# Plantar pressure- based stride length and walking speed estimation

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## Introduction

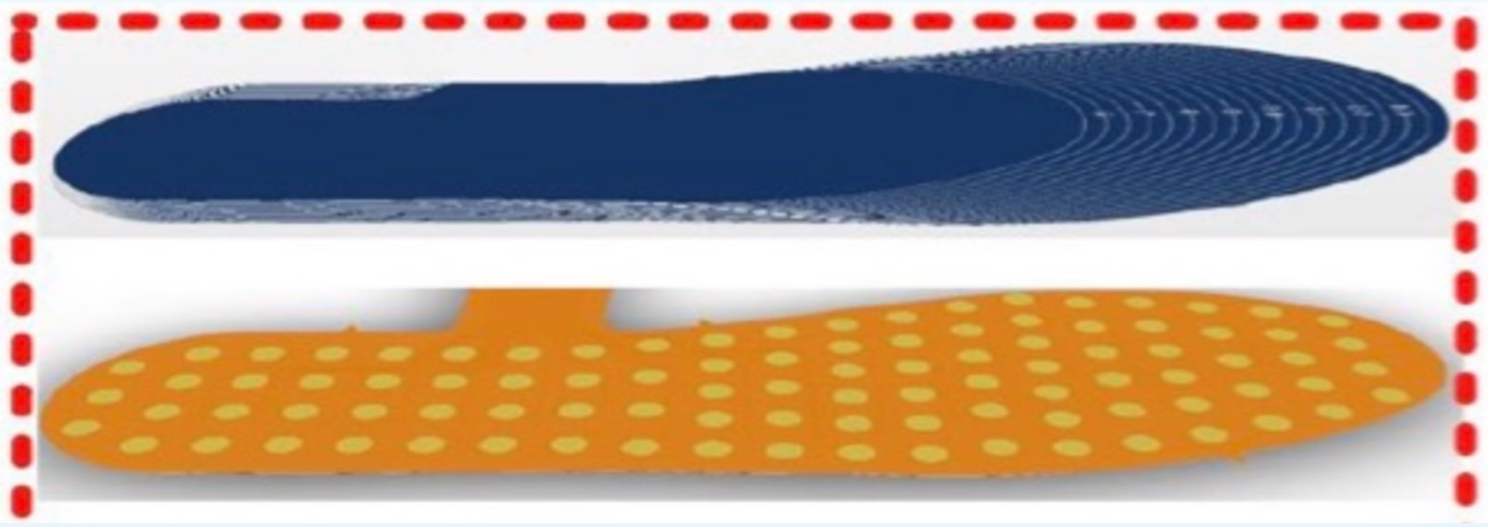
**Goal**:

This project aims to develop an algorithm to measure stride length with the smart insole data.

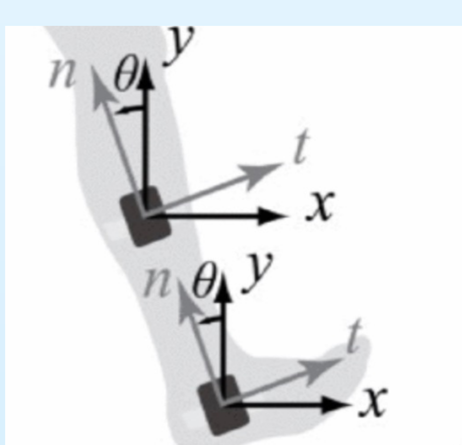
**Motivation:**

The smart insole will continuously monitor gait patterns, stride lengths, and biomechanical parameters during activities like walking and running. This data can provide insights for medical diagnostics of movement disorders, optimizing athletic performance, and monitoring rehabilitation progress

## Method



Smart Insole boasts 96 high-sensitivity sensors, providing a granular view of foot pressure dynamics.



**IMU**

**Motion-Tracking (Camera-Based):**

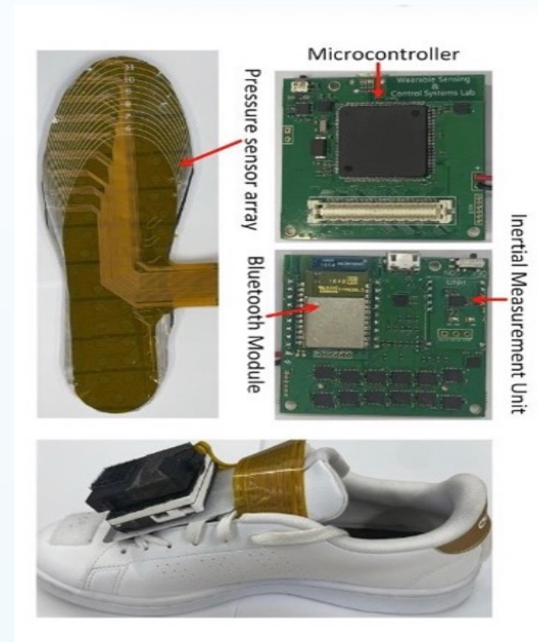
**Advantages compared with traditional method**

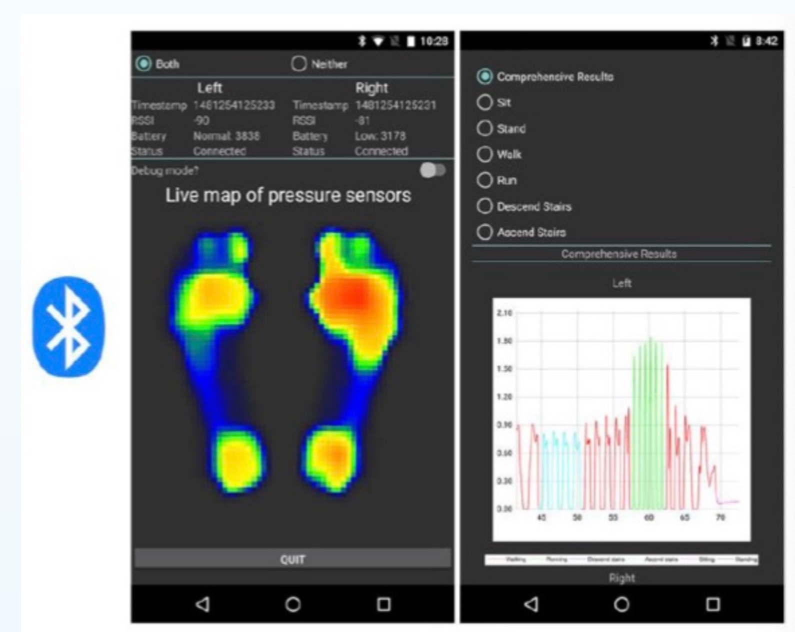
- Lower manufacturing and operational costs
- Highly wearable, compact, and unobtrusive.
- Easily integrated into daily routine.
- Automatic data transmission to paired devices

## Experimental Design

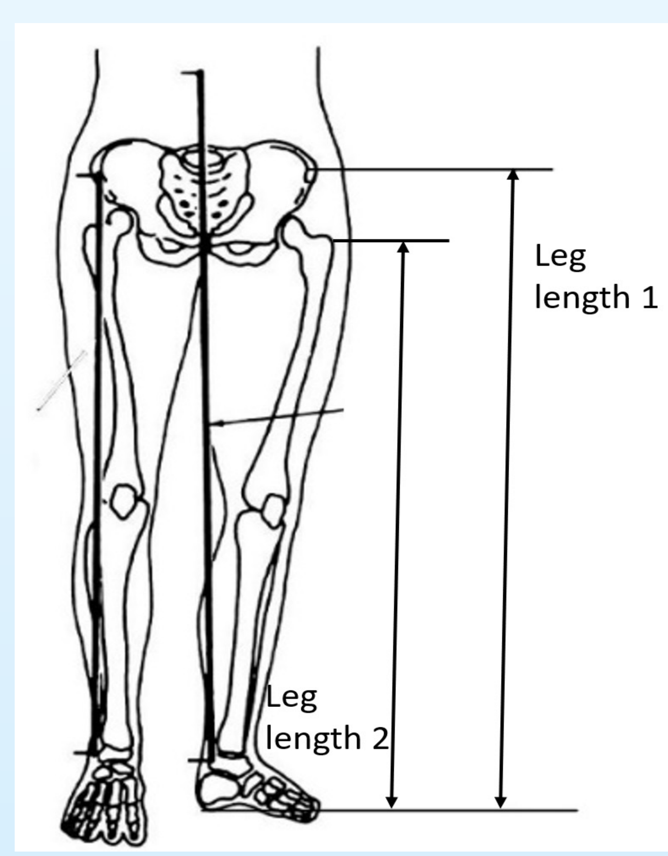
1. Set up the Smart Insole System by assembling the insoles with integrated IMUs, arranging the individual insole boards, and preparing protective shoe bags.

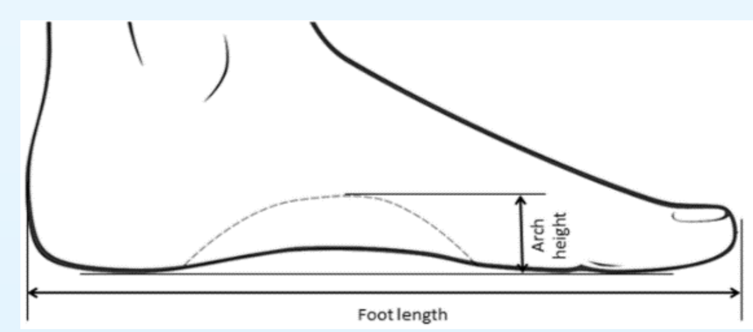
2. Prepare additional equipment, including smartphones for data acquisition and video recording, power supplies, camera stand, weighing scale, and measuring tape.

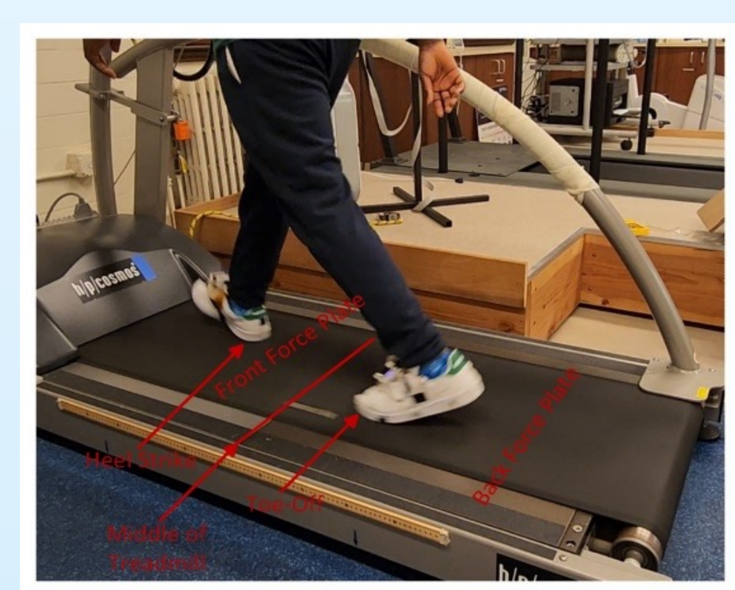



3.Collect participant's anthropometric data: a. Record participant's name and contact information. b. Measure and record body weight, height, leg length and foot length.



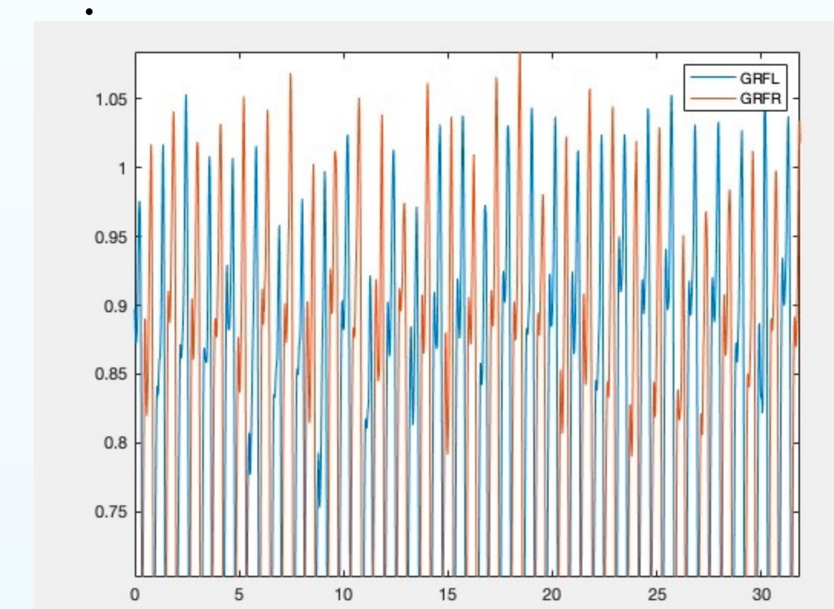



4. Set up the treadmill, camera, smart insoles, and participant for the walking trials at different speeds. Record insole bodyweight data as well as data from the walking trials at each speed, ensuring proper participant positioning and logging all necessary details.

## Software Design

- The MATLAB code
- Read pressure test data CSV files for different walking speeds (0.7m/s, 1m/s, 1.4m/s).
- Convert pressure resistance data to actual pressure values using the formula: pressure = 1266*(1/resistance)^3 + 417*(1/resistance)^2 + 32.95*(1/resistance) + 0.02068
- Calculate total ground reaction force (GRF) for left and right feet at each time point.
- Extract timestamps and convert them to actual time using a 50Hz sampling rate.




## Result

All features from both legs were used
Model trained and tested for stride length estimates of the left leg only.
1.Trained on 90% of the data and tested on 10% of the data
**Mean Absolute Error (cm):** 2.8257
**Mean Absolute Error(%):** 2.35

Only features from the IMU only were used.
Model trained and tested for stride length estimates of both legs.
1.Trained on 90% of the data and tested on 10% of the data
**Mean Absolute Error (cm):** 3.504
**Mean Absolute Error(%):** 3.103

## References

Diliang Chen (2019) Bring Gait Lab to Everyday Life: Gait Analysis in Terms of Activities of Daily Living. IEEE Internet of Things Journal, 7 ,1298 - 1312.