Prediction of Kinematic and Kinetic Behavior of a Human Body while Performing Labor-intensive Repetitive Task Using Machine Learning

Sudip Subedi[1] and Nipesh Pradhananga[2]

[1]Ph.D. Candidate, Department of Civil and Environmental Engineering, Florida International University, 10555 West Flagler Street, Miami, FL 33174; email: ssube002@fiu.edu
[2]Associate Professor, Moss Department of Construction Management, Florida International University, 10555 West Flagler Street, Miami, FL 33174; email: npradhan@fiu.edu

ABSTRACT

Civil construction projects have numerous labor-intensive repetitive activities such as manual material handling, tile laying, concreting, among others. A handful of safety personnel cannot monitor the dispersed workers performing these tasks on the construction site. Besides, manual monitoring can be tedious, error-prone, and challenging to analyze postural safety. For computing the "safe work posture" of a task, unique actions and the moment exerted on major joints for each movement frame needs to be identified. For this, the paper proposes to use the *Kinect* to get the skeletal postural data while performing lifting and setting down task. Also, the research implements different machine learning algorithms to predict the unique actions and the moment exerted on the lower back for each movement frame. The training data was collected using *Kinect* in a controlled lab setup. The unique actions were manually identified for each movement frame. Then the kinetic analysis was performed in *OpenSim* using a human musculoskeletal model to compute the moment exerted on the lower back. The identified unique actions were used to train the action classification model using a *random forest classifier*, and the moment data was used to train the moment prediction model using a *random forest regressor*. Additional postural data were collected to validate the applicability of the developed model. The proposed research can play a pivotal role in assisting safety personnel in real-time safety monitoring of such repetitive tasks.