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DESIGN AND DEVELOPMENT OF AN OPTICAL BLOOD GLUCOSE MEASUREMENT FOR INFRARED AND NEAR-INFRARED TESTING

SARAH ADDYANI BINTI SHAMSUDDIN

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Univeriti Teknologi MARA. It is original and is the results of my own work, unless other is indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

Name of Student	:	Sarah Addyani binti Shamsuddin
Student I.D. No.	:	2011187861
Programme	:	Master of Science (Biomedical Engineering)
Faculty	:	Electrical Engineering
Thesis Title	:	Design and Development of an Optical Blood Glucose Measurement for Infrared and Near-infrared Testing.
Signature of Student	:	.....
Date	:	March 2015

ABSTRACT

Yearly, four million people to die because of diabetes and it also leads people to other serious disease. Hence, the existence of the portable blood glucose self check device is very helpful to the patients and others who concern to know their blood glucose reading. Non-invasive method is more preferable since it should be painless compared to conventional finger pricking device. Besides, patients who need to do self test often need to refer to the procedures and storing surrounding condition which can be hassle to some people with language restriction. Alternatively, using non-invasive will not be wasteful and the measurement or reading can be done any time and numbers of time. Previously, many researches had been done on non-invasive using near-infrared sensing. From previous research by Sia, he had investigated near-infrared sensing using signal penetrating finger method. However, by using finger penetration, there are no results obtained. He only obtained signal using glucose concentration. Therefore the objectives of this research are to investigate the performance of three different wavelength of sensors; infrared 940nm and infrared 950nm and also near-infrared 1450nm. Sensor that gave the best output had been chosen to achieve the second objective of this project which is to design non-invasive blood glucose measurement device based on optical sensing and to develop prototype of a blood glucose optical sensing instrumentation with acceptable accuracy and repeatability. Generally, the overall system consists of three parts including sensor part, signal conditioning circuit, and also numerical display. The initial design tested by considering initial voltage 1.616Vto 1.68V which referred to previous research by Sia as the output of the sensor. Then proceed by using test tube which contains various percentage of glucose concentration. The same methods had been used to the human samples fingers instead of test tube. From the experiment, output graph of the 950nm shows more consistent pattern compared to the 940nm. 950nm also has a larger range scale for voltage which from 5.016V to 5.4633V compare to the 940nm voltage range scale which from 5.0327V to 5.4201V. Further test on human finger had been done by using 950nm infrared but the output voltages were too small. The performance of the measurement can be improved by controlling the surrounding condition and fixed the path length between transmitter and receiver. Test using test tube showed that the near infrared and infrared were capable to predict different glucose concentration. By comparing the performance of infrared and near-infrared, near-infrared gave better performance since near-infrared had higher output voltage range which from 0.6 to 3.4174V compared to infrared. Graph near-infrared output voltage shows that the voltage is almost directly proportional to the percentage of glucose concentrations. By using circuit designed, it can be seen that the voltage reading became higher compared to before meal which shows that there were increment in glucose reading from before to after meal. Therefore, it can be concluded that the circuit design functions accordingly and non-invasively. During human sample test, increment pattern can be seen from fasting to non-fasting condition but the main effect is all samples have different fingers' diameter which each of user needs to be calibrated.

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