2026 IEEE International Symposium on Circuits and Systems (ISCAS) | 979-8-3315-7769-8/26/$31.00 ©2026 IEEE | DOI: 10.1109/ISCAS66217.2026.11562880

Live Demonstration: A High-Resolution Plantar with Crosstalk Compensation for Human-Machine Interaction

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***Abstract* — This work presents a method to compensate for undesired crosstalk commonly found in crossbar pressure sensor arrays. With a cleaner pressure image, more features can be extracted for finer human–machine interface (HMI) applications. The platform comprises a custom-designed resistive plantar plate, resistance readout circuits, wireless transmission via Wi-Fi, and a battery. These components together form the plantar sensing system. A neural network deployed on a laptop compensates for crosstalk effects and visualises interactive functions. The system captures subtle foot movements in all directions and fine pressure variations from toe contacts. Leveraging these micro-pressure dynamics, visitors can experience novel interactive controls and gaming through a customised HMI.**

I. Introduction

High-resolution plantar pressure measurement systems have shown great potential not only for continuous health monitoring [1] but also for intuitive foot-gesture-based control in human–machine interface (HMI) applications, particularly in crowded or medical environments [2], [3]. In this work, we first address the crosstalk issue inherent to low-cost crossbar sensor structures. To achieve similar performance without additional hardware, a compensation approach based on a U-Net neural network is developed and trained on paired datasets from diode-isolated and non-isolated insole systems. Compared with conventional zero-potential (ZPM) and multi-MOSFET switching methods, the proposed approach achieves high compensation accuracy at 93% while significantly reducing system power, cost, and size [4]. This method further demonstrates the potential of the plantar sensing platform in HMI applications, providing an alternative interaction modality for specialised industrial and medical scenarios. For demonstration, several interactive games have been designed to allow visitors to experience this foot-based control interface in real time.

II. Demonstration Setup

Fig. 1 shows the proposed plantar sensing hardware integrated with the HMI platform, which comprises the following components:

- **High-resolution wireless insole system:** Acquires data from 253 resistive pressure sensors at 30 Hz and transmits it to the laptop via Wi-Fi.
- **U-net neural network**: Runs on a GPU-enabled laptop to compensate for crosstalk and reconstruct accurate pressure maps.
- **The HMI experience**: Provides an intuitive platform for real-time gaming and control tasks, such as operating a 3×3 virtual button array and controlling robot motion.

This work was supported by the Rosetrees Trust [UCL-IHE-HA\1], the Engineering and Physical Sciences Research Council (EPSRC) [grant number UKRI1493], and the UCL NNTI Joint Lab fund.

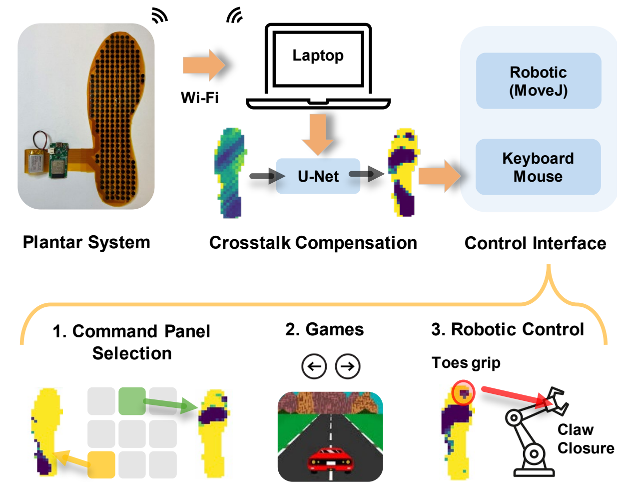

Fig. 1. Overview of the proposed plantar sensing and HMI interaction system.

III. Visitor Experience

Visitors will first wear the prepared insole system. After a brief instruction, they can interact with several integrated HMI demonstrations on the laptop. The first task involves selecting commands from a 3×3 virtual panel by shifting plantar pressure. The second is a driving game controlled by left–right balance movement. The third demonstration enables robotic control, where the user's foot centre of pressure guides the robot's motion and toe presses trigger the gripper's open–close actions. Through these interactive experiences, visitors can explore the potential of the smart insole as a novel human–machine interface for future applications.

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