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Tri-Service General Hospital Smart and Sustainable Healthcare

Transformation Project under the Healthy Taiwan Cultivation Plan

An AI-Driven REPAIR—RSAI Framework for Posture, Balance, and Functional Mobility



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Background and Purposes

Postural dysfunction, pain, and mobility decline are major concerns among individuals with musculoskeletal or neuromotor impairments. Accurate posture and movement assessments are essential for identifying underlying problems and guiding effective interventions. This study introduces an AI-assisted framework integrating biomechanics, neuromuscular control, and functional task analysis to support health promotion and functional recovery in clinical and community-based populations with movement-related impairments.

Materials and Methods

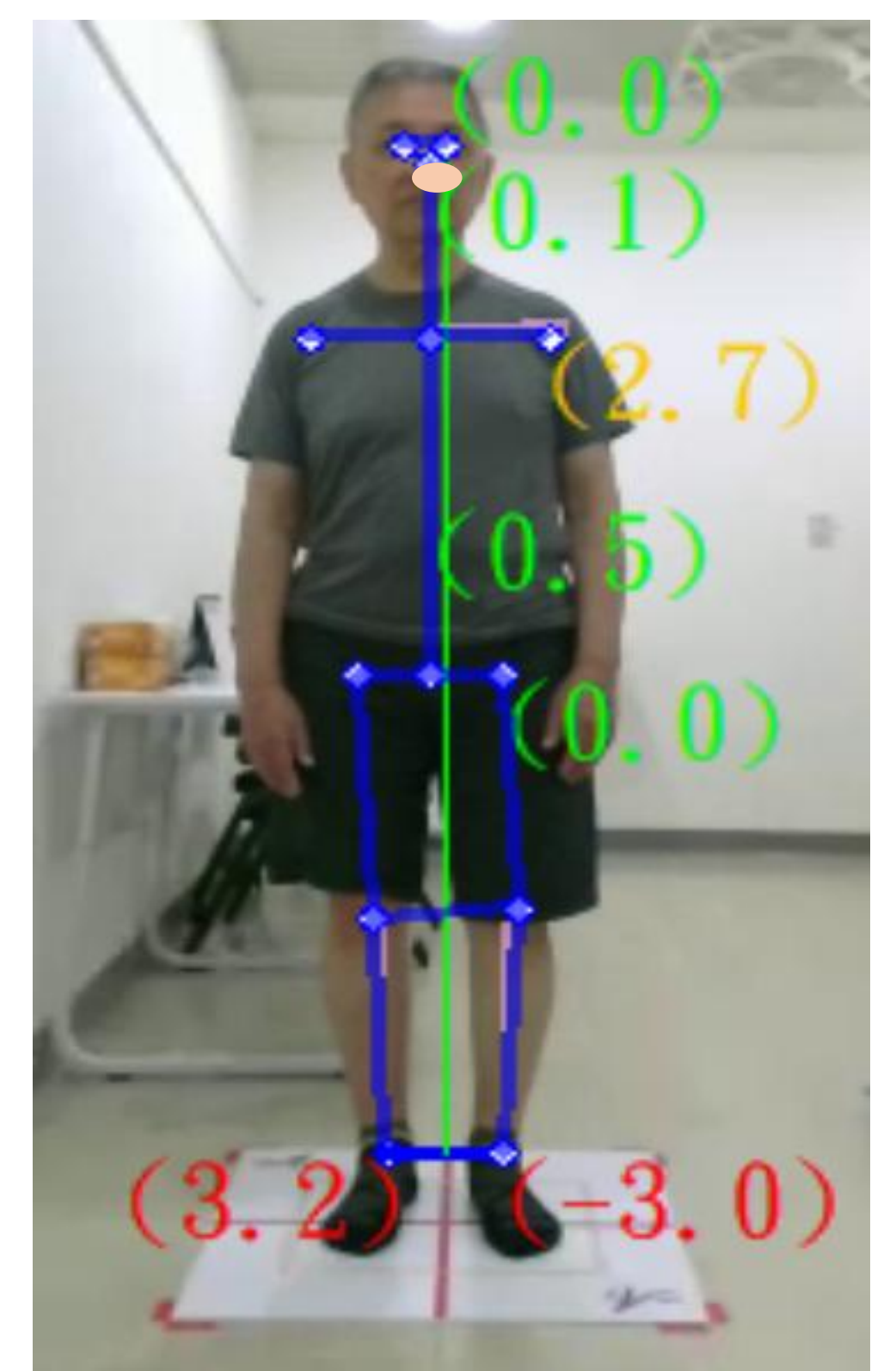
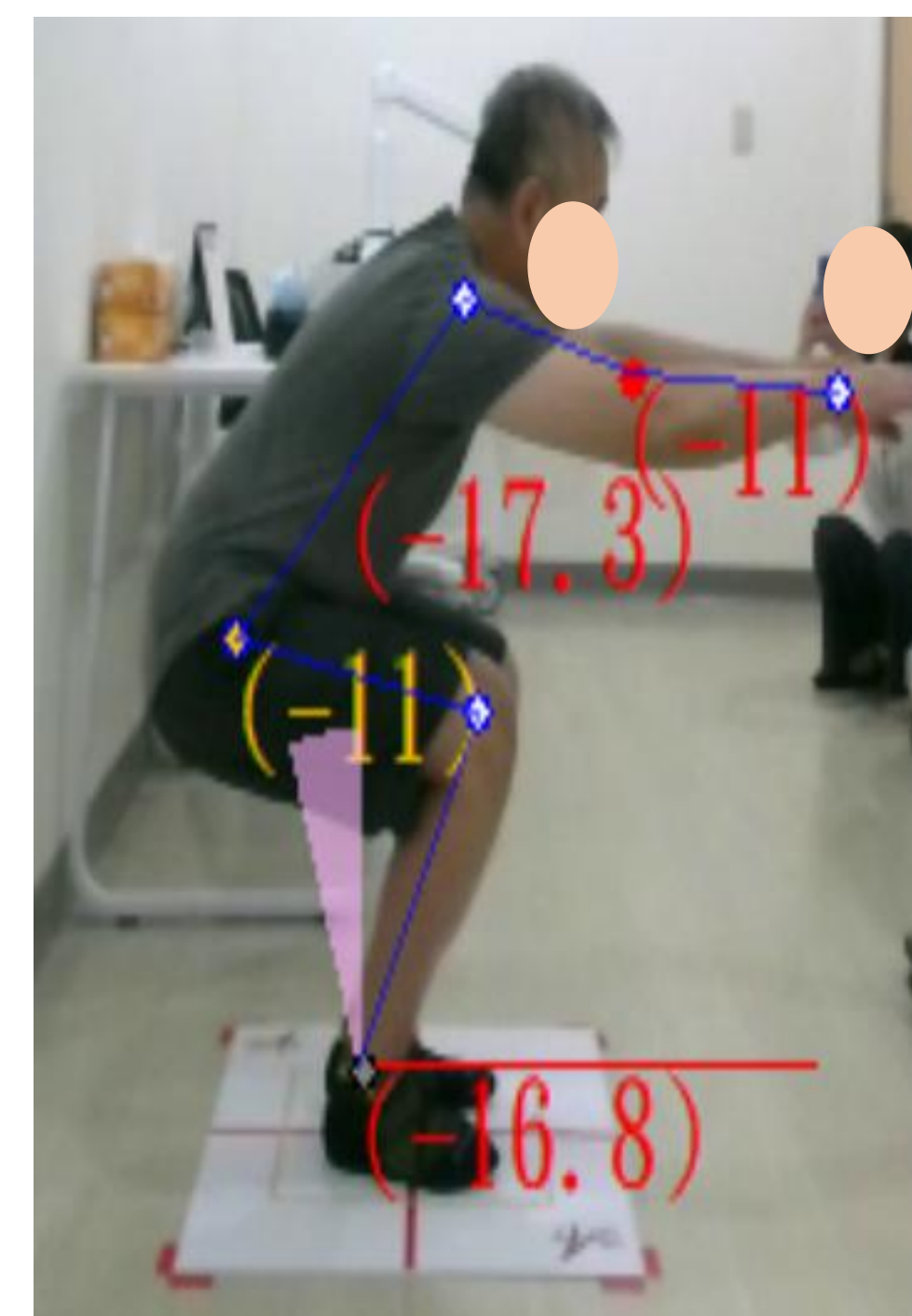
Developed by EZAI HEALTH CO., LTD. based on more than 12 years of R&D in AI-assisted biomechanics and corrective movement training, this AI-assisted movement assessment and corrective training framework integrates the eAi 5S model and REPAIR system to evaluate posture, movement dysfunction, and neuromuscular control. The eAi 5S model includes static structural analysis, dynamic three-chain performance assessment, AI posture evaluation, dynamic movement screening, and ABCDEK biomechanical cueing. Functional screening included assessments of cervical mobility, upper-limb mobility, trunk motion, squat performance, and balance control. The REPAIR framework (Recognize, Evaluate, Physical modeling, Analyze, Issue correction, Reinforce control) combines AI posture analysis, movement modeling, and individualized corrective exercise prescription based on RSAI principles (Release, Stretch, Activate, Integrate). Camera-based image and video analysis were used without wearable sensors. Home training with remote physiotherapist feedback was incorporated. The system was clinically implemented in collaboration with Tri-Service General Hospital.

Results

The eAi agent system enables rapid and objective assessment of movement quality and postural control. Static posture can be captured through a 3-second image acquisition, while functional movements are recorded via 6-second video clips. Within approximately 10 seconds after data upload, the system generates a structured assessment report summarizing postural alignment, movement quality, and potential neuromuscular control deficits. The AI model identifies dysfunctional movement patterns and analyzes underlying muscle imbalances, highlighting specific muscle groups associated with impaired control. Based on these findings, the system provides personalized exercise prescriptions, including corrective movement strategies and muscle strengthening programs. The framework translates complex biomechanical concepts into structured and interpretable outputs, facilitating efficient training and learning. In 2026, the system was implemented in clinical practice at Tri-Service General Hospital; preliminary feedback from patients and physical therapists suggested favorable acceptance of the platform.

Conclusions

Developed by EZAI HEALTH CO., LTD. and clinically implemented at Tri-Service General Hospital, the eAi agent system provides a rapid, camera-based, and structured approach for identifying movement dysfunctions and supporting individualized corrective training. Through AI-assisted visual feedback and biomechanical cueing, the framework may support movement control and neuromuscular re-education. **Contact information: juodo87@gmail.com**



eAi REPAIR Smart Movement Control Agent System

Overcome Movement Dysfunction: Apply AI Biomechanics and Restore the Body's Original Motion Design

5 Steps (S1-S5) to Experience the Body's Original Motion Design

- S1. Static Structural Foundation**: Learn the anatomy of the head/neck, trunk, pelvis, upper limbs, and lower limbs; understand the physics behind movement; avoid blind training.
- S2. Dynamic 3-Chain Performance**: Understand how the body "machine" works through the bone-joint, muscle-fascia, and neural-control chains.
- S3. Static Posture Assessment**: Use eAi posture assessment to detect joint angles and deviations in real time.
- S4. Dynamic 3-Chain Screening**: Assess 7 movement patterns to identify priority weak links.
- S5. eAi ABCDEK Cueing Demo**: Use proprietary biomechanical cues to master training movements.

Step S1. Static Anatomy & Original Design
Humans are biological systems. Understanding physical laws helps prevent movement dysfunction.

- Head**: initiates motor-control commands.
- Cervical spine**: stabilizes rotational transmission.
- Thorax**: supports breathing mechanics and energy.
- Core (Lumbar-abdominal)**: provides cylindrical support for the spine.
- Pelvis**: central support hub and force-transfer center.
- Lower Limbs**: connect ground-reaction force and drive locomotion.
- Upper Limbs**: enable fine movement and tool use.

Step S2. Three Dynamic Chains & Original KPIs
Use the three dynamic chains to understand how the body maintains balance during movement.

- Bone-joint chain**: the body's chassis; determines lever mechanics and joint mobility.
- Muscle-fascia chain**: the motor system; determines muscle length, force, and plantar-fascia tension.
- Neural-control chain**: the control system; governs center-of-mass range, stability, and balance.
- AI detection**: captures compensatory movement and identifies weak links.
- ABCDEK hints**: synchronizes all three chains to improve structural balance.

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Step S3. eAi Static Posture Assessment: Identify Structural Imbalance

- eAi marker points: the subject stands naturally on preset floor markers.
- AI real-time capture: a posture-deviation report is generated within seconds.
- Imbalance analysis: deviations may indicate strength or motion-control imbalance, structural loading, or movement dysfunction.
- Step S4 further breaks down movement to identify weak-link categories. eAi coaches provide effective movement lists and ABCDEK cues (Step S5) for corrective training.

Step S4. Dynamic Three-Chain Assessment: Self-Check Weak Links

- Neck / Cervical Mobility**: Flexion: chin touches sternum; trunk upright. Extension: face-to-ceiling angle <math> < 10^\circ </math>. Head rotation: chin reaches the shoulder and about 1/2 clavicle length.
- Shoulder / Upper-Limb Mobility**: Left hand above: fingers reach the opposite scapula from both directions. Right hand above: fingers reach the opposite scapula from both directions.
- Trunk — Multi-segmental Flexion**: Fingertips reach toes. Weight shifts backward; spine forms a smooth curve. Sacral angle >math> > 70^\circ </math>.
- Trunk — Multi-segmental Extension**: Elbow line passes behind the shoulder joint. Upper trunk / thoracic rotation >math> > 50^\circ </math>. ASIS moves ahead of the toes. Scapula moves behind the heels.
- Trunk — Multi-segmental Rotation**: Upper trunk / thoracic rotation >math> > 50^\circ </math>. Lower quarter / lumbar + pelvis rotation >math> > 50^\circ </math>.
- Squat — Deep Squat Test**: Arms stay overhead throughout the movement. Tibia and trunk stay parallel or more upright. Thighs move below horizontal. Knees align over ankles. No excessive effort, weight shift, or motor-control issue.
- Stand — Single-Leg Balance Test**: Lift one leg to hip height; hip and knee flex to 90°. Shoulders and pelvis nearly parallel. Eyes open: stable 10 sec. Eyes closed: stable 10 sec.

Step S5. eAi Movement List & ABCDEK Biomechanical Cues

Demo Pose: Dead Bug

Step S5. ABCDEK Biomechanical Cues — Dead Bug Example	
A Starting Position	Supine on floor; shoulders flexed 90°; hips and knees flexed 90°.
B Joint Configuration	Right shoulder flexion 45°; left hip extension 45°; spine remains neutral.
C Target Muscle Group	Core muscles.
D Sensory-Motor Control	As limbs move away from the trunk, abdominal muscles contract and feel braced.
E Time / Frequency	10 reps per side per set; 3 sets per session.
K KPI	Stable, balanced, no compensation.

ABCDEK converts biomechanics into clear, repeatable coaching cues.

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eAi REPAIR Ai Movement Co-training Agent

From toe alignment to whole-body movement, your AI Agent helps safeguard your movement health!

Recognize Body Region Awareness
Link to the Self-Assessment Form with body region self-screening

Reinforce Proprioceptive Motor Control
Apply the eAi Agent ABCDEK framework to enhance self-directed motor control. eAi REPAIR Training Videos

Issue Correction AI-Guided Exercise Selection
Real-Time Exercise Q&A for Optimal Exercise Selection. Integrated with the eAi Agent

Evaluate weakness eAi-KFC Weakness Evaluation
Assess muscle imbalance in eAi-KFC standing & squatting postures. Standing Posture Report Interpretation. Squat Posture Report Interpretation. Interpretation of 29 Common Postural Deviations.

Physical model Ai Movement Modeling
Understand the neuromuscular principles of standing, squatting, and walking. Integrated with plantar pressure assessment. Movement Guide / Body Movement Guide.

Analyze Active Identification of Muscle Imbalance
Analyze & develop awareness of the 7 major body regions through 3-kinetic-chain self-screening. Three Kinetic Chain Self-Screening Form.

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