Non-Invasive Glucometer

Problem Statement Code - DA1064

Abstract - Diabetes Mellitus (DM) or diabetes is one of the metabolic diseases exhibiting high blood glucose level over a prolonged period. The management of diabetes is associated with the proper monitoring of blood glucose level. In the case of diabetes, fingertip pricking for a blood sample is inconvenient for glucose measurement. Invasive approaches like laboratory test and one-touch glucometer enhance the risk of blood-related infections.

To mitigate this important issue, we propose a **novel**, **cost effective**, **accurate** and **sustainable** Internet-of-Medical-Things (IoMT) enabled edge-device for precise, non-invasive blood glucose measurement. In this work, a near-infrared (NIR) spectroscopic technique using wavelength (940 nm - 1300 nm) is taken to detect the glucose molecule from human blood. The novel device is based on NIR spectroscopy and machine learning (ML) models of high accuracy.

The feasibility of non-invasive measurement of glucose within aqueous solutions that assimilate the composition of human blood plasma is investigated. The device includes a pair of sensing unit consists of NIR emitter and NIR receiver (photodetector) positioned on either side of the measurement. When the NIR light is propagated through the fingertip in which it interacts with the glucose molecule, a part of NIR light gets absorbed depending on the glucose concentration of blood and remaining part is passed through the fingertip. The amount of NIR light passing through the fingertip depends on the amount of blood glucose concentration. The transmitted signal is detected by the photodetector. The output current of the photo detector is converted into voltage signal and then it is filtered and amplified. The inbuilt ADC block of ESP32 is used for converting the received analog signal to digital form. This digital signal is processed by using ML algorithms analysis to predict the blood glucose value and the blood glucose value is displayed on the mobile application.

Objective/Outcome

Hardware Section –

- To develop an industry standard PCB for fabrication of the device. Along with the development of the square-wave generator to be installed with an IR photo detector and emitter to prevent the daylight disturbances and also other electrical noises.
- To develop a microcontroller (ESP32) based circuit to transfer those voltage channels obtained from the above circuits to be deployed onto the web server.

Software Section –

- Now various ML models such as SVM, Random Forest, KNN and Regression Analysis will be performed with the obtained voltages along will the glucose level obtained via clinical techniques.
- This co-relation and comparative analysis of different ML models will eventually result in a predicted glucose level.
- Finally, along with our prototype we will integrate an interactive mobile application for seamless communication between the diabetic patient and doctor. The database will eventually help the patient to track his/her sugar levels on a parodic basis.
- The collaborative clinical authorities will eventually validate the predicted glucose level with the actual glucose level of the human subject
- Hence our accuracy is measured and validated as well.

Unique Selling Proposition of the Project –

- The prototype hence developed is highly cost efficient.
- Our ML model will be highly accurate and sustainable as well.
- Our predicted glucose result obtained via prototype will be clinically tested and validated by corresponding clinical labs and doctors.
- Our prototype is a one-time investment and can be used by people of any age group.