GaitKeeper: Revolutionising Standardised Gait Speed Measurement with AI-Enabled Mobile Technology

N. Davey 1,2, G. Harte 1,5, A. Boran 3,4, P. Mc Elwaine 1, 2, S P Kennelly 1,2,4

1. Institute of Memory and Cognition, Tallaght University Hospital, Dublin, Ireland. 2. Department of Medical Gerontology, School of Medicine, Trinity College Dublin, Ireland. 3. Insight Centre, Dublin City University, Ireland. 4. Digital Gait Labs, Dublin, Ireland. 5. Department of Physiotherapy, Tallaght University Hospital, Dublin, Ireland.

Tallaght University Hospital | Ospidéal Ollscoile Thamhlachta

An Academic Partner of Trinity College Dublin

Background

Gait speed, often termed the 'sixth vital sign,' is a key health indicator in older adults, predicting morbidity and functional status. (1)

This study evaluated **GaitKeeper**, a mobile technology enabled by artificial intelligence (AI) and augmented reality (AR), to standardise gait speed measurement and address inconsistencies in traditional clinical assessments.

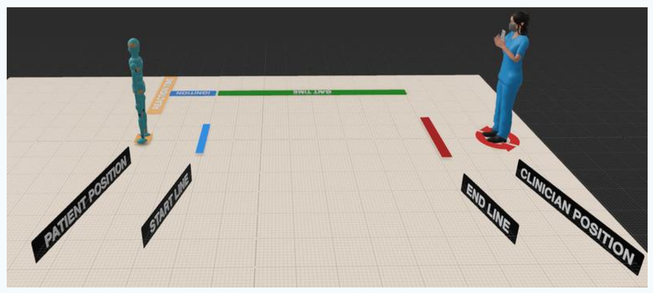

Figure 1. GaitKeeper's AR Gait Lab: Virtual Walkway. This illustration depicts a clinician with a smartphone, positioned beyond the end line, more than four meters away from the patient. The patient is standing in front of the start line, ready to begin the walking assessment.

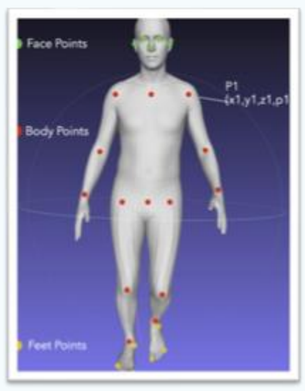

Figure 2. Twenty-five joint positions across the body are captured by GaitKeeper at a rate of 60 frames per second.

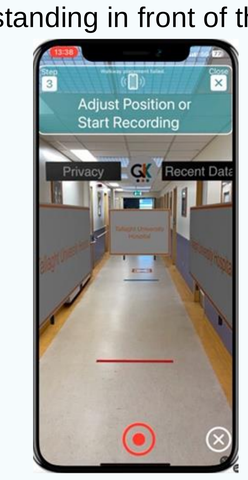

Figure 3. Clinician's view of the AR Gait Lab on a smartphone, showing the virtual walkway prepared for use just before the walking assessment is initiated

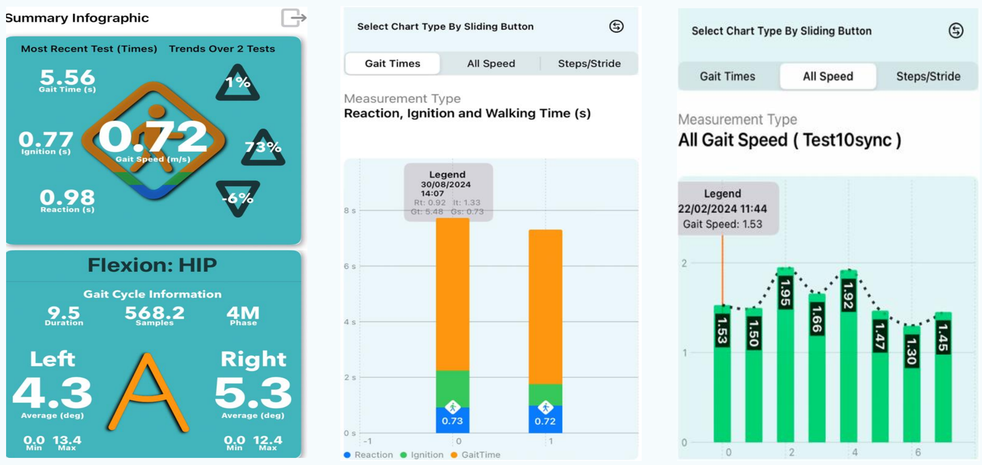

Figure 4. A visual representation of the clinician's phone screen displaying gait analysis results. It includes a summary infographic of gait metrics, hip flexion data, and interactive charts for reaction time, ignition time, walking time, and gait speed trends.

Methods

Study Design: GaitKeeper was validated against Vicon and GaitRite, two established gait analysis systems, in two phases for gait speed, stride length, and step length.

Phase One Validation:

- 35 healthy volunteers.
- Laboratory setting
- Comparison: GaitKeeper vs. Vicon.

Phase Two Validation:

- 30 participants with mild cognitive impairment
- Clinic setting.
- Comparison: GaitKeeper vs. GaitRite.

Results

Phase One: age: 20-32 years

- Gait Profiles: Gait speed range 0.8–1.2 m/s, stride lengths 65–80 cm, body swing <1 m
- Accuracy: GaitKeeper measurements within 2% variance compared to Vicon
- Correlation
- Gait Speed: Spearman's ρ = 0.947 ($p < 0.0001$) (Figure 5)
- Stride Length: Spearman's ρ = 0.989 ($p < 0.0001$)

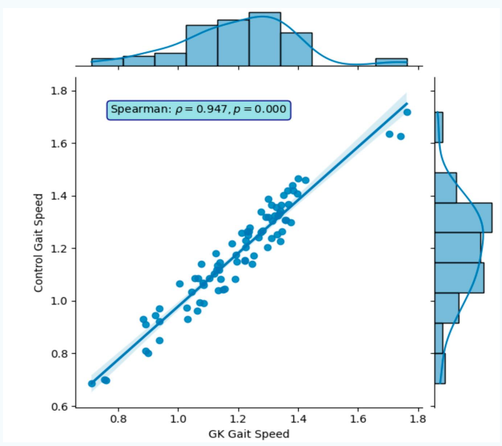

Figure 5. Phase One: Correlation between GaitKeeper and Vicon (gait speed) external consistency: Spearman coefficient 0.947 ($p < 0.0001$).

Phase Two: mean age 74 years

- Correlation (Figure 6)
- Stride Length: Pearson's r = 0.71 ($p < 0.0001$)
- Gait Speed: Spearman's ρ = 0.918 ($p < 0.0001$)
- Internal consistency: Pearson correlations: $p < 0.0001$ across all tests (Figure 7)

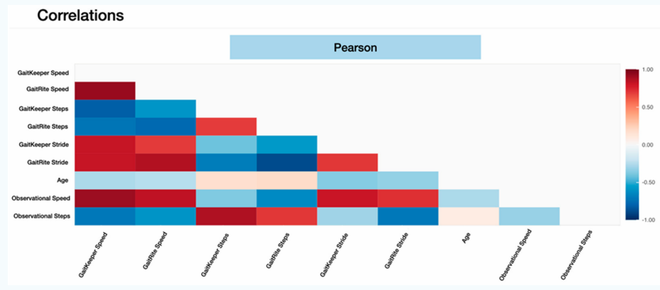

Figure 6. Phase Two: External consistency: Pearson correlation coefficient ($p < 0.0001$ all tests).

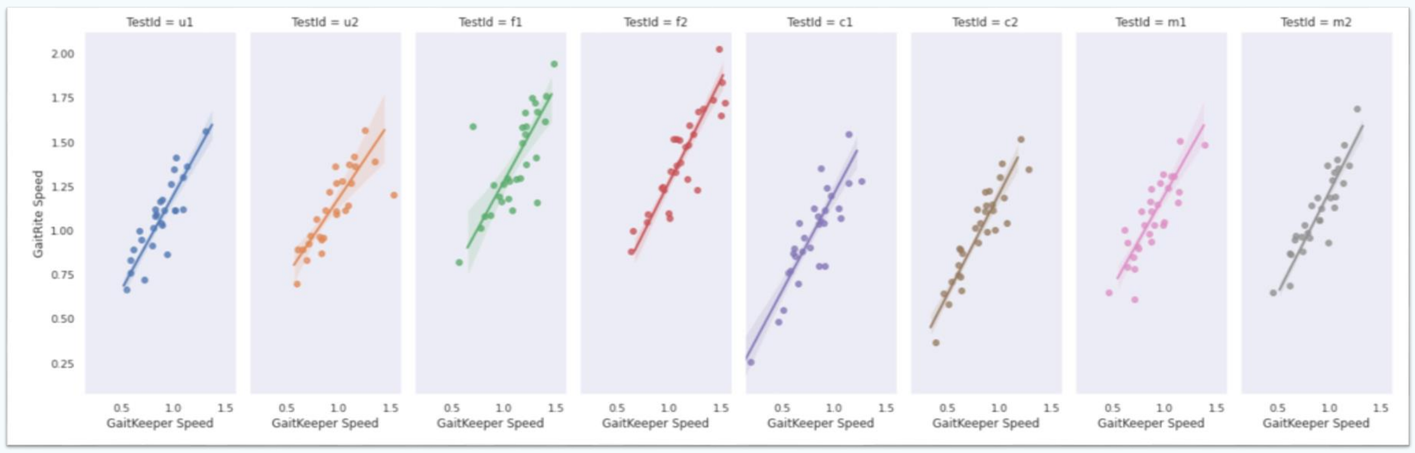

Figure 7. Phase Two: Internal consistency across multiple test conditions (Pearson correlation coefficients, $p < 0.0001$)

Strong agreement with both Vicon and Gaitrite

Accuracy within 2%
of established systems

Conclusion

- **Proven Reliability**: GaitKeeper delivers prompt, standardised measurements with high external and internal consistency.
- **Longitudinal Monitoring**: Supports management of chronic conditions and rehabilitation programmes.
- **Versatile Deployment:** Suitable for diverse settings, from hospitals to home-based environments.
- **Transformative Potential:** Addresses limits of routine assessments, paving the way for broader adoption in clinical practice.

Reference: (1) Fritz S, Lusardi M. White paper: "walking speed: the sixth vital sign". Journal of geriatric physical therapy. 450 2009;32(2):2-5.