from blood is categorized into three techniques- invasive, minimally invasive, and noninvasive. Invasive techniques in glucose measurement devices are widely used because of its high measurement accuracy. The most common and inexpensive invasive technique is finger prick which requires blood extraction from the finger by using a lancet (small, sharp needle). The blood sample is used to measure blood glucose level using a glucometer. Some common practices allow the blood extraction to be taken from other sites of the body such as the upper arm, forearm, base of the thumb and thigh. However there might be differences in readings of blood glucose level from other parts when compared to the reading obtained from the fingertip.

2. PROJECT METHODOLOGY

2.1 System Diagram

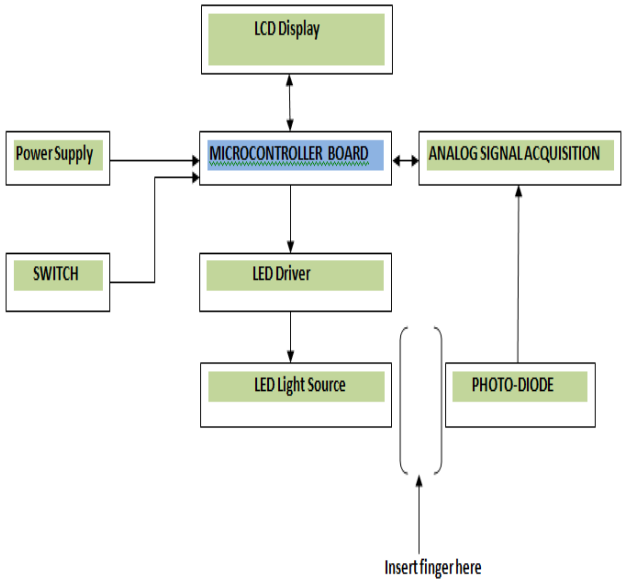

Fig -1: SYSTEM DIAGRAM

2.2 Working

- The microcontroller in use here is Arduino pro micro. The main function of the Arduino is to take care of the functioning of the led section.
- The LED section consists of 4 LEDs - red, green, IR and NIR. The LED drivers are used to handle the glowing of the LEDs. Based on the instructions given to the microcontroller the LEDs glow.
- Between the LEDs and the photodiode there is a space to insert our finger. Light from the LEDs is passed through a person's finger and once it passes the refracted light is received at the photodiode.
- This optical signal is converted to its electrical equivalent and passed to the analog acquisition system where the analog signal is converted to its digital form.
- This output is further sent to the microcontroller where it is processed further and the readings are displayed on the LCD screen.

3. CONCLUSION

In this article we have presented a non-invasive blood glucose meter 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 blood oxygen level and maintain a history of these measurements. The device algorithm can also be modified to provide other capabilities like heart rate using the same devices and sensors.

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