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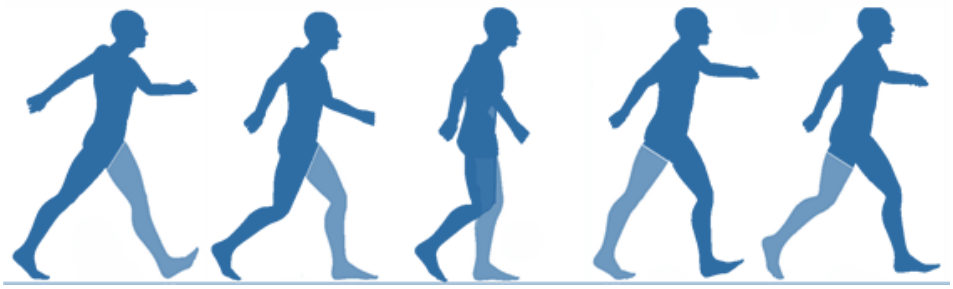

Fig1. Illustration of a gait cycle (source: www.footbionics.com, 2015).

NeuropathyDetect

DETECTION OF PERIPHERAL NEUROPATHY IN DIABETES PATIENTS

Analysis of the human gait begun in the 19th century, being at the present time subject of many research projects. This type of analysis has been centered on achieving quantitative objective measurement of different parameters that characterize gait in order to apply them to various fields.

In the medical field, accurate reliable knowledge of gait characteristics at a given time, and even more importantly, monitoring and evaluating them over time, will enable early diagnosis of diseases, prevention of their complication and help to find the best treatment.

Motivation

Neuropathy is a common and costly complication of diabetes, being the leading cause of non-traumatic limb amputations. There are increasing evidences that even pre-diabetic conditions can also be associated with some forms of neuropathy. In some cases, Diabetic Peripheral Neuropathy (DPN) may go unnoticed, since up to 50% of the patients with this condition have no symptoms. Therefore, the aim behind this project was to analyze walking patterns of diabetic patients in order to identify signs that allow the discrimination of DPN stages.

Implementation

With reference to previous studies in this area, plantar pressure sensors (Fig2.) and smartphone built-in accelerometers were used to collect gait data. These data were collected from both healthy and diabetes patients. The presence of neuropathy

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Datasets

Dataset 1 – 13 healthy subjects and 25 diabetes patients (16 of them with DPN).
The data was collected only with plantar pressure sensors. Each participant was asked to perform two tests:
1) Conditioned test – walk 10m distance with normal walking speed with examination of physician/doctor
2) Free test – walk during 2 minutes at normal walking speed.

Dataset 2 – 5 healthy subjects and 7 diabetes patients (none of the diabetes patients presented DPN).
The data was collected with plantar pressure sensors and accelerometers.
Participants were asked to walk 20mat normal speed.

Future Work

- Validate the obtained results on a larger dataset
- Integrate features that describe the range of motion of different joints
- Evaluate symmetries
- Explore wearable systems containing inertial sensors

was only tested in individuals with diabetes.

After data collection, machine learning techniques were implemented to identify the presence of diabetes and DPN. Two datasets were analyzed.

Results

In dataset 1, the identification of diabetes and neuropathy presence was 89% and 90%, respectively. Comparing conditioned with free test, the identification of neuropathy was more accurate in the second test. One explanation is the fact that the free test is more representative of a real life situation, which could enhance the classifiers' performance.

Since no diabetes patient of dataset 2 had DPN, for further analysis, this group was divided based on the duration of the disease. This division parameter was chosen since it is estimated that prevalence of neuropathy increases with the duration of diabetes. Hereupon, it is expected that the results obtained in this condition will be similar to the ones encountered if tested between patients with and without neuropathy.

The obtained results show a 96.6% of accuracy.

The accuracy of the classification was higher in dataset 2, suggesting that the use of both plantar pressure sensors and accelerometer data are important to characterize the gait of diabetes patients and identify the presence of DPN. However, it is important to mention that the dimension of dataset 2 was smaller, which could influence the obtained results.

Conclusions

The obtained rates of classification suggest that both plantar pressure sensors and accelerometers allow the identification of DPN stages. Therefore, protective measures can be taken in order to prevent feet injuries and improve the diagnosis, treatment, and follow-up of DPN patients.

Despite these results, the dimension of the datasets was small. Hereupon, additional validation on a higher number of subjects is needed.

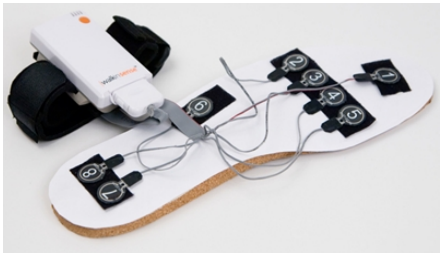

Fig2. Plantar Pressure Sensors (source: www.tomorrow-options.com, 2015).

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