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醫院管理局研討大會

醫院管理局社區復康中心
Community Rehabilitation Service Support Centre
Hospital Authority

HandCube

A 3D Quantitative Assessment System for Hand Kinematics

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Clinical Challenges

CHALLENGES IN HAND & FINGER KINEMATICS ASSESSMENT

ESSENTIAL FOR DIAGNOSIS & TREATMENT

Quantitative assessment of hand and finger kinematics provides objective data for precise diagnosis and personalized treatment planning.

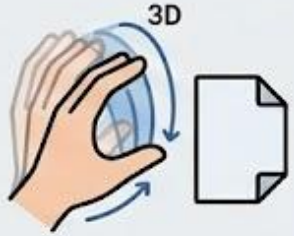
LIMITATIONS OF CONVENTIONAL TOOLS

Manual goniometry and observational scales are labor-intensive and time-consuming for both clinicians and patients.

HIGH EXAMINER DEPENDENCY

Outcomes often vary between examiners, leading to reduced assessment repeatability and reliability.

INABILITY TO CAPTURE COMPLEX MOTION



Traditional methods are severely limited in their ability to capture complex, dynamic 3D motion patterns required for functional tasks.

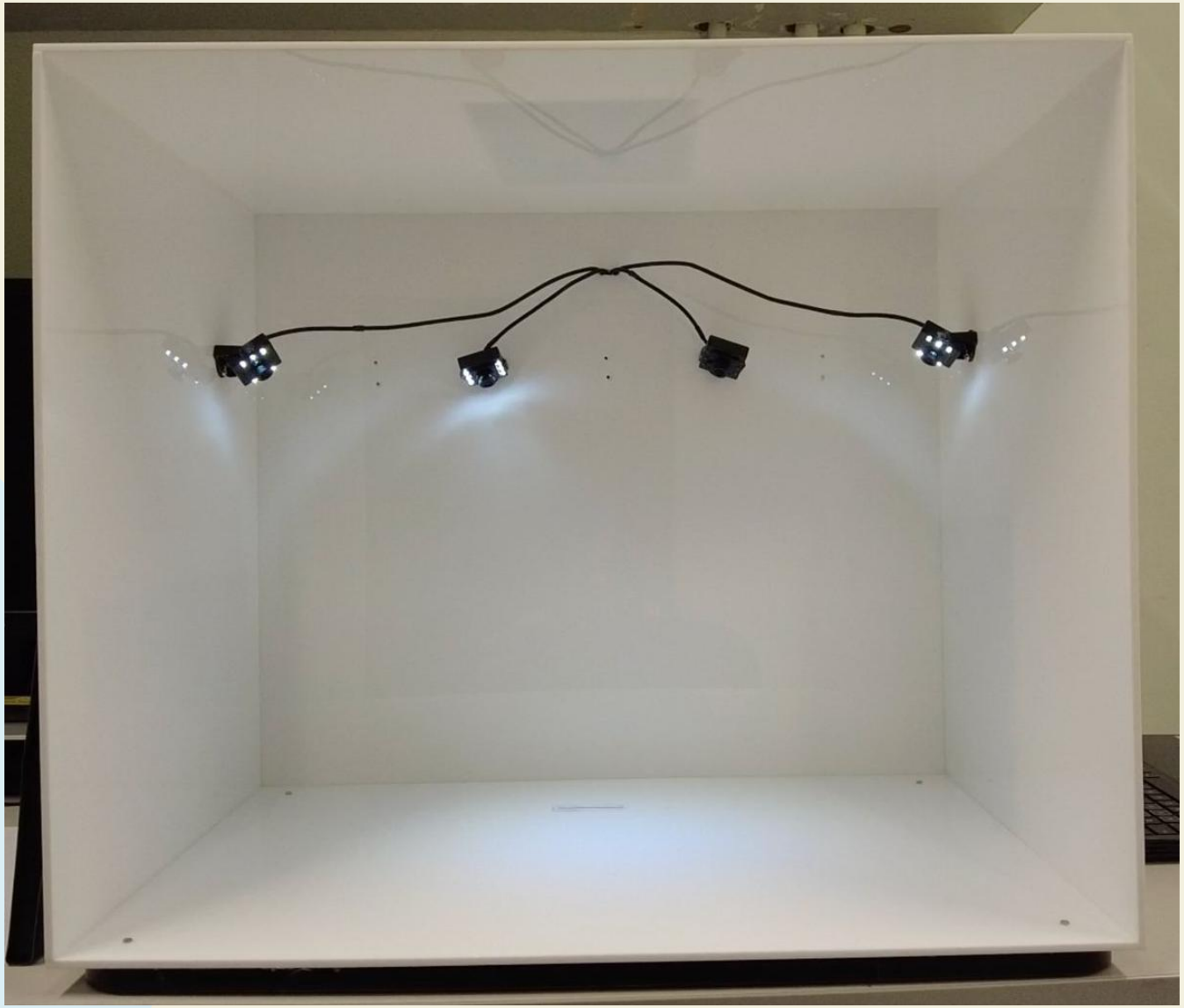
The HandCube Solution

Markerless Technology

Uses advanced computer vision & AI for **accurate, unencumbered clinical evaluation.** No physical sensors required.

Multi-View Reconstruction

The HandCube Solution



System Operation & Output

Evaluation

Patients **perform gestures within the cube,** such as hand opening, making a fist, oppositions, and pinches.

Algorithm

Advanced **computer vision** and **machine learning** algorithms process the multi-view feeds to **reconstruct joint landmarks in 3D space**.

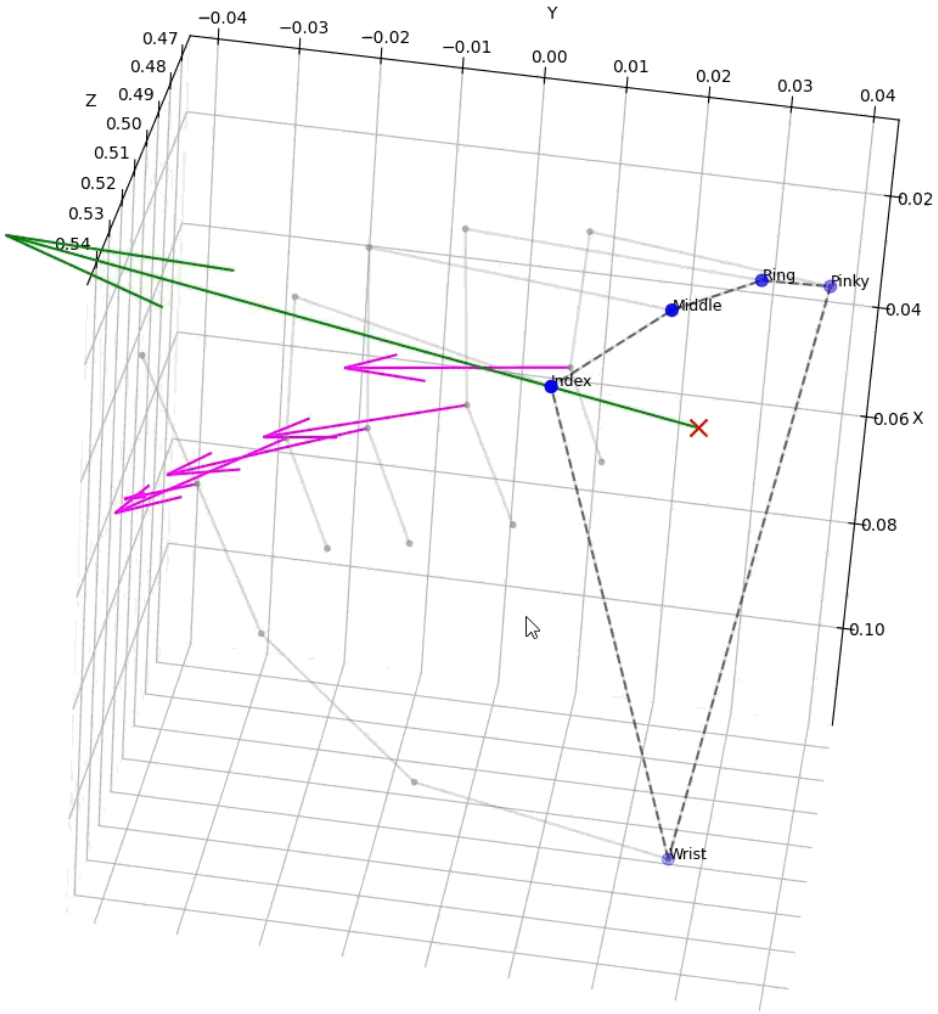
Reporting

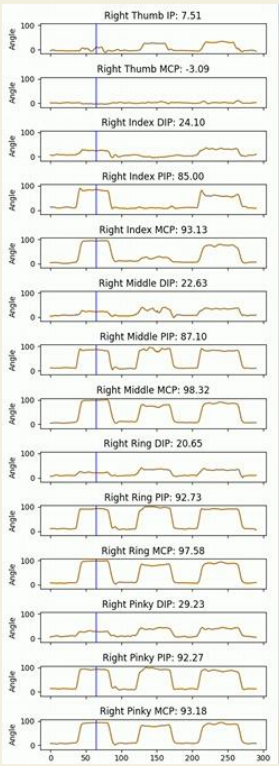
Automatically generates **detailed kinematic reports**, providing precise **joint angles** and interdigital web space ranges.

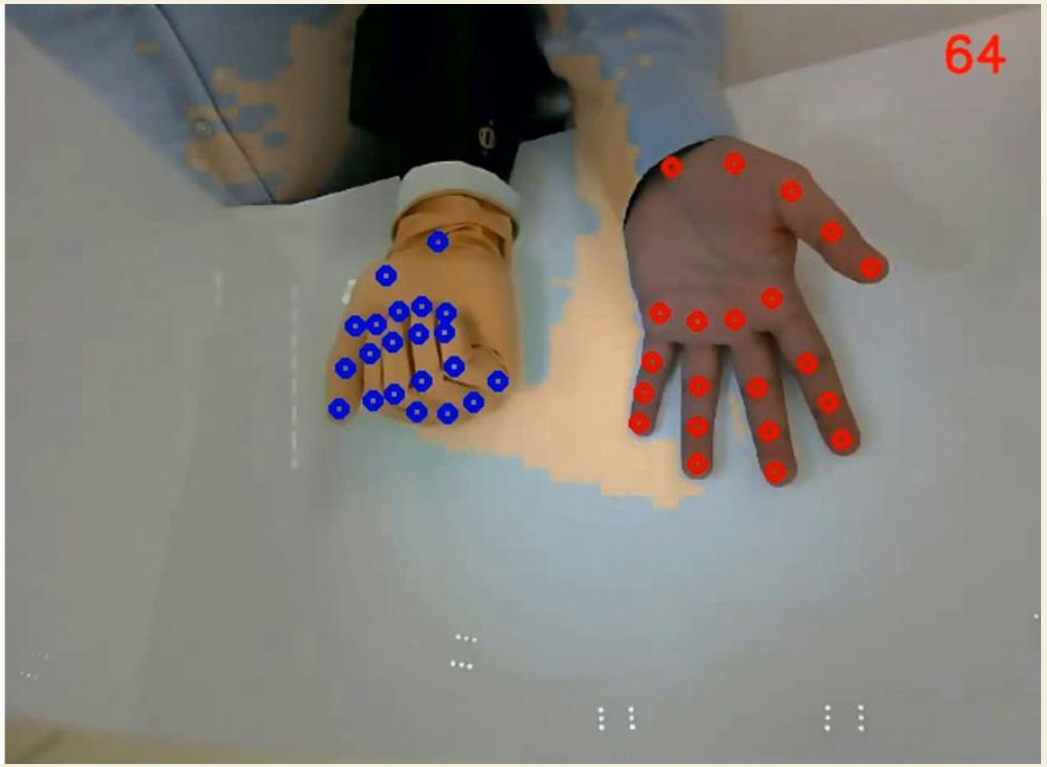
Reliability Validation Study

- A calibrated robotic hand (Ohand, OYMotion) was controlled to perform 4 gestures (**Hi-Five, Fist, Pointing & Pinch**) in HandCube.
- Robotic hand performs gestures **without observable fluctuations and variations**, which is perfect for controlled reliability validation
- Measurements of joint angles by Handcube and goniometer were compared for evaluation of validity. All measurements of goniometer are taken from surface of joint.

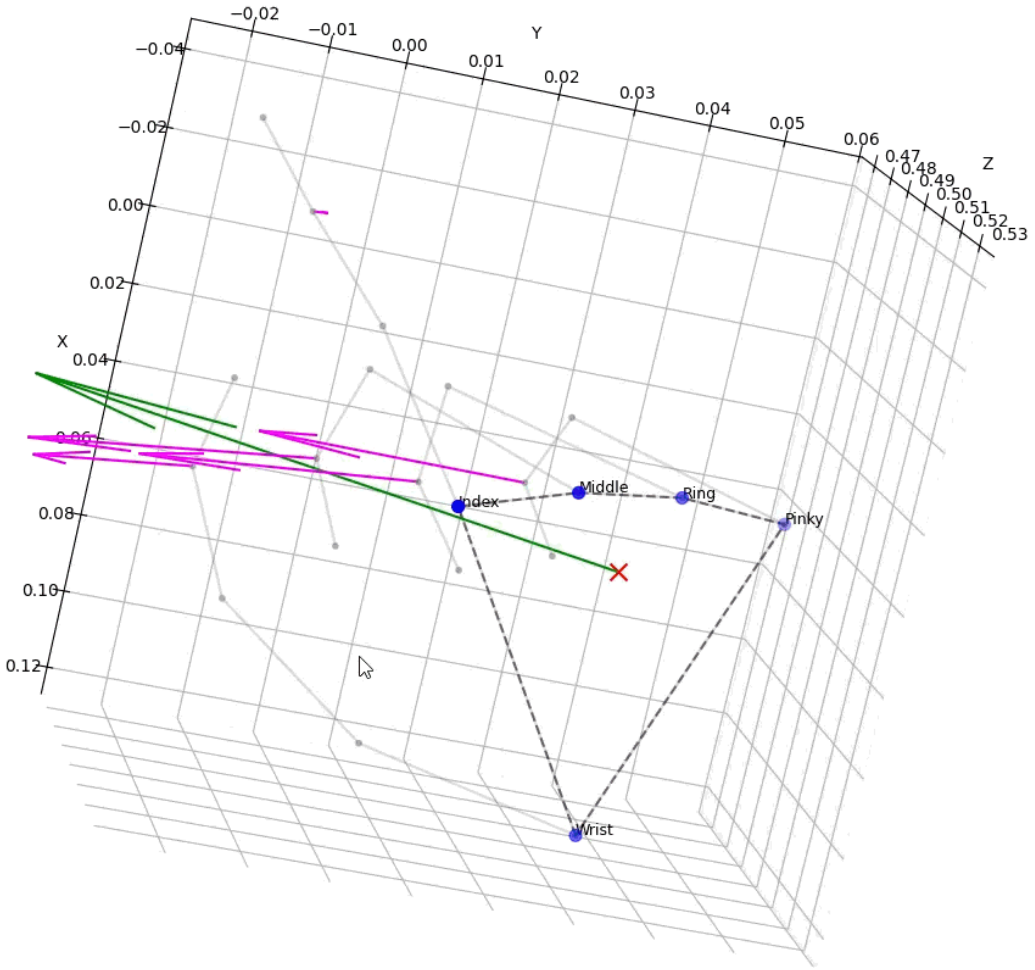
Reconstruction to 3D space

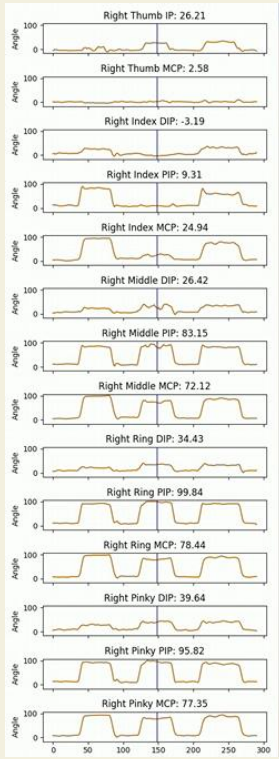


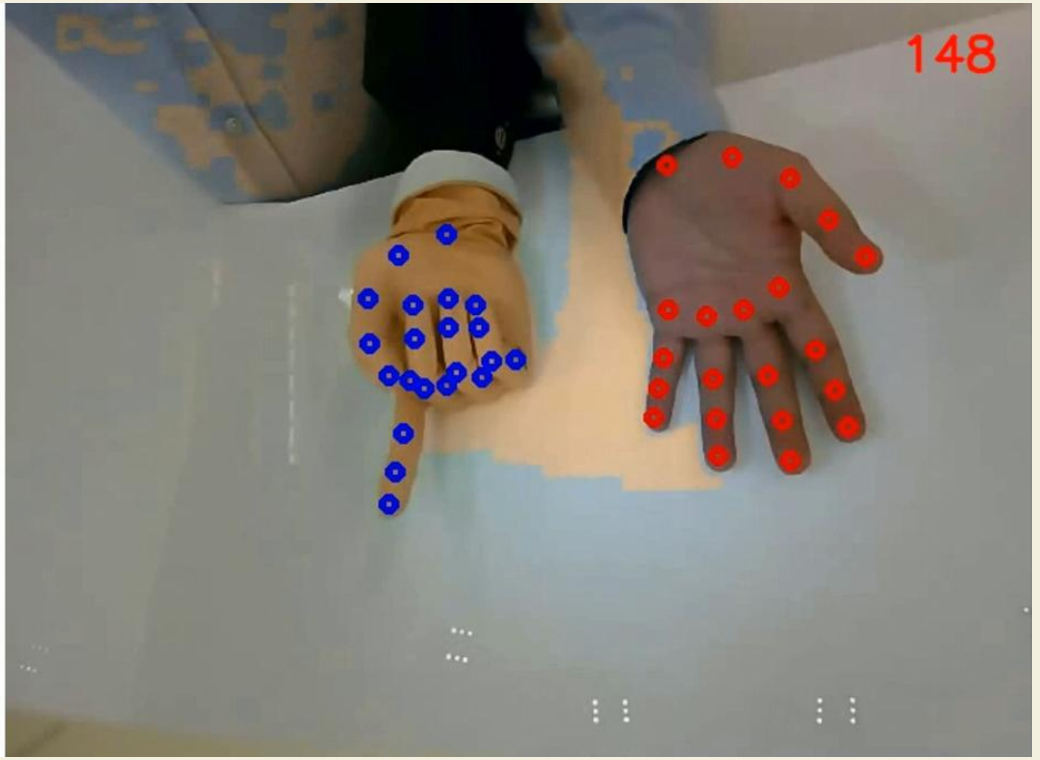




Reconstruction to 3D space







High Reliability & Accuracy

ICC Score

0.951

Mean Absolute Error

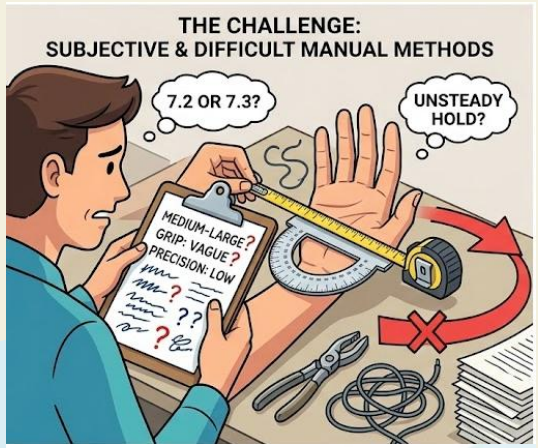
9.6°

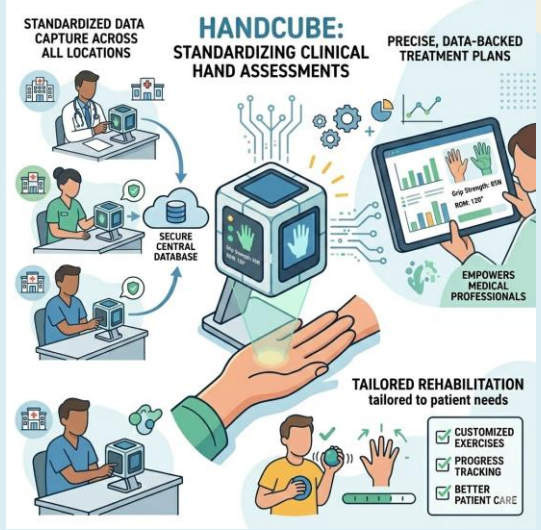
Excellent Test-Retest Reliability

- ICC Score showed closed to 1.0 ($p < 0.01$)
- Strong agreement of measurement between using Handcube and a standard goniometer.

- Mean Absolute Error (MAE) for joint angles was exceptionally low at just 9.6
- Sits comfortably within the clinically acceptable range of under 10°.

Clinical Impact & Future





Pilot study on human subjects: Study for evaluation of Handcube on human subjects (affected and non-affected) is planned to launch.

Overcoming Traditional Limitations: HandCube effectively bypassing the **subjectivity** and **difficulty** of manual methods, including

- Dynamic assessment
- Acute measurement (e.g. wearing fixators)
- Accessing chain of movement

Standardizing Hand Evaluation: Handcube standardize clinical hand assessments across different practitioners and facilities

- promoting **traceability** of treatment and rehab process

Data-Driven Clinical Decisions: **Tailored** treatment and rehabilitation plan can be provided according to measurements

System is Improving
With your

Comments

Thank you for your time and attention.