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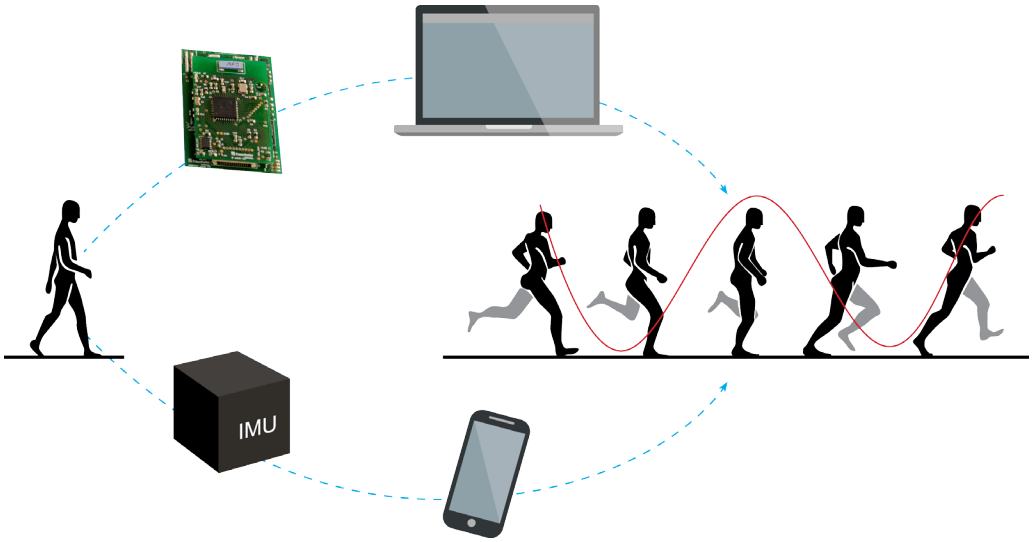

Fig1. Overview of the system.

SmartRecovery

GAIT ANALYSIS IN PATIENTS RECOVERING FROM TOTAL JOINT REPLACEMENT USING BODY FIXED SENSORS

Project

The purpose of this project is the development of a system capable of evaluating gait changes in the postoperative phase of patients who underwent a Total Knee Replacement surgery, trying to overtake the limitations of current analysis strategies.

Motivation

Locomotion is one of the most important functions of the human being. It involves a complex interaction of joint movements controlled by muscle activity and positional perception, which enables a human to walk at a desired speed and direction. This process is commonly referred to as gait control.

Human motion may be affected by various problems and diseases such as osteoarthritis, a musculoskeletal disorder characterized by the progressive loss of articular cartilage. Due to the aging process that reduces the cartilaginous tissue capable of supporting loads and stresses, this disorder is the most common cause of long-term disability in people over 65 years.

The surgical procedure for patients suffering from severe osteoarthritis is the arthroplasty, which aims to relieve pain and to restore the range of motion. However, after surgery, many people still experience an antalgic gait pattern that may extend over months or even years, and also the contralateral

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Features

This solution, through the incoming data from the inertial sensors and the electromyographic monitoring system, estimates various spatio-temporal parameters as well as muscular activation patterns. A smartphone and a laptop are necessary in order to connect the several devices via Bluetooth .

Fig2. Inertial sensors and electromyographic electrodes positioning.

Gait parameters

- Step time
- Step length
- Cadence
- Speed
- Knee angle related parameters
- Single and double support
- Muscle activation duration

Advantages

- Mobility
- Cheaper than camera-based systems
- Both spatio-temporal and kinematics information

limb can adopt compensation strategies.

Description

Four inertial sensors (Fraunhofer Portugal Pandlets) strategically positioned over the lower limbs are used to acquire acceleration data. A smartphone is needed in order to record this information, using an Android application where the user can select the corresponding position of the different sensors. Simultaneously, a BITalino (Plugged version) with 6 adapted electromyography (EMG) channels is used to acquire muscular information during the gait cycle. A laptop is needed in order to control the process and record the EMG data.

The collected data is processed to obtain not only spatio-temporal parameters but also muscular activity information. Limb initial and final movements are considered to detect steps, so that the time interval to be analyzed can be restricted. Thigh and shank angles are determined by filtering the acceleration data with a low-pass Butterworth filter. These two signals are used to calculate most of the gait parameters and also the knee angle over time.

Future Work

An Android application capable of recording data from both inertial sensors and electromyographic system would be a valuable asset to the project.

Moreover, tests should be carried out in the same subjects over time in order to have a more reliable comparison, which was not possible to accomplish due to time limitations.

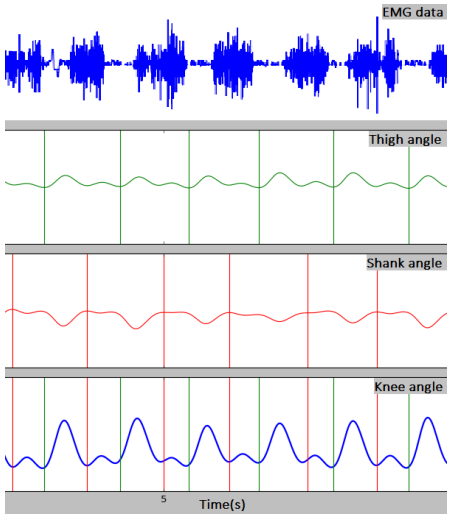

Fig3. Example plot of collected data.

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