ASI	ASI biomechanical thesis specification	DA01

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Abstract

This document describes the work that the trainee will do for his biomedical engineering internship in our company. The proposed work includes: 1) State of the art on ECG noise removal and processing techniques in wearables; 2) Evaluate the performance FieldWiz single led ECG; 3) Adaption and evaluation of the algorithms to extract RR-intervals and heart rate variability metrics. 4) Validation of the algorithm under proposed conditions. The signal processing must have a low computational complexity and work in real-time as this one will be embedded into our system.

History

Date	Revision	Description	Author
2019-02-11	0.1	Initial release draft	SSH
2019-11-29	1	Revised draft	TR

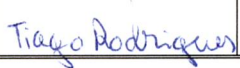| Approval				
Date				
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Table of Contents

1 INTRODUCTION

ASI is a company specialized in designing GNSS tracking device for sport. Our product, FieldWiz has a heart rate sensor which can record raw heart rate measurement and an IMU sensor. We would like to have some embedded computation algorithm that will allow us to provide our customer new metrics.

2 THESIS SPECIFICATION

During his internship within our company the student will be asked to develop an embedded computation algorithm working in real time based on the two leads raw ECG signal provided from our sensor.

Roadmap of the Thesis project:

- State-of-the art: Methods to extract the RR-intervals from ECG
- Evaluate the performance of the FieldWiz device single lead ECG monitor:
    - ECG acquisition under different conditions (e.g. rest, walk and running) using different acquisition devices (FieldWiz, medically validated ECG monitor (ideally) and wearable smartwatch).
- Use of different noise and artifact removal techniques in the ECG signal. Adaptation and development of algorithms to provide the following metrics:
    - Heart-Rate value in BPM based on R-R intervals
    - Heart-Rate variability:
      Time domain (e.g. RMSSD)°
      Frequency domain (e.g. LF/HF ratio)°
      Non-linear (e.g. Sample Entropy)°
- Validation of the algorithm under extreme conditions (e.g. football game):
    - Comparative analysis of the algorithm using FieldWiz and validated device (e.g. wearable watch).

First, noise removal tecniques and algorithms will be validated offline using recorded data as a proof of concept then be ported to our device. The algorithm should have a low complexity as this one will be embedded on the FieldWiz device.

If time remains during the internship, we might ask the student to do some research on other metric such as working load or IMU signal processing (e.g jump, acceleration, change of direction).