Demo: The Health Conductor

Bodily interaction with music for the promotion of seniors' health and well-being

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***Abstract*— This demo shows an interactive prototype, the *Health Conductor*, which couples repetitive human movement to the beat and tempo of pre-recorded music. Employing the Microsoft Kinect motion sensor, the system tracks simple movement patterns performed by the user and adjusts the tempo of a piece of music to match the frequency of those movements. This ensures that the beat of the music coincides with the perceived beat points in the user's movements. Also, a slideshow of pictures are projected on the wall in front of the user(s). The progression of the slideshow is proportional to the rate of users' movement. The prototype is part of a research-through-design project that explores bodily interaction with music as a way to engage and motivate senior citizens to be more physically active.**

Keywords - movement; music; health; elderly; welfare; bodily interaction; Kinect;

I. BACKGROUND

There are three important reasons why senior citizens in Norway move into care homes: Falls, cognitive decline, and social isolation. These age-related health challenges influence each other negatively, and may lead to a vicious circle of deteriorating health and premature death [1]. Accordingly, the Norwegian Department of Health has made it a priority to develop preventive measures and technological solutions that can help counteract this development, and promote more active and healthier lifestyles [1].

Regular physical activity and exercise is widely acknowledged as central to good health. For seniors, immobility and sedentary lifestyles are associated with increased risk of falls, and exercise is highly recommended to reduce this risk. There are also indications that exercise may have a neuro-protective effect in Parkinson's disease [2] and improve physical and cognitive function in people with Alzheimer's disease [3], [4].

Nevertheless, many seniors struggle to find motivation to adhere to exercise programs over time. This research project seeks to understand if and how music can be employed interactively to motivate an increased level of physical activity.

Music induces and inspires movement, and moving to music is an inherently enjoyable activity. We dance, tap, sway, and move our bodies and limbs to the rhythm of music Research also indicates that music may have beneficial effects on a wide variety of serious health challenges such as stroke, dementia, Parkinson's, and depression, as well as improve well-being, reduce stress, improve the effect of exercise, and reduce perceived exertion during exercise [5]–[9].

There is an increasing interest in exploring interactive exercise games (exergames) as health-promotion tools for clinical practice as well as for home use [10]–[13]. However, music is only anecdotally used in such exergames, or used in a way that confuses users [14]. On the other hand, there is a growing demand within music therapy "to apply electronic music technologies in clinical practice" [15].

II. SYSTEM

The Health Conductor is comprised of a Kinect motion sensor, a Mac, and custom software built in Max 7 [16] and Processing [17]. A large screen or projector is used to display the slideshow of images.

Before starting a session there are two choices to be made: (1) Which song to play, and (2) what kind of movement pattern to perform. Songs are chosen from a list of pre-prepared songs, and there are currently 5 different movement patterns to choose from (all movement patterns are performed in a standing position facing the sensor):

- *Conductor* - Move hands from side to side. The system monitors horizontal (x-axis) movement of the hands and calculates movement frequency based on the timing of direction changes (left-to-right or right-to-left).
- *Arm swing* - Swing arms alternately from front to back. The system determines which hand is closer to the sensor (z-axis) and calculates frequency based on the switching position of the hands (from right hand in front to left hand in front, and vice versa).

- *Body sway* - Sway the body from side to side. The system tracks the horizontal position of the head. Frequency is determined by direction changes (left-to-right or right-to-left).
- *Knee bend* - Bend and extend both knees at the same time. The system monitors the vertical (y-axis) position of the head, and frequency is calculated by direction reversals (down-to-up or up-to-down).
- *Knee lift* - Alternately lift one knee while standing on the other (walking in place). The system tracks the vertical (y-axis) position of both knees and determines which knee is above the other.

After song and movement pattern have been chosen, the system is ready. It will automatically detect users and start to track the movements of any person within its field of view. The slideshow of pictures start to display on the screen in front of the user.

The system has been tested with seniors in a variety of settings, and it has been generally well received. Test persons have commented that they enjoy moving to the music and are able to control the tempo of the music through their movements. Several have also commented that completing a song (lasting 3-5 min.) feels like a small workout. Towards the end of the song the muscles may start to burn, and heart rate and breathing rate increases moderately. Future work will explore how the system can be used as one of several weekly activities in an open activity center for senior citizens.

III. REFERENCES

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