Interactive Pose Estimation for Active Pauses

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Abstract. Occupational health affections related to ergonomics result in musculoskeletal problems that affect the locomotion apparatus through the muscles, tendons, ligaments and nerves, yielding to numerous cases of work absence. The World Health Organization (WHO) has acknowledged occupational health problems associated with excessive computer work resulting in the execution of repetitive tasks and sedentary cycles. With increased use of mobile electronic devices (laptops, smartphones and tablets) and initiatives as bring your own device, work time has increased recently and users do not take care of their posture or joints during usage of these devices. Recommendations on taking active pauses and do exercises for avoiding occupational health problems are promoted with videos, animations, reminders, guides and surveys, however use of this tools or taking time for active pauses is not done by several users. This project addresses the problem through an application for reminding the pause and monitor user exercises using Kinect.

Keywords: Active pause, Interaction, Motion tracking, Occupational health.

1 Introduction

Occupational health affections related to ergonomics result in musculoskeletal problems that affect the locomotion apparatus through the muscles, tendons, ligaments and nerves, yielding to numerous cases of work absence [1]. Solutions for tackling the occupational health problem regarding sedentary are based on surveys for monitoring user's health while at work [2], consulting enterprises [3], reminding active pause software [4], and reports such as the one presented by the World Health Organization in [5], that aims to raise awareness about this problem for avoiding occupational health risks, recommending active pauses, changing routines, and exercising among others according to different working scenarios. The growth information and technology indexes is the result of current technological trends [6], where computers and mobile devices have become widely used tools for developing daily tasks whether, for studying, working, procrastinating, entertainment or reading among many other activities.

At Military Nueva Granada University the office of Preventive Medicine and Occupational Health uses an active pause flash-based multimedia application with

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still images and animations along with information for users to download and follow on their own. Research on this area have presented studies showing that software assisted breaks leads to an increased execution of exercises, while others state that passive pauses make little difference in decreasing the overall loading produced while working seated, and suggests that pauses should introduce more physical activity [7]. An approach to raise awareness used eLearning as a tool for improving and understanding computer ergonomics which resulted in better work habits for their users.

This work presents the development of a prototype tool for increasing computer workers interest in taking active pauses based on motion tracking and data monitoring. The application aims not only to remind the user of taking the active pause, but also to improve exercise accuracy by presenting a visual feedback of how each motion sequence is performed while tracking the user within each taken pause.

This paper is organized as follows, in Section 2 the methods are presented; in Section 3 the results and findings are documented; finally, in Section 4 the conclusions are discussed.

2 Methods

For developing the application, the occupational health guidelines for our university were taken as design parameters. Active pauses are to be perform from one to two minutes for every 45 minutes of work, additionally, exercises are presented for lower member, back, neck and hands (each series to be performed for 10 s) [8]. The first active pause sequence begins with neck rotation from either side; shoulder rotation backward and forward; alternate arm rising by arm abduction, elbow extension, elbow flexion and arm adduction; torso flexion and extension; and finally, knee flexion and extension while standing. It is worth noting that each of the previous exercises is recommended to be executed for a period of 15 seconds, for achieving the time frame of 1 to 2 minutes.

For tracking the user, the Kinect sensor was chosen as it allows body tracking from a range of 1 m (using a magnifying lens) to 3 m. The sensor uses depth maps and tracks joint's positions and orientation in 3D, however, only frontal tracking is recognizable and environmental characteristics as light and clothing color may affect the tracking [9]. For the proposed prototype only upper member active pause exercise was chosen as it can be performed while standing up or seated within 2 m from the sensor and it is successfully recognized by the sensor.

The upper member exercises consist on alternating arm motion going from sideways of the body to fully extend arose above the head by combining flexion/extension and adduction/abduction, this sequence is presented in Fig.1.

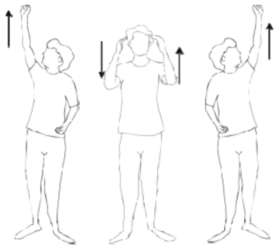

Fig. 1. Upper member sequence

The application development was achieved using the Kinect SDK and XNA for the graphics user interface. This combination allowed creating an interface were the user follows the respective sequences and executes it, an image was inserted to inform if the posture was successfully achieved or not. The application was programmed to emit an alert after 45 minutes of being launched, then instructs the user to step away from the sensor in a standing position and executes the programmed sequence. Additionally, while the user is performing the sequence, a plain text file is created with spatial data of each joint's motion for monitoring and further analysis.

3 Results

After testing the application, results showed that while the Kinect tracked each user, lights and clothing color were only affected in overexposed spaces. Tracking motion and having visual feedback proved to increase accuracy in exercise execution as presented in Fig.2. A survey was applied to 15 computer users whose time in front of the device is around 8 hours a day, this included students, teachers and laboratory assistants. The goal was to check if a tool for active pauses would encourage them for improving their occupational health through motion tracking and monitoring.

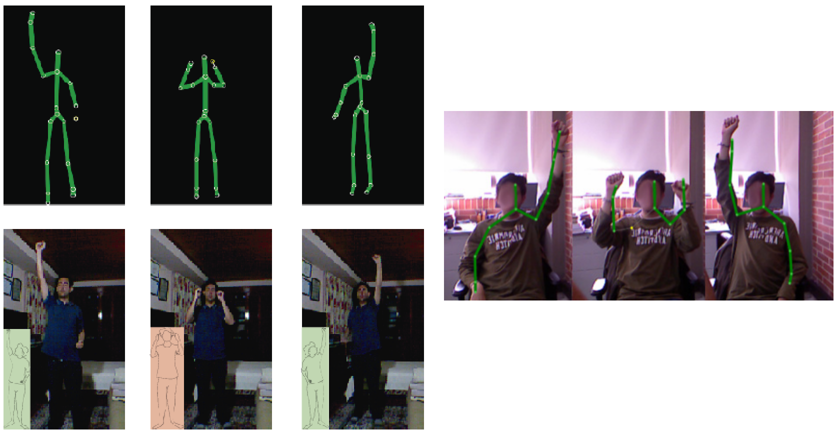

Fig. 2. Standup and seated results

The survey results showed that all participants do not practice active pauses; they are aware of the consequences of occupational health risks, 79% would be interested in using passive active software and considers it an useful tool.

4 Conclusions

The sequence information offered enough information for defining the inputs and outputs of the application, postures and motion for each exercise are programmed considering each joint relation to another, so the application can be used by several users without needing personalized configuration. With the previous information user motion is captured through skeletal tracking implemented with Microsoft ® Kinect, whose three-dimensional information for each joint allows comparing user the motion to the programmed exercises. The outputs are entirely visual, as the sequence is presented for the user to follow, while a tracked body is also visualized for the user to check how he or she is doing, also, time and numbers of exercises are displayed for user information.

Further improvements to the application will consider more exercise sequences, the ability to choose independent exercises and data exportation and statistics for further analysis by a specialist.

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