**Improved Non-invasive Glucometer alongside a data Logging application to improve on Diabetes Monitoring**

**Background**

Diabetes is a chronic health condition that affects how your body turns food into energy. Most of the food we eat is broken down into glucose and released into your bloodstream, when this glucose levels go up, it signals the pancreas to release insulin. Insulin acts like a key to let the blood sugar into your body’s cells for use as energy.

Recent studies have indicated that the health risks associated with diabetes are significantly reduced when the blood glucose level are well and frequently controlled. Therefore, having proper monitoring at home or work is important. The commonly used method of measuring glucose levels is by the use of invasive glucometers that require obtaining blood samples by pricking a fingertip with a needle.

This concept note proposes a non-invasive method where the patient only places his/her fingers on a measuring point on top of a portable glucometer rather than using injections. This Glucometer is an IoT based device in the sense that these readings are sent to the patient’s handset where one is to fill in some additional information regarding their nutritional uptake for the day. With the help of an embedded machine learning algorithm, patterns can be detected from this data points and recommendations(inference) given regarding what nutritional elements the patient should uptake the following day for an optimal glucose level to be maintained.

**Principle behind blood glucose measurement.**

When a light ray passes through biological tissues, it is both absorbed and scattered by the tissues. Light scattering occurs in biological tissues due to the mismatch between the refraction index of extracellular fluid and the membranes of the cells. Variation in glucose level in blood affects the intensity of light scattered from the tissue. The proposed technique is therefore based on the NIR (Near Infrared) optical technique. An NIR light source of 940 nm wavelength is chosen because it is suitable for measuring blood glucose concentration. The sensing unit consists of NIR emitter and NIR receiver (photodetector) positioned on either side of the measurement site (fingertip). 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.

**System Design and Requirements**

The components required to achieve this proposed system are:

1. NIR emitter
2. NIR receiver/photo diode
3. Noise filtering Circuit – LM324 OpAmp
4. Amplification circuit – LM324 OpAmp
5. Arduino Pro Mini Microcontroller
6. LCD Display
7. Bluetooth Module
8. Cross platform Android Application

**Working**:

The near infrared circuit involves the use of NIR sensor of range 900nm -1100nm as the emitter and photodiode as detector. These two are mounted side by side in a finger cap and the finger is pressed against these two. The photodiode con verts the light signal to voltage signal. The magnitude of the obtained signal is in mV.

The output of photodiode is connected to the amplification circuit. The amplification circuit makes use of the op-amp LM324, resistors of the range 220Ω,1KΩ, 1.8KΩ, 8.2KΩ, 39KΩ, 68kΩ, 470KΩ, capacitors of range 0.1µF and 1µF and transistor 2N3904.

The output of this amplification circuit is fed as an input to the A0 pin of the microcontroller. The microcontroller used here is Arduino Pro Mini. Regression analysis which gives the relation between input and output parameters is carried out to calculate the glucose levels in mg/dl in microcontroller. The glucose level obtained is displayed on the LCD (16X2 LCD display) which is connected to the digital pins of the micro-controller or it can also be displayed on the serial monitor of the developer’s machine.

**Filtering & Amplification Circuit Diagram**

