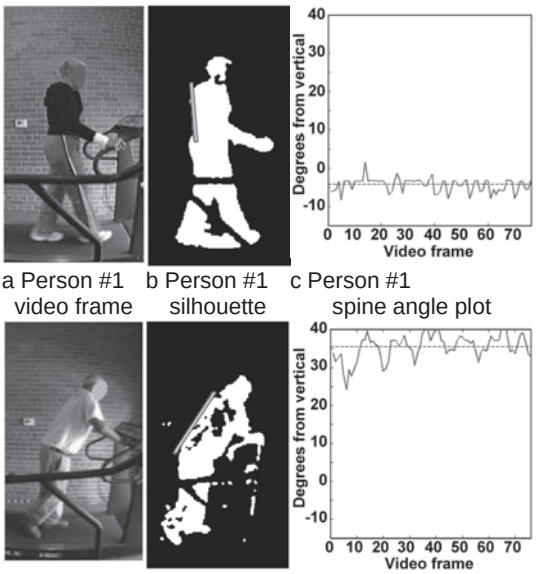
G.L. Alexander, T.C. Havens, M. Skubic, M. Rantz, J.M. Keller, C. Abbott. Markerless human motion capture-based exercise feedback system to increase efficacy and safety of elder exercise routines. Gerontechnology 2008; 7(2):67. Older adults make up the fastest growing segment of the American society. Older people participate in limited exercise; leading to decreased fitness and reduced energy levels[1]. Maintaining or initiating a lifestyle including exercise, older persons can improve their cardiovascular, metabolic and skeletal muscle function. Human motion capture[2] has important implications to help elders understand about their body posture and motion during exercise routines resulting in greater efficacy and safety of exercise regimens. This paper presents a novel exercise feedback system using markerless motion capture techniques to increase exercise effectiveness and safety for older adults. **Methods** We built upon existing markerless motion capture methods[2] to create a system to measure kinematics of 17 adults over the age of 65 using a treadmill, stationary bike, and overhead pull-down machine. All participants performed exercises with the same settings for each piece of equipment; for example, the treadmill had no incline and was set for 1.3 km/hr. Our system uses standard inexpensive digital web-cams to: (i) capture anonymized silhouette sequences; (ii) track the contours of the shoulders and the spine to measure kinematics data on posture and gait, including stride, balance, forward pitch, and upright body position (*Figure 1*). Investigators conducted usability studies with participants to get feedback about how interfaces could support the subjects during their exercise routines. The transcriptions of the interviews and observations were aggregated to provide conclusions on how the feedback system could be improved. **Results and Discussion** Figure 1 illustrates two participants' images produced by our system. Figures 1a,d show a video frame of two participants, while Figures 1b,e display the corresponding silhouette with the spine tracking reference overlaid. Finally, Figures 1c,f are plots of the spine angle (positive angle is leaning forward) versus video frame (at 7.5 frames/second). Note how our system is able to capture both the overall difference in the two participants' posture but also the temporal differences as they performed exercises. The extreme forward pitch demonstrated by participant two as he held on to the treadmill is demonstrated in the graph (*Figure 1 f*); from vertical this man pitches forward approximately 35 degrees as he ambulates. Our system was also able to capture the same participant's pronounced limp as evidenced by the periodic variable pattern in Figure 1(f). In contrast participant one was nearly upright with good posture and alignment of her core body during treadmill exercises. These images illustrate the extreme differences in range of motion older people exhibit when trying to perform exercise activities. During interviews participants indicated these interventions could inform them about their abilities to perform exercises, enabling them to correct their posture and making them feel safer while exercising.



a Person #1 video frame | b Person #1 silhouette | c Person #1 spine angle plot

d Person #2 video frame | e Person #2 silhouette | f Person #2 spine angle plot

Figure 1 Exercise Feedback Examples

References

1. Fletcher BJ, Gulanick M, Braun LT. Medsurg Nursing 2005;14:101-109
2. Moeslund T, Granum E. Computer Vision and Image Understanding 2001;81:231-268

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