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Towards a Smart Home for Older Adults with Multiple Sclerosis

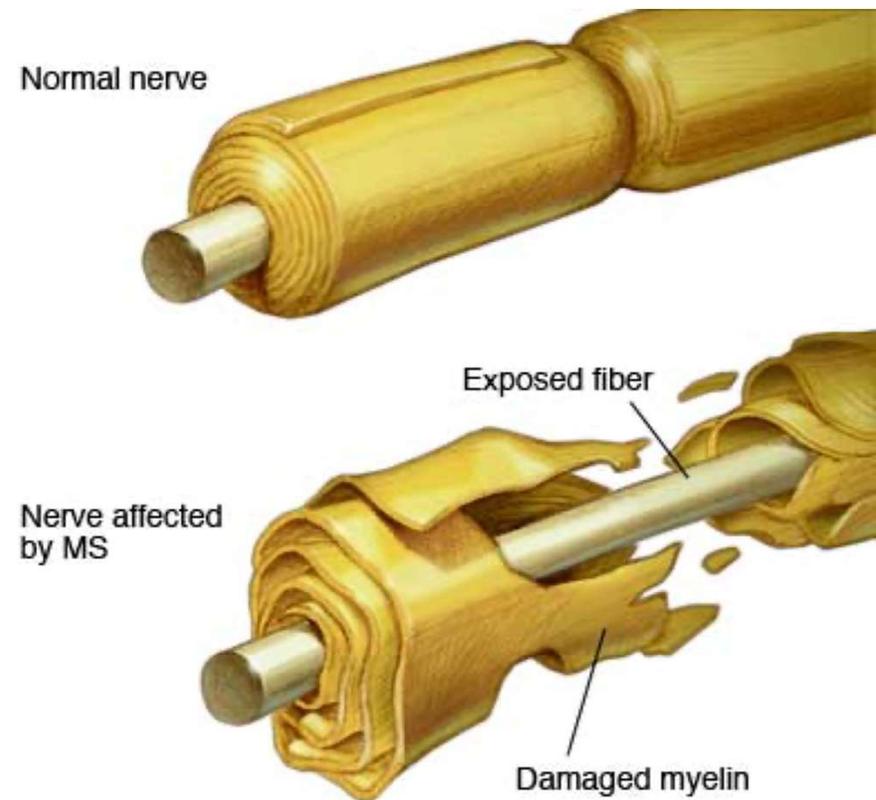
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Multiple Sclerosis (MS)

- Autoimmune disease affecting nerve-insulating myelin
- 2+ Million people affected worldwide
- Typically diagnosed between 20-50 years of age
- Peak prevalence of MS shifting to older age groups¹



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1. Marrie, et al., 2011.



MS-related declines

- Attention and executive function are crucial for cognitive control of mobility in persons with MS²
- Declines in balance, mobility, strength, sensory, cognitive, and mental health function expected from MS³

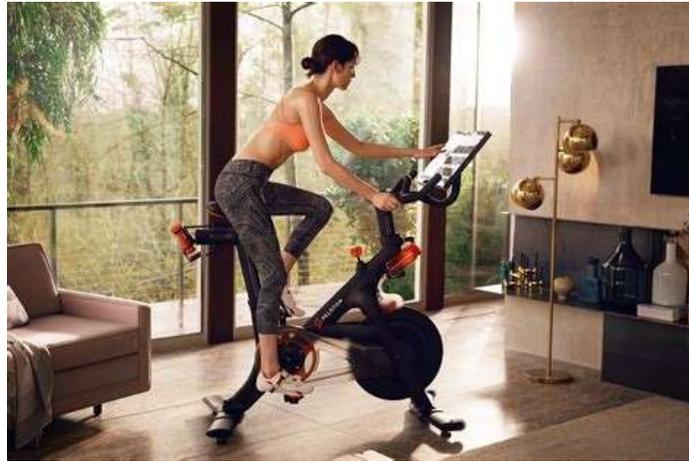


Barriers to engagement with physical activity

- Despite benefits, exercise participation remains in low in persons with MS⁴
- Lack of physical activity could be due to **personal, environmental, and societal barriers**⁵



The good news...



Intelligent Home Exercise System for Motor-Cognitive Rehabilitation

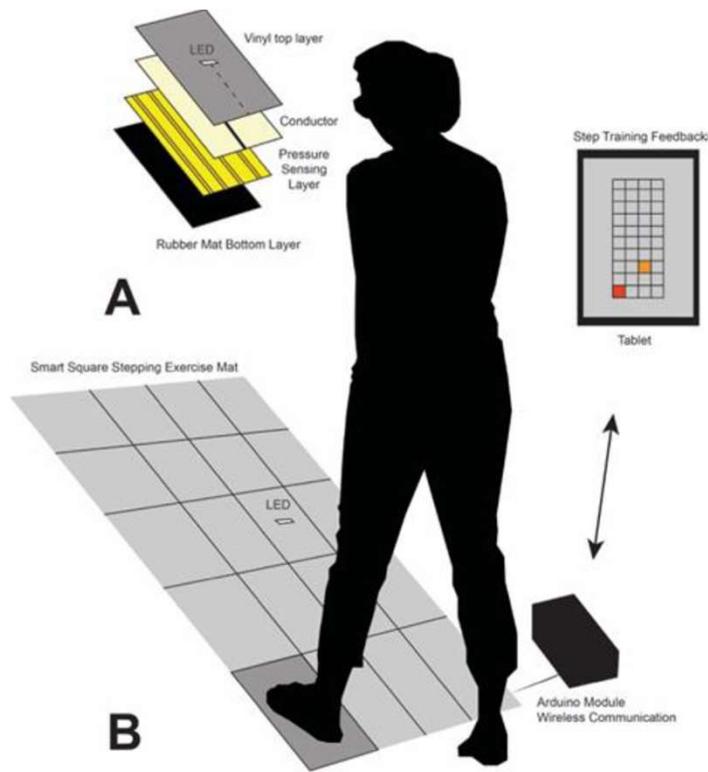
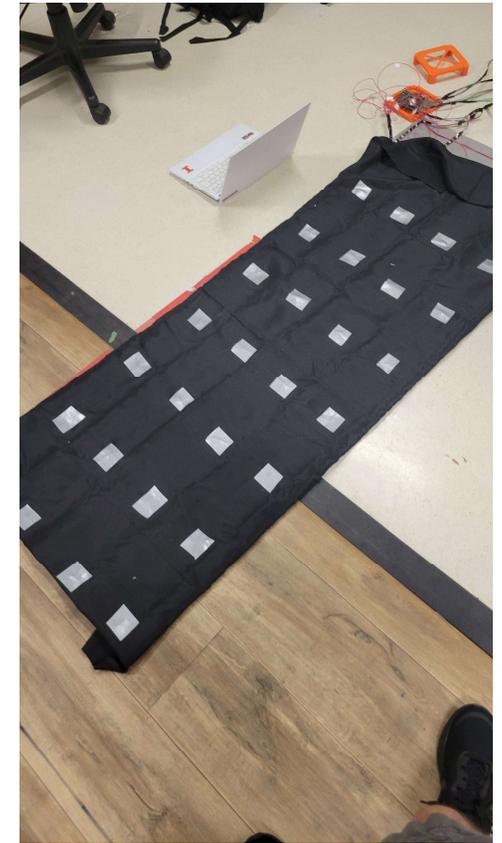
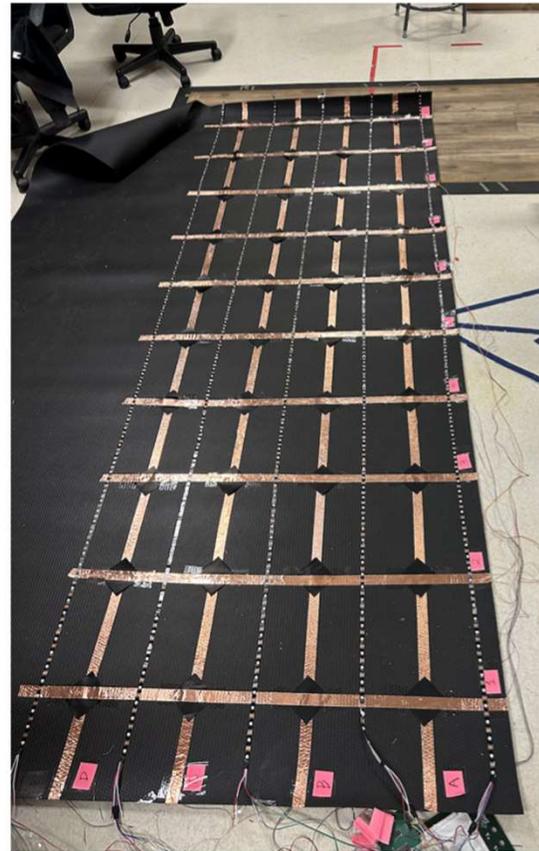


Figure 1. A) Cross-section of sensing mat, and B) Smart Square Stepping Exercise Mat (s-SSE) system.



Smart Insoles for Fall Risk and Frailty Prediction

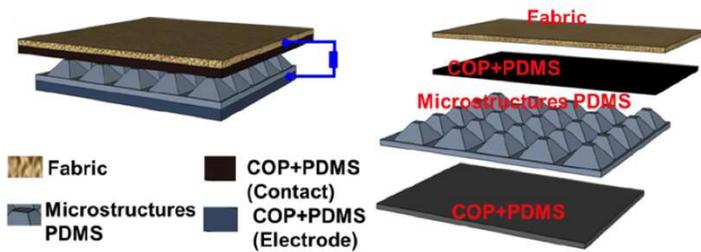


FIGURE 1: OVERVIEW OF THE CARBONIZED ORANGE PEEL TRIBOELECTRIC SENSOR



Wearable device attached on the sandal

Dimensions: 3 cm × 1.5 cm



Wearable device

FIGURE 2: PROTOTYPE OF THE CARBONIZED ORANGE PEEL TRIBOELECTRIC SENSOR



FIGURE 3: FINAL DEVICE ASSEMBLY ON USER

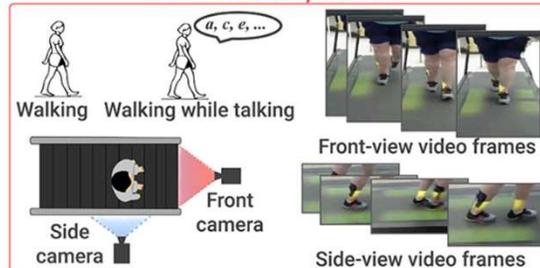
Computer Vision for Gait Impairment Identification

1
Experimental design

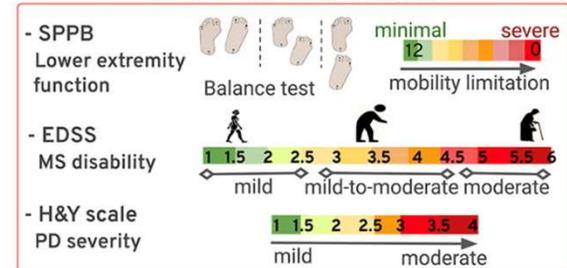
Inclusion & exclusion criteria

All	- Medically stable - No lower limb injury in past 6 months	- Normal vision - Right hand dominant
PwMS	- Mild to moderate disability (EDSS scores 1-6) - No relapse in past month	No other cognitive dysfunction
PwPD	- Mild to moderate severity (H&Y stages 1-4) - ON medication state	

Gait data acquisition

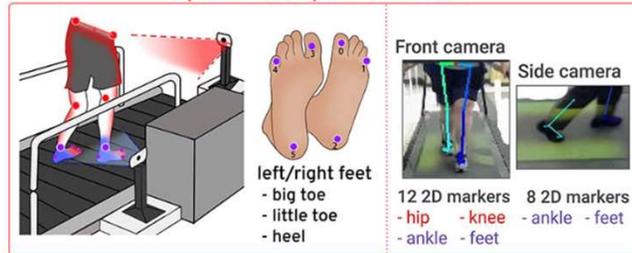


Clinical measurements

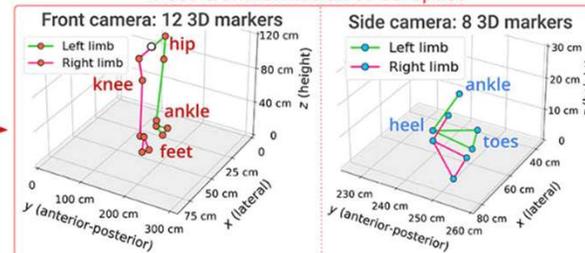


2
Gait video processing

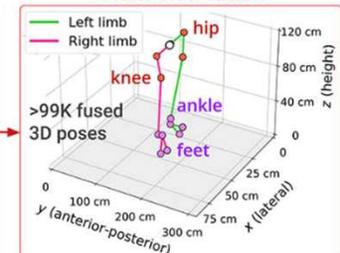
OpenPose: 2D pose estimation



Pose transformation to 3D space



Multi-view fusion



Next steps

- **Goal 1:** Evaluate prior work and refine system specifications, sensor selection, and system design.
- **Goal 2:** Build a (robust and reliable) hardware prototype.
- **Goal 3:** Evaluate user feedback.

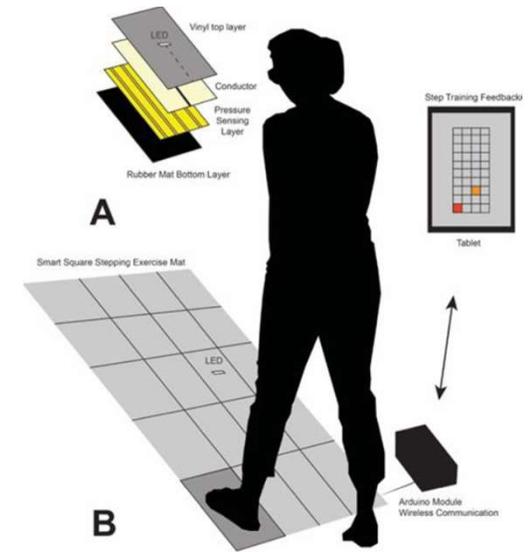


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Emerson Sebastiao



Robert Motl



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