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A Proposal for a AI-Based Early Screening and Medical Referral System for Neurological Impairment

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Introduction

Despite the escalating prevalence of neurological disorders in the aging population, a significant number of patients miss the optimal intervention period due to the misinterpretation of early neurological deficits as age-related physiological changes. Conventional neurological evaluations primarily rely on in-person clinical assessments, which often lack the ecological validity required to detect subtle functional impairments in daily living. **This study proposes an integrated screening platform that digitalizes the Fugl-Meyer Assessment (FMA), a gold standard in clinical practice, using smartphone-artificial intelligence (AI)-based pose estimation technology to facilitate early detection and seamless medical referral.**

System Design

The proposed system utilizes the components of the FMA and operates through a three-stage process.

- **Step 1. Kinematic data acquisition:** The system performs real-time joint trajectory tracking via a smartphone camera to extract quantitative kinematic parameters, including range of motion (ROM) and movement velocity. Notably, it utilizes deep learning algorithms to identify pathological synergy patterns and compensatory motor strategies characteristic of upper/lower motor neuron lesions.
- **Step 2. Automated FMA scoring engine:** Captured kinematic data are mapped onto the FMA's 3-point ordinal scale (0–2). If the performance fails to reach the clinical cut-off (2 points), the system flags the movement as a prodromal sign of neurological impairment and triggers a targeted clinical questionnaire to further evaluate subjective sensory-motor deficits.
- **Step 3. Decision support & medical referral:** By synthesizing FMA scores and patient-reported outcomes, the system stratifies risk levels. For high-risk individuals, it provides geolocated referrals to specialized rehabilitation facilities and automatically generates a comprehensive kinematic report to support evidence-based clinical decision-making during initial consultations.

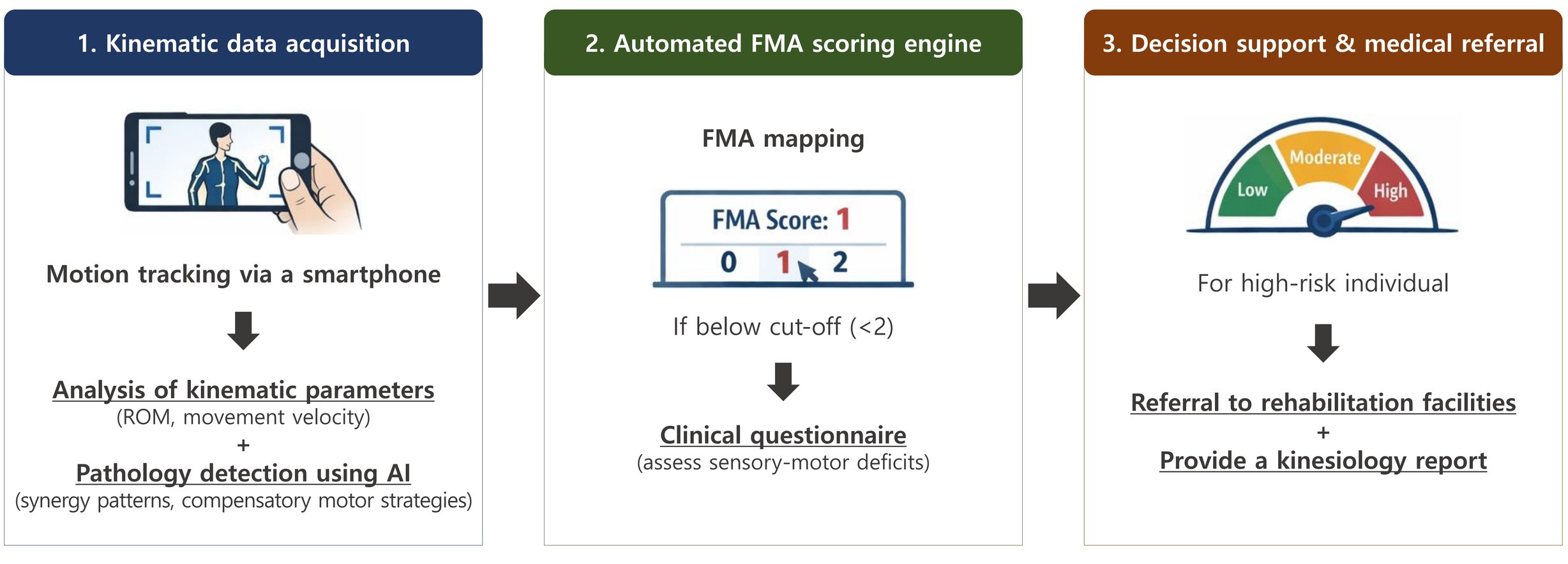

Figure 1. System design

Conclusion

This study demonstrates the potential of transforming the FMA into a digital biomarker for remote longitudinal monitoring. **Such a system could serve as a cornerstone for proactive rehabilitation, enhancing medical accessibility and preventing the progression of chronic disability.** Subsequent studies will focus on the clinical validation of the algorithm's sensitivity and specificity through comparative analysis with expert-led assessments in actual clinical settings.

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