Project Proposal

Glucose Level Detection in Blood using Non-Invasive Techniques

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Problem Statement:
To develop a prototype of spectroscopy-based noninvasive glucose monitoring system that establishes a relationship between the optical signals and the changing levels of blood–glucose concentration [1]

Motivation:
One of the diseases that affects a huge population worldwide is diabetes. Since diabetes has no well-established cure, control of elevated glucose levels is critical for avoiding severe secondary health complications in multiple organs including the retina, kidney and vasculature. 50% of the Diabetes patients are anticipated to be suffering from nerve damage. From progressive side effects, this condition has had a global impact, particularly in the developing world. The disease is expected to proliferate from 422 million in 2016 to 700 million by 2030 and as the numbers suffering from this disease continue to rise, and correspondingly the economic costs associated with it.

While finger-stick testing continues to be the mainstay of blood glucose detection, advances in electrochemical sensing-based minimally invasive approaches have opened the door for alternate methods that would considerably improve the quality of life for people with diabetes. Monitoring this disease has proven to prolong life expectancy for diabetics, although current monitoring systems are either invasive or non-continuous. This scenario highlights the consumer demand for some real-time, affordable, continuous and non-invasive glucose-monitoring products.

Prior Research:
The present methods to measure blood glucose levels is normal conventional electro chemical blood tests, spectroscopy. Current research also includes 60Ghz imaging and Fluorescence sensing to measure the blood glucose levels.

Several optical technologies, such as Electromagnetic Sensing, Reverse Iontophoresis, Near Infrared spectroscopy, Raman spectroscopy, and Fourier transform Infrared (FTIR) spectroscopy, have been investigated to develop non-invasive glucose monitoring sensors/systems. Near Infrared (NIR) spectroscopy has gained attention because of its ability to analyze samples without any prior manipulation, penetrate human tissues and affordable equipment.

Proposed Solution:
The solution that we are proposing is based on the fact that most of the biological cells and tissues are transparent in the wavelength region of 700–1100 nm. This spectral region is also called the optical window of cells and tissues. The molecular extinction coefficients of oxygenated haemoglobin and melanin and the absorption coefficient of water are shown in [2]. The Beer-Lambert Law provides a mathematical formulation of the method that allows the calculation of absorbance of a sample from the concentration and the thickness of the sample.

The process starts with the measurement of the sample thickness (for example, a finger), which is then placed in between the NIR light source (peak wavelength 940nm) and the detector

(Silicon PIN Photodiode, BPX 65 (spec sheet in references [3])). We use a continuous light wave and hence no high frequency sampling is required.

The sensor output is collected and fed to the Analog to Digital Converter (ADC) module. The data is then filtered (remove the noise from the data) and the values of absorbance and concentration are calculated using a data processing algorithm.

We then conduct experiments and establish a trend that details a relationship between the output voltage and the concentration value of the solution. If the concentration (mMol) increases the (readout) output voltage should increases as well. [1]

Future Work:
To Develop a cloud based platform that could send readings directly to the doctor for continuous trend monitoring

Timeline

Literature Survey and finalize the methodology to proceed: February 15 – February 23	
Developing circuit:	February 24 – March 13
Start experiments:	March 14 – April 20
Buffer Time (For any last-minute changes):	April 20 – April 25

References

1. http://ieeexplore.ieee.org/document/7782291/
2. http://onlinelibrary.wiley.com/doi/10.1046/j.1365-2818.2000.00738.x/epdf
3. https://www.dropbox.com/s/pra1nfa3df5ptke/BPX%2065%2C%20Lead%20%28Pb%29%20Free%20Product%20-%20RoHS%20Compliant-318136.pdf?dl=0