

Can wearable technologies be used for out-of-clinic gait training to improve gait symmetry?

Wearable Biofeedback System for Lower-limb Amputee Gait Training

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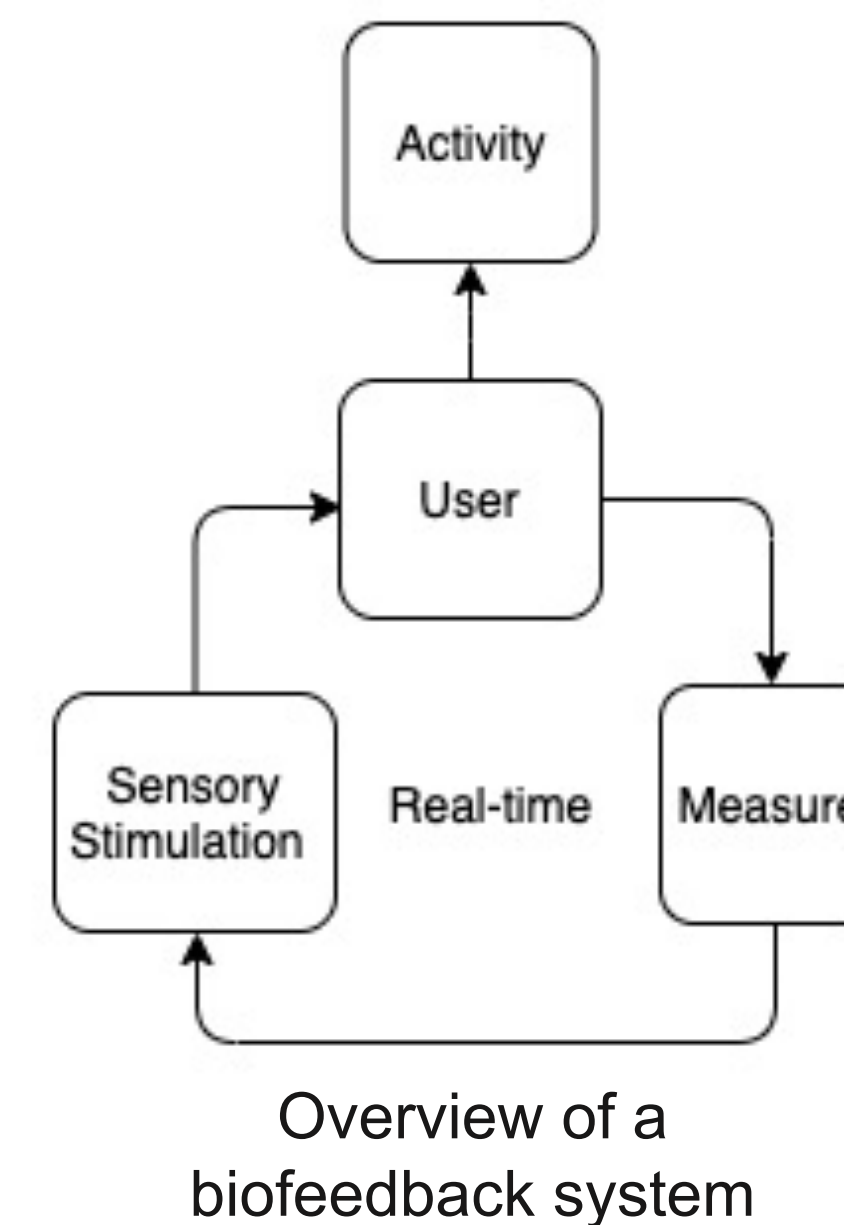
Introduction

Biofeedback (BFB) provides users with real-time feedback that can elicit changes in gait patterns. Two major gaps:

1. Integrating rhythmic stimulation (proven to improve gait symmetry and maintain speed) [1]
2. Validating wearable BFB systems in free-walking environments for gait training

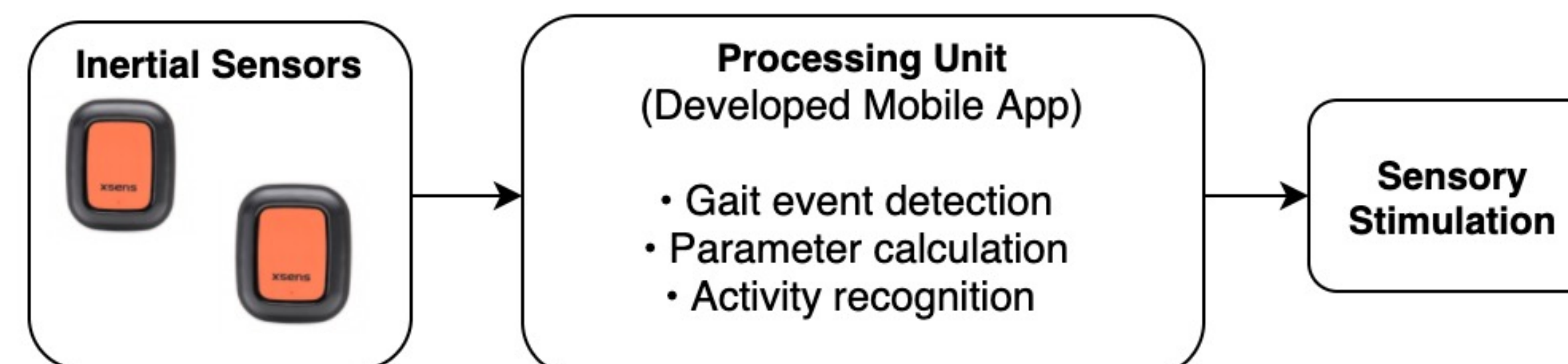
Objectives

1. Develop and validate a wearable BFB system using rhythmic stimulation (evaluate overall gait changes during training targeting stance-time symmetry)
2. Develop and validate an activity recognition algorithm to apply during BFB gait training



Methods

- Validate performance of wearable BFB system (developed mobile-app) targeting *stance-time symmetry* ratio
- Variable rhythmic stimulation – incremental
- Participants: able-bodied (n=10) and lower-limb prosthesis users (n=10)



Preliminary Results

- Gait parameter calculation based on gait event detection
- TO/HS timing errors significantly small for real-time BFB application*

Timing Error (ms)	AB	
	Right	Left
Heel-Strike	0.008 ± 0.015	0.010 ± 0.014
Toe-Off	-0.004 ± 0.01	0.000 ± 0.015

Timing Error (ms)	LLPU	
	Prosthetic	Intact
Heel-Strike	0.015 ± 0.011	0.011 ± 0.010
Toe-Off	-0.005 ± 0.008	0.007 ± 0.41

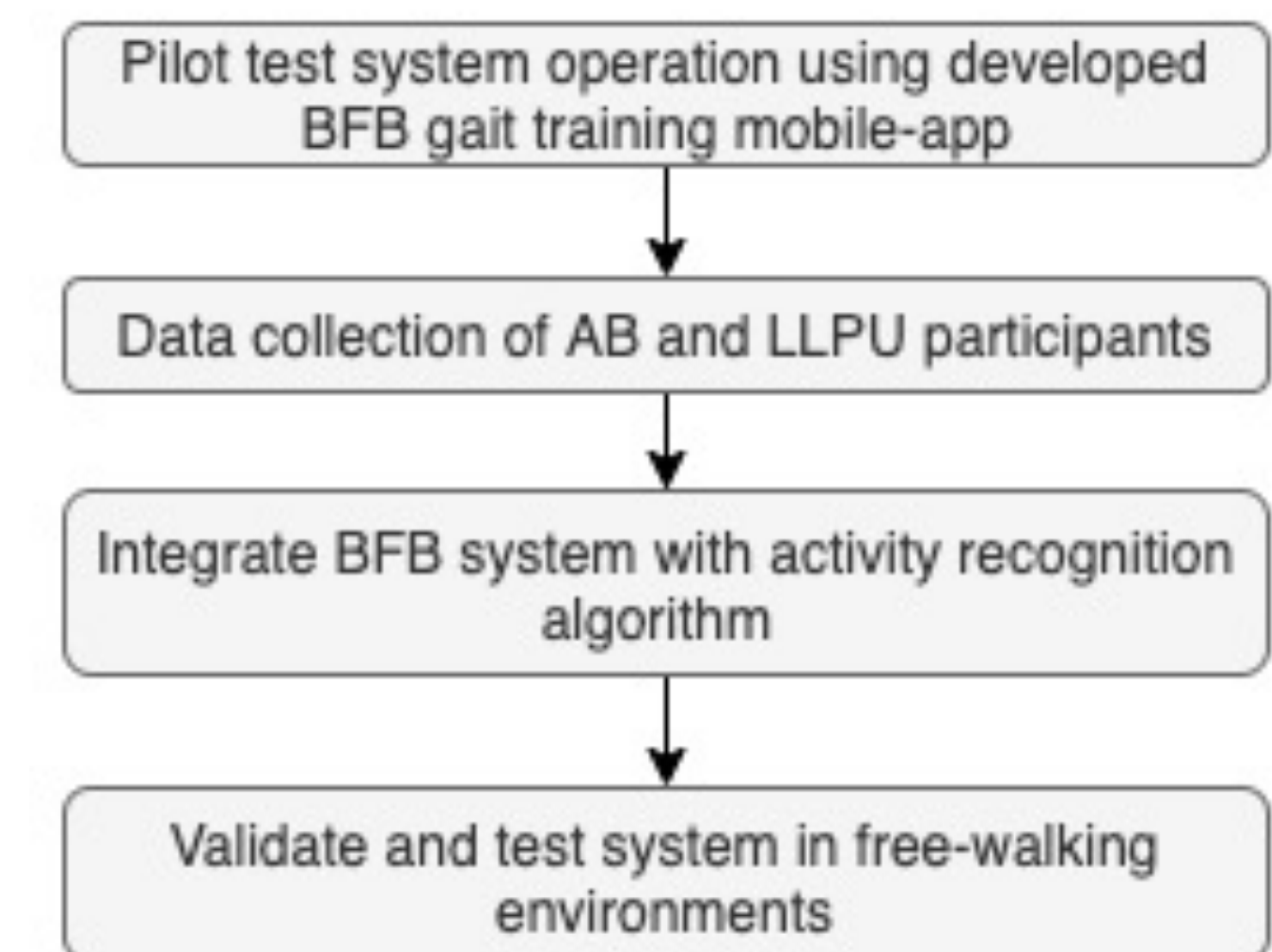
Significance & Impact

- Provides opportunity for gait training systems to move beyond the clinic, for youth and children with disabilities
- Biofeedback can help reinforce good gait habits
- Cost-effective and time-efficient solution
- Increased mobility → increased quality of life



Created by Massupa Kaewgahya from Noun Project

Next Steps



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References

[1] A. Michelini and J. Andrysek, "Evaluating the Effectiveness of Rhythmic Vibrotactile and Auditory Stimulation for a Biofeedback Gait Training System for Individuals with Lower Limb Amputation," *Canadian Prosthetics & Orthotics Journal*, 2021.



*This research study was approved by the Research Ethics Board at the Holland Bloorview Kids Rehabilitation Hospital, Canada. (REB-0102).