World Academy of Science, Engineering and Technology
International Journal of Biomedical and Biological Engineering
Vol:10, No:01, 2016

Design and Evaluation of a Prototype for Non-Invasive Screening of Diabetes – Skin Impedance Technique

Authors : Pavana Basavakumar, Devadas Bhat

Abstract : Diabetes is a disease which often goes undiagnosed until its secondary effects are noticed. Early detection of the disease is necessary to avoid serious consequences which could lead to the death of the patient. Conventional invasive tests for screening of diabetes are mostly painful, time consuming and expensive. There's also a risk of infection involved, therefore it is very essential to develop non-invasive methods to screen and estimate the level of blood glucose. Extensive research is going on with this perspective, involving various techniques that explore optical, electrical, chemical and thermal properties of the human body that directly or indirectly depend on the blood glucose concentration. Thus, non-invasive blood glucose monitoring has grown into a vast field of research. In this project, an attempt was made to device a prototype for screening of diabetes by measuring electrical impedance of the skin and building a model to predict a patient's condition based on the measured impedance. The prototype developed, passes a negligible amount of constant current (0.5mA) across a subject's index finger through tetra polar silver electrodes and measures output voltage across a wide range of frequencies (10 KHz – 4 MHz). The measured voltage is proportional to the impedance of the skin. The impedance was acquired in real-time for further analysis. Study was conducted on over 75 subjects with permission from the institutional ethics committee, along with impedance, subject's blood glucose values were also noted, using conventional method. Nonlinear regression analysis was performed on the features extracted from the impedance data to obtain a model that predicts blood glucose values for a given set of features. When the predicted data was depicted on Clarke's Error Grid, only 58% of the values predicted were clinically acceptable. Since the objective of the project was to screen diabetes and not actual estimation of blood glucose, the data was classified into three classes 'NORMAL FASTING','NORMAL POSTPRANDIAL' and 'HIGH' using linear Support Vector Machine (SVM). Classification accuracy obtained was 91.4%. The developed prototype was economical, fast and pain free. Thus, it can be used for mass screening of diabetes.

Keywords : Clarke's error grid, electrical impedance of skin, linear SVM, nonlinear regression, non-invasive blood glucose monitoring, screening device for diabetes
Conference Title : ICBEDA 2016 : International Conference on Biomedical Electronics, Devices and Applications
Conference Location : Singapore, Singapore
Conference Dates : January 07-08, 2016