

# Exploration of the Integration of Markerless Motion Capture and Virtual Reality for Ergonomics Assessment of Products in Early Design

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## **Abstract**

Optical Motion Capture (MOCAP) and physical prototyping are one of the most commonly used methods for monitoring how humans interact with products early in conceptual design to evaluate ergonomics outcomes. However, they often associated high cost and excess time. MOCAP systems require special data collection setup, including multiple infrared cameras, reflective marker, and motion suits for subjects to put on. Lighting needs to be controlled and reflective objects need to be covered to insure adequate reflection of the markers. The physical prototyping requires modeling and construction, which is often cumbersome when concept models require heavy modifications. As a result, cost of the hardware for data collection and post-processing for ergonomics purposes is typically high, especially for design studies focusing on early design concept evaluation. A markerless MOCAP system with a Virtual Reality (VR) setup is proposed in this study, which has the potential to eliminate excess cost and time associated with physical prototyping. The proposed ergonomics analysis methodology utilizes Microsoft Kinect as a markerless motion capture system and HTC Vive for representing the work environment for ergonomics analysis. Validation of the proposed markerless virtual ergonomics analysis composed of two experiments: *Physical Experiment* (physical workplace + markerless MOCAP + DHM) and *Virtual Experiment* (virtual + markerless MOCAP + DHM), which measure L4/L5 compression forces during a shelving task. In addition, a questionnaire was required to measure the users' preference on ease and comfort about two experiments. Results indicates proposed virtual ergonomics method was able to replicate the physical test conditions in virtual environment with high fidelity.

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