INSTITUTE OF PSCM

TECHNISCHE UNIVERSITÄT DARMSTADT

Master's Thesis

A systematic comparison of Microsoft Azure Kinect and open-source motion capture tools

Background

Markerless motion capture technology has gained significant attention for ergonomic risk assessment in production and logistics environments due to its ease-of-use and cost effectiveness (Zheng et al., 2024). Microsoft Azure Kinect, for example, embeds an RGB camera and a depth sensor, and uses neural networks to track human joint positions (Pterneas, 2022). Open-source tools such as OpenPose or MediaPipe use deep learning techniques to estimate human poses from RGB images directly. Recent studies have shown that open-source solutions can achieve high accuracy in detecting human joints and postures (Kim et al., 2021). Compared to Azure Kinect, open-source solutions have advantages in terms of cost and flexibility, which makes them attractive for industrial applications. However, there is limited empirical evidence of how well Azure Kinect performs compared to such open-source tools, especially with respect to ergonomically relevant body parts (neck, shoulders, elbows, spine, knees) for both static and dynamic motions. Understanding the differences between Azure Kinect and purely vision-based Open-source pose estimation solutions is crucial for selecting the most suitable technology for ergonomic evaluation.

Objective

The aim of the thesis is to systematically compare Azure Kinect and Open-source solutions (OpenPose and MediaPipe) in tracking postures and motions. To achieve this goal, the student is first going to understand how the Azure Kinect and Open-source solutions work, and subsequently design a controlled experiment to capture static and dynamic motions to evaluate the performance of Azure Kinect and Open-source solutions in comparison with the "gold" standard (goniometer, angle scale) in terms of injury-prone body parts, such as neck, shoulder, elbow, spine, and knee. Python, GitHub, and statistical analysis skills are recommended, but you may also learn them during the thesis work.

References

Kim, W., Sung, J., Saakes, D., Huang, C. and Xiong, S. (2021). Ergonomic postural assessment using a new open-source human pose estimation technology (OpenPose), International Journal of Industrial Ergonomics, Elsevier B.V., Vol. 84, p. 103164, doi: 10.1016/j.ergon.2021.103164.

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Zheng, T., Wildt, C., Zhang, M., Glock, C.H., Weidinger, F. and Grosse, E.H. (2024). A new Kinect-enabled motion analysis approach for warehouse materials handling activities, IFAC-PapersOnLine, Vol. 58 No. 19, pp. 730–735, doi: 10.1016/j.ifacol.2024.09.216.

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