

Criticality Analysis of Diabetic Gait in Children (CARDIGAN)

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ABSTRACT

CARDIGAN project aims to use criticality analysis of gait to identify individuals at risk of developing diabetes among overweight teenagers in Mexico. This project will draw together computer scientists, life scientists and clinicians from Mexico and UK and can significantly change the way that diabetes is detected. The result of this research may facilitate the clinical assessment, leading to better treatment and prognosis.

KEYWORDS

diabetes, obesity, gait, criticality

1 BACKGROUND AND OBJECTIVES

Diabetes is a chronic health condition, its global prevalence is rising rapidly. According to the World Health Organisation the percentage of adults with diabetes rose from 4.7% in 1980 to 8.5% in 2014. The cost to society is enormous: the International Diabetes Federation reported that the condition accounted for at least \$727 billion USD in health expenditure in 2017. Mexico has a relatively high prevalence of type 2 Diabetes Mellitus (T2DM). According to the Mexican Health Organisation (ENSANUT) 9.4% of adult Mexicans had diabetes in 2016. A survey also identified 14% of non-diagnosed T2DM adults (high prevalence of T2DM is closely related to obesity).

The objectives of this project are to:

- (1) Evaluate the use of Criticality Analysis of Gait as means of Diabetes assessment.
- (2) Design and set up a clinical feasibility study in a hospital (MCH) with adolescent patients on different clinical stages of type 2 DM.
- (3) Analyse the collected data and validate Gait data analysis as mechanism for identifying and monitoring pre-diabetic teenagers.
- (4) Use the feasibility study conducted in Mexico to develop a robust method using Gait analysis for diabetes prevention and management.

2 METHODOLOGY

The traditional lab approach to gait analysis uses an Optical Motion Capture System, but the equipment is costly and requires a large amount of training. This project will leverage recent research to track and plot gait analysis via portable Inertial Measurement Units (IMUs)[2]. The gait data will be analysed using a novel machine learning approach based on Criticality Analysis[4]. This technology will be utilised in a feasibility study conducted by Hospital Infantil

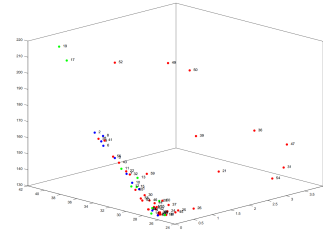


Figure 1: Preliminary results of criticality gait analysis of normal(blue), normal(green), and Diabetic (red).

de Mexico (Mexico Children Hospital MCH) on overweight teenage subjects.

For the study, forty teenagers will be selected and divided into three groups: 20 obese non-diabetic subjects, 10 with T2DM and 10 healthy subjects as controls. Participants will walk on a flat surface from slow to fast walking speeds. Critical changes in walking control, stride frequency and length will be observed as individuals change speed; effectively stressing their mobility. Critical pathology characteristics will be measured prior to and during walking using a movement sensor on the lumbar spine and wrist. Standard clinical tests will be performed prior to the study: blood tests, anthropomorphic data, and other relevant tests. The study will be repeated after 3-6 months as a follow up.

OBU will perform the data analysis in a semi-blind manner in order to test the efficacy of the Criticality RCC model. In order to provide an objective measure of analysis, the anonymised data will be presented to the nonlinear RCC models, where results can be extracted and compared afterwards to known states. Preliminary models have already been constructed and tested against ground truth (Fig.1), with remarkable efficiency and reliability.

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