DSAIL-Orthopedia: A computer vision-based software for automated measurements of flexion angle and lower limb alignment

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Introduction

- Accurate limb alignment and joint motion measurements are essential for diagnosing and treating musculoskeletal disorders.
- The Hip-Knee-Ankle (HKA) angle is a critical parameter for assessing limb alignment.
- Traditionally, orthopedic assessments primarily rely on X-rays for lower limb evaluation.
- Prolonged X-ray radiation exposure could pose potential health risks, especially when frequent assessment is required.
- To address challenges, we have developed an advanced computer vision-based software capable of real-time measurement called Dsail-Orthopedia.
- This study aims to evaluate the reliability of the software by analyzing its consistency in angle measurements for the same individual across various software setups, as part of a comprehensive software reliability assessment.

Methods

Functionality: The Dsail-Orthopedia software processes live video streams of individuals using Mediapipe pose estimation AI model to detect and extract pixel coordinates of the hip, knee, and ankle joint centers from video frames. It computes the Hip-Knee-Ankle (HKA) angle in real time.

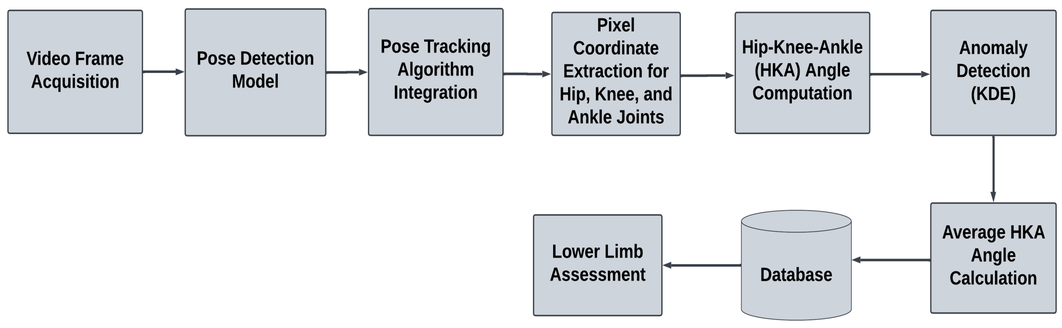


Fig 1: Workflow of Dsail-Orthopedia

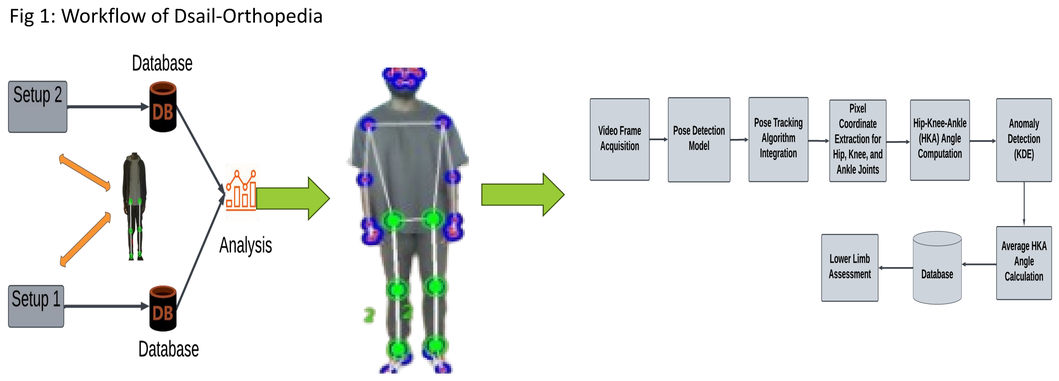


Fig 2: Sequence of Images – Mediapipe Pose Landmarks, Posture with Landmarks, and Lower Limb Assessment

Reliability Analysis: In the initial setup, two computers were positioned 3 meters from the test subject, oriented perpendicularly, to assess consistency across different configurations.

Fig 3: Study Setup

Results

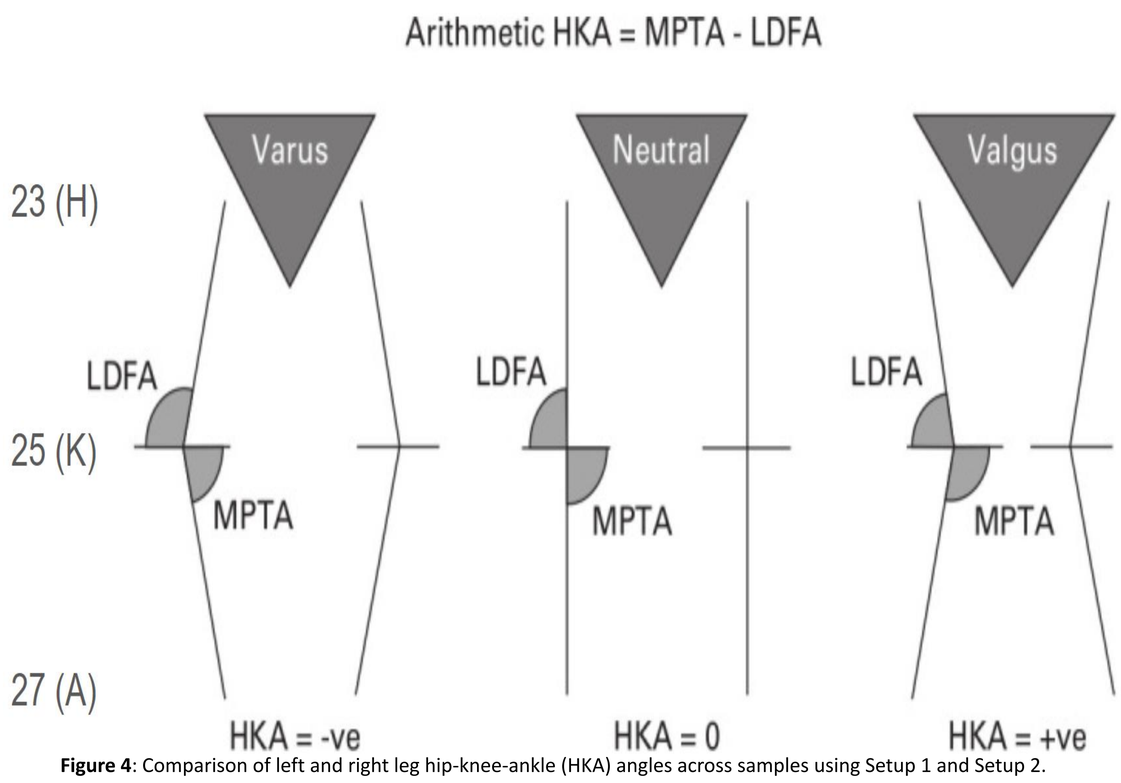


Figure 4: Comparison of left and right leg hip-knee-ankle (HKA) angles across samples using Setup 1 and Setup 2.

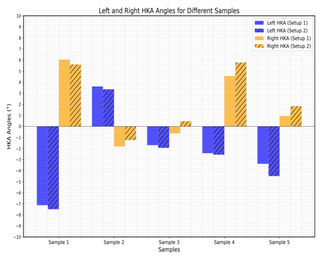
- Data analysis demonstrated strong consistency between the two setups, with a variability of only 0.63°.
- Preliminary findings indicate that DSAIL-Orthopedia can reliably measure lower limb alignment.

Conclusion

- DSAIL-Orthopedia presents a non-invasive, accessible solution for orthopedic assessment.
- It holds the potential to enhance clinical practice, improve patient recovery outcomes, and contribute to more effective healthcare delivery.

What Next?

Clinical validation of the software by comparing lower limb alignment measurements obtained through the software with those from traditional assessment methods



SCAN FOR DEMO

https://dekut-dsail.github.io/

MORE FROM DSAIL

Acknowledgment

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The views expressed herein do not necessarily represent those of IDRC or its Board of Governors, or the UK government's official policies.

[1] N. Marques Luís and R. Varatojo, "Radiological assessment of lower limb alignment," *EFORT Open Reviews*, vol. 6, no. 6, pp. 487–494, Jun. 2021, doi: https://doi.org/10.1302/2058-5241.6.210015.

[2] C. Lugaresi *et al.*, "MediaPipe: A Framework for Building Perception Pipelines," Jun. 2019, doi: https://doi.org/10.48550/arxiv.1906.08172