3D Human Motion Capture by Combining Kinect and Vicon Data

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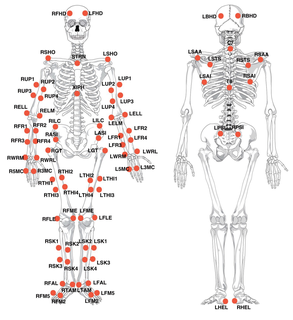
01. Abstract

The widespread use of virtual reality (VR) in gaming, training, and simulation has led to both advancements and safety risks, like collisions. Current VR safety systems typically use one type of sensor, reducing their effectiveness. This project aims to improve VR safety by combining motion capture data from Vicon cameras and Kinect sensors

02. Objective

Our goal is to create a dataset combining Vicon's high-precision tracking with Kinect's depth imaging and skeletal tracking. We synchronized and calibrated both systems to collect simultaneous data on user movements and interactions. This integrated approach improves the detection of boundary breaches and hazardous movements.

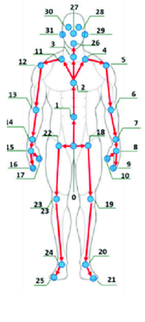
03. Analysis



1.Vicon body marker positions

The Vicon system uses multiple high-speed cameras enabling precise 3D motion capture with high accuracy and low latency.

The Kinect system utilizes a single camera that combines RGB, infrared, and depth. Kinect's skeletal tracking algorithm identifies key joints and body points directly from the depth data.



0. PELVIS
1. SPINE_NAVAL
2. SPINE_CHEST
3. NECK
4. CLAVICLE_LEFT
5. SHOULDER_LEFT
6. ELBOW_LEFT
7. WRIST_LEFT
8. HAND_LEFT
9. HANDTIP_LEFT
10. THUMB_LEFT
11. CLAVICLE_RIGHT
12. SHOULDER_RIGHT
13. ELBOW_RIGHT
14. WRIST_RIGHT
15. HAND_RIGHT
16. HANDTIP_RIGHT
17. THUMB_RIGHT
18. HIP_LEFT
19. KNEE_LEFT
20. ANKLE_LEFT
21. FOOT_LEFT
22. HIP_RIGHT
23. KNEE_RIGHT
24. ANKLE_RIGHT
25. FOOT_RIGHT
26. HEAD
27. NOSE
28. EYE_LEFT
29. EAR_LEFT
30. EYE_RIGHT
31. EAR_RIGHT

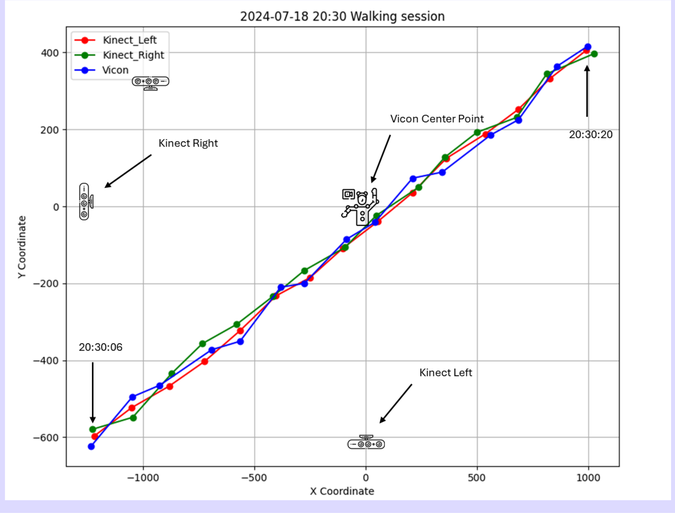
2.Kinect body joint position

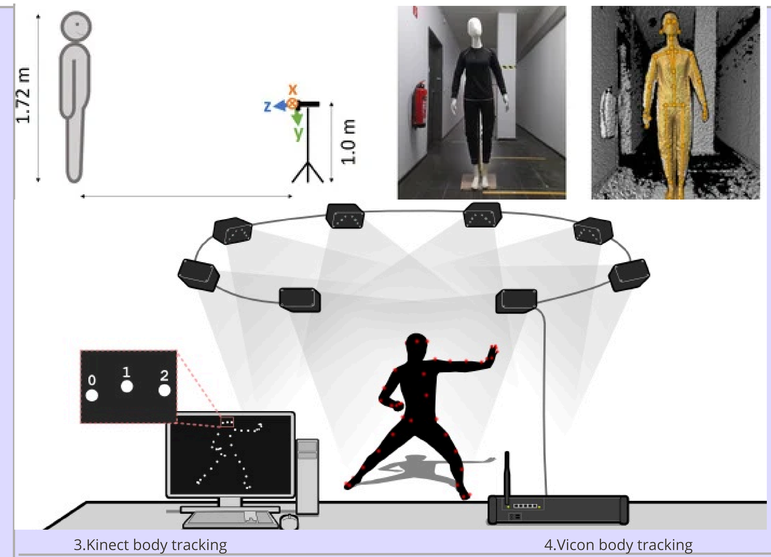
04. Methodology

System setup, calibration, data synchronization, integration, and feature extraction. By leveraging the strengths of both Vicon and Kinect systems, we collect comprehensive motion data.

05. Results

By making a common coordinate system, the one from the Vicon, and giving each frame its timestamp we can match the data.





3.Kinect body tracking 4.Vicon body tracking

06. Future work

Future work will involve trial sessions to gather a diverse dataset of VR activities and user interactions. This dataset will capture body positions, proximity to boundaries, and movement patterns. Advanced machine learning models will be developed to predict safety risks by analyzing these features, identifying potential hazards, and alerting users in real-time.

07. Conclusion

Integrating Vicon and Kinect data, and in the future VR data is set to enhance VR safety by providing more accurate and comprehensive motion tracking. Despite the challenges in synchronization and data processing, the combined dataset will help improves boundary detection and risk prediction.

08. References

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