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PII: S1071-5819(16)30020-9
DOI: http://dx.doi.org/10.1016/j.ijhcs.2016.04.010
Reference: YIJHC2033

To appear in: *Journal of Human Computer Studies*

Received date: 29 July 2015
Revised date: 24 April 2016
Accepted date: 25 April 2016

Cite this article as: John Majikes, Rita Brugarolas, Michael Winters, Sherri Yuschak, Sean Mealin, Katherine Walker, Pu Yang, Barbara Sherman, Alper Bozkurt and David L. Roberts, Balancing Noise Sensitivity, Response Latency and Posture Accuracy for a Computer-Assisted Canine Posture Training System *Journal of Human Computer Studies* http://dx.doi.org/10.1016/j.ijhcs.2016.04.010

Balancing Noise Sensitivity, Response Latency, and Posture Accuracy for a Computer-Assisted Canine Posture Training System

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Abstract

This paper describes a canine posture detection system comprised of wearable sensors and instrumented devices that detect the postures sit, stand, and eat. The system consists of a customized harness outfitted with wearable Inertial Measurement Units (IMUs) and a base station for processing IMU data to classify canine postures. Research in operant conditioning, the science of behavior change, indicates that successful animal training requires consistent and accurate feedback on behavior. Properly designed computer systems excel at timeliness and accuracy, which are two characteristics most amateur trainers struggle with and professionals strive for. Therefore, in addition to the system being ergonomically designed to ensure the dog's comfort and well-being, it is engineered to provide posture detection with timing and accuracy on par with a professional trainer. We contend that providing a system with these characteristics will one day aid dogs in learning from humans by overcoming poor or ineffective timing during training. We present the initial steps in the development and validation of a computer-assisted training system designed to work outside of laboratory environments.

The main contributions of this work are a) to explore the trade-off between low-latency responses to changes in time-series IMU data representative of posture changes while maintaining accuracy and timing similar to a professional trainer, and b) to provide a model for future ACI technologies by documenting the user-centered approach we followed to create a computer-assisted training system that met the criteria identified in (a). Accordingly, in addition to describing our system, we present the results of three experiments to characterize the performance of the system at capturing sit postures of dogs and providing timely reinforcement. These trade-offs are illustrated through the comparison of two algorithms. The first is Random Forest classification

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