

## Author's Accepted Manuscript

Risk Factors Identification and visualization for Work-related Musculoskeletal Disorders with Wearable and Connected Gait Analytics System and Kinect Skeleton Models

Diliang Chen, Yi Cai, Jiawei Cui, Jia Chen, Haotian Jiang, Ming-Chun Huang



PII: S2352-6483(17)30113-7  
DOI: <https://doi.org/10.1016/j.smhl.2018.05.003>  
Reference: SMHL32

To appear in: *Smart Health*

Received date: 31 December 2017  
Revised date: 28 March 2018  
Accepted date: 21 May 2018

Cite this article as: Diliang Chen, Yi Cai, Jiawei Cui, Jia Chen, Haotian Jiang and Ming-Chun Huang, Risk Factors Identification and visualization for Work-related Musculoskeletal Disorders with Wearable and Connected Gait Analytics System and Kinect Skeleton Models, *Smart Health*, <https://doi.org/10.1016/j.smhl.2018.05.003>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting galley proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

# Risk Factors Identification and visualization for Work-related Musculoskeletal Disorders with Wearable and Connected Gait Analytics System and Kinect Skeleton Models

Diliang Chen<sup>a</sup>, Yi Cai<sup>a</sup>, Jiawei Cui<sup>a</sup>, Jia Chen<sup>a</sup>, Haotian Jiang<sup>a</sup>, Ming-Chun Huang<sup>a,\*</sup>

<sup>a</sup>Department of Electrical Engineering and Computer Science, Case Western Reserve University, Cleveland, OH 44106.

---

## Abstract

Risk factors, such as overexertion, awkward postures, excessive repetition, and the combination of these factors are main causes of work-related musculoskeletal disorders (WMSDs). In this paper, we proposed an automatic WMSDs risk factors identification and visualization method based on Wearable and Connected Gait Analytics System (WCGAS) and Kinect skeleton models. WCGAS was capable of recording plantar pressure from which postures, force exertions, and repetitions could be recognized with algorithms such as sequential minimal optimization (SMO) algorithm and long short term memory (LSTM) network. Kinect skeleton models were used to make the WMSDs risk factors visualized. Experiments with quasi-static and sequential postures were designed to evaluate the recognition performance of work-related motion type (i.e. “lifting”, “carrying”, “bending”, “pulling”, and “pushing”). A load variable (with/without 10 Kg load) was introduced for evaluating the performance of force exertions recognition. 5 repetitions of each motion were used for evaluating the performance of repetitions recognition. Results showed that quasi-static postures could be recognized with 100% accuracy and the accuracy for sequential motions recognition were 74%, 79%, 92%, 99% and 99% for “bending”, “carrying”, “lifting”, “pulling” and “pushing”, respectively. Force exertions were recognized with 100% accuracy. For repetitions recognition, except the accuracy in the “bending” motion was 80%, the repetitions of other motions could be recognized correctly. Kinect skeleton model showed its ability of making the WMSDs risk factors vivid which would contribute to the accuracy of WMSDs risks evaluation. These results indicated that it is possible to use WCGAS and Kinect skeleton models for WMSDs risk factors identification and visualization applications.

Keywords: Plantar Pressure, Work-Related Musculoskeletal Disorders (WMSDs), Overexertion, Long short term memory (LSTM), Kinect, OpenSim.

---

## 1. Introduction

Work-related musculoskeletal disorders (WMSDs) are leading nonfatal occupational injuries. In 2015, WMSDs accounted for 31% (356,910 cases) of the total nonfatal occupational injury cases in U.S. [1]. WMSDs are identified as injuries or dysfunctions of the muscles, nerves, tendons, bones, ligaments, joints, cartilage, blood vessels or spinal discs that caused by a single event or accumulative traumas during work [2, 3]. Sprains and strains are common types of WMSDs, which accounted for 39% of all allowed lost time claims [4]. Back, neck, shoulder, elbow, and wrist are the most common parts of body affected by WMSDs [2]. Taking construction workers for example. Brickmasons, drywall installer, and insulation workers use bending and twisting motions repetitively during most of their work [3]. Researches showed that bending

---

\*Corresponding author

Email addresses: dxc494@case.edu (Diliang Chen), yxc757@case.edu (Yi Cai), jxc743@case.edu (Jiawei Cui), jxc1135@case.edu (Jia Chen), hxj172@case.edu (Haotian Jiang), ming-chun.huang@case.edu (Ming-Chun Huang)  
URL: <http://engineering.case.edu/profiles/mxh602> (Ming-Chun Huang)

Download English Version:

<https://daneshyari.com/en/article/10224476>

Download Persian Version:

<https://daneshyari.com/article/10224476>

[Daneshyari.com](https://daneshyari.com)