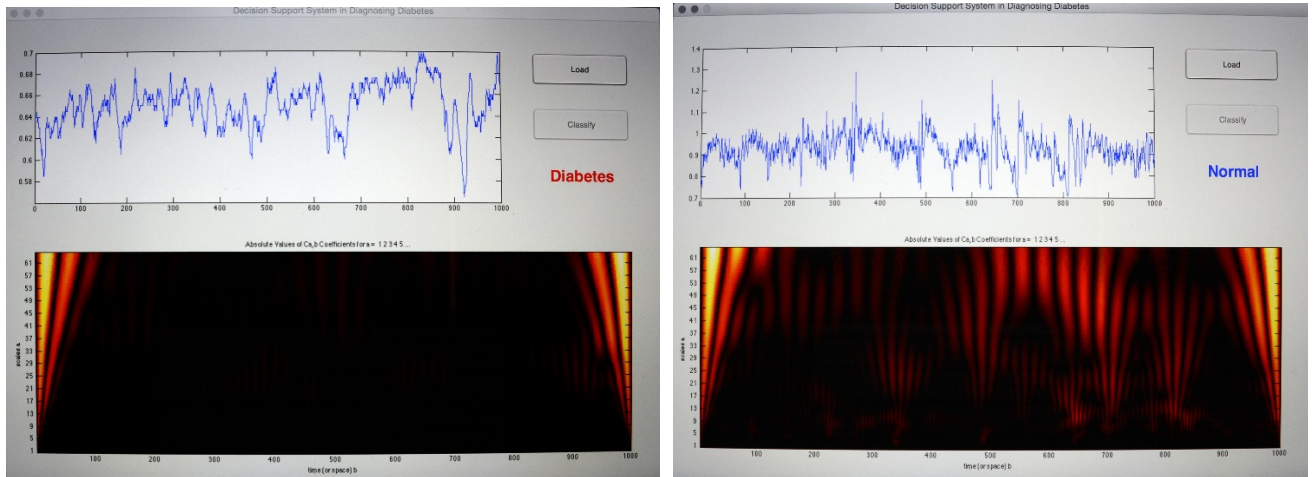


Automated Detection of Diabetes Using HRV Signals



Technology Overview

Prolonged diabetes results in severe complications, such as retinopathy, neuropathy, cardiomyopathy and cardiovascular diseases. Diabetes is an incurable disorder. Thus, diagnosis and monitoring of diabetes is essential to prevent the body organs from severe damage. Heart rate variability (HRV) signal processing can be used as one of the methods for the diagnosis of diabetes mellitus. This work introduces a non-invasive technique of automated diabetic diagnosis using continuous wavelet transform, Shearlet transform methods. The Fuzzy Sugeno classifier with selected features has yielded more than 95% accuracy.

The proposed system has the following stages:

Pre-processing

The ECG signals are pre-processed to remove the noise and then R-R interval is extracted using QRS detection algorithm. Then the Heart rate is estimated using equation: $60/(R-R \text{ interval})$

Continuous wavelet transform (CWT)

The R-R interval signals are converted in CWT and subjected to Shearlet transform.

Features extraction

Entropies, textures, and Higher Order Spectra (HOS) features are extracted.

Features reduction and selection

- The Locality Sensitive Discriminant Analysis (LSDA) is used to reduce the features.
- Bhattacharyya distance, Wilcoxon signed-rank test, Student s t-test, Information entropy and Fuzzy MRMR are used to rank the features.

Classification

Fuzzy Sugeno classifier is used for classification.

Technology Features & Specifications

First normal and diabetes ECG signals are pre-processed to remove the noise and then R-R interval is extracted using QRS detection algorithm. The R-R interval signals are converted in CWT and subjected to Shearlet transform. Various entropies, textures, and Higher Order Spectra (HOS) features are extracted. Then these extracted features are subjected to Locality Sensitive Discriminant Analysis (LSDA) to reduce the features. Then various feature ranking methods namely, Bhattacharyya distance, Wilcoxon signed-rank test, Student's t-test, Information entropy and Fuzzy MRMR are used to rank the features. Then these ranked features are fed to various classifiers one by one for automated classification.

Potential Applications

This technology will be applicable to all the healthcare industry related to diagnosis of diabetes.

Market Trends and Opportunities

In 2014 the global prevalence of diabetes was estimated to be 9% among adults aged 18+ years. In 2012, an estimated 1.5 million deaths were directly caused by diabetes and more than 80% of diabetes deaths occur in low- and middle-income countries. World Health Organization projects that diabetes will be the 7th leading cause of death in 2030. (WHO)

Customer Benefits

1. The technique is cost effective and completely automatic.
2. It can be easily programmed and installed in any clinician's laboratory.
3. The expert training is not preferred as the results obtained are highly objective.
4. Completely automated, no inter-observer variability and reproducible as compared to manual diagnosis.
5. The diagnosis support system helps in reducing the workload of healthcare professionals because ECG measurements can be obtained by nurses and the initial diagnosis results are automatically available in the hospital network.

OVERVIEW

- Technology Category Healthcare - Telehealth, Medical Software & Imaging
- Technology Status Available
- Technology Readiness Level [TRL2](#)
- Keywords diabetes imaging



CONTACT:

Technology Development and Innovation Office
Website : www.np.edu.sg/tdi
Email: dept-tdi@np.edu.sg