Live Demonstration: A High-Resolution Plantar Insole System for Lower Body Estimation

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***Abstract*—This work presents a high-resolution plantar pressure measurement system designed to capture detailed foot information for gait analysis. After training, the customized regression model can estimate lower body joints positions in real-time using foot pressure data. The demonstration will feature a UK size 8 insole, equipped with 253 resistive pressure sensors wirelessly connected to the server. Visitors will have the opportunity to experience walking with the insole, observing the plantar force distribution displayed and lower body joints as predicted by the model on the computer.**

I. Introduction

Gait analysis has been widely carried out with wearable sensors to monitor an individual's health conditions [1]. The changes of plantar forces distribution during various phases of a walking cycle can identify different body postures and motions. Several researchers have pointed out that these subtle force variations are essential for the prediction of lower body joints movement [2]. Current plantar pressure measurement systems mostly use a limited number of large sensors [3] and tends to neglect details in certain foot areas. Using a denser array of smaller sensors to predict lower limb joint motion has the potential for applications in rehabilitation and sports performance optimisation, though its potential has been relatively underestimated in existing methods [4].

In this demonstration, we present a high-resolution smart insole hardware system, consisting of flexible printed circuit board (FPC) base and a Kapton top layer that sandwiches the circular piezoresistive material (Velostat) as shown in Fig. 1. It can achieve visualization of comprehensive pressure heatmaps on the computer at a fast wireless transmission rate. Combining a customized Convolutional Neural Networks (CNNs) and Long Short-Term Memory (LSTM) model, it can predict six lower body joint landmark positions (left hip, right hip, left knee, right knee, left foot, and right foot) with a high coefficient of determination [5].

II. Demonstration Setup and Visitor Experience

A 253-resolution wireless insole system, an RGB camera and a laptop for predicting lower body estimation from the transmitted pressure data is provided in the demonstration. This demonstration allows visitors to wear the smart insole and observe their lower limb joints prediction through the laptop's GUI. To enhance the visitors' understanding of how the pressure-sensitive insole predicts lower limb dynamics, a classic human skeleton recognition algorithm using an RGB camera will be set up as a comparison group. After completing the experience with the control group, users will wear the smart insole and can observe their lower limb movements in real-time on the GUI. Additionally, a heatmap displaying the plantar pressure distribution will be shown as a reference for visitors.

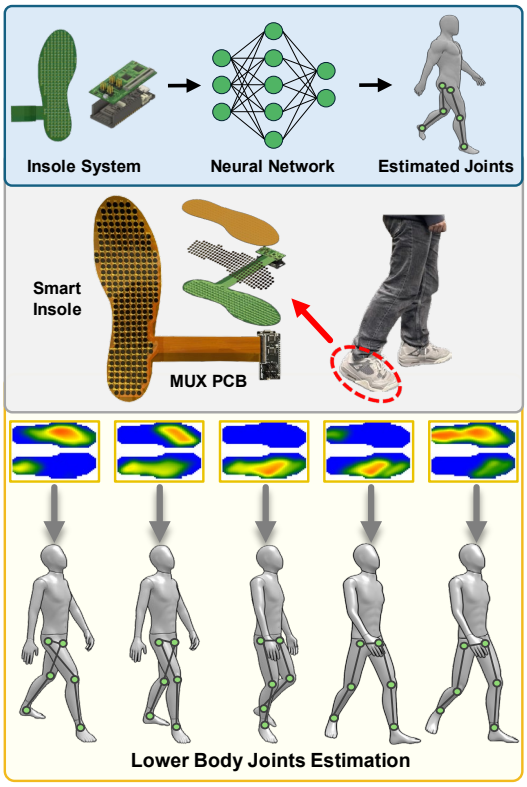

Fig. 1. Proposed smart insole system for demonstration

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