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Pneumatically Controlled Wearable Tactile Actuator for Multi-Modal Haptic Feedback

1st Ahsan Raza
Computer Science & Engineering
Kyunghee University
Yongin-si, Gyeonggi-do, South Korea
ahsanraza@khu.ac.kr

2nd Mohammad Shadman Hashem
Computer Science & Engineering
Kyunghee University
Yongin-si, Gyeonggi-do, South Korea
ayon7019@khu.ac.kr

3rd Seokhee Jeon*
Computer Science & Engineering
Kyunghee University
Yongin-si, Gyeonggi-do, South Korea
jeon@khu.ac.kr

***Abstract*—This demo presents a wearable pneumatic actuator capable of delivering multiple types of tactile feedback, including vibration, static pressure, impact, and lateral force, using a single end-effector. The compact device consists of a 3D-printed structure with five soft silicone air chambers, pneumatically controlled via solenoid valves. At the conference, we will demonstrate real-time actuation control, including simultaneous multimodal feedback. A Unity-based VR environment will also be showcased, where participants can experience reactive haptic feedback while shooting targets or using tools. These scenarios highlight the actuator's responsiveness, versatility, and suitability for immersive and training applications.**

***Index Terms*—Multimodal tactile feedback, pneumatic, vibrotactile, pressure, haptic actuator.**

I. Introduction

We present a wearable, pneumatically controlled haptic actuator capable of delivering diverse tactile sensations including vibration, static pressure, impact, and lateral force, all through a single, compact end-effector. The device features five independently controlled air chambers enclosed in soft silicone air cells, housed in a lightweight 3D-printed structure. By modulating air pressure using solenoid valves, the actuator produces rich multimodal feedback suitable for various body locations. The actuator is designed for flexibility in use, allowing for attachment to the wrist, arm, or leg with a Velcro strap. It supports simultaneous actuation modes, enabling concurrent delivery of multiple tactile cues. With its strong performance, compact form factor, and adaptability, the actuator is well positioned for applications in virtual reality, simulation, cognitive training, and interactive systems.

II. Demonstration

We will demonstrate a wearable pneumatic actuator capable of delivering simultaneous tactile feedback through a compact, single end-effector. Attendees can wear the device and interact via a real-time interface to trigger vibration, pressure, impact, and lateral force individually or in combination.

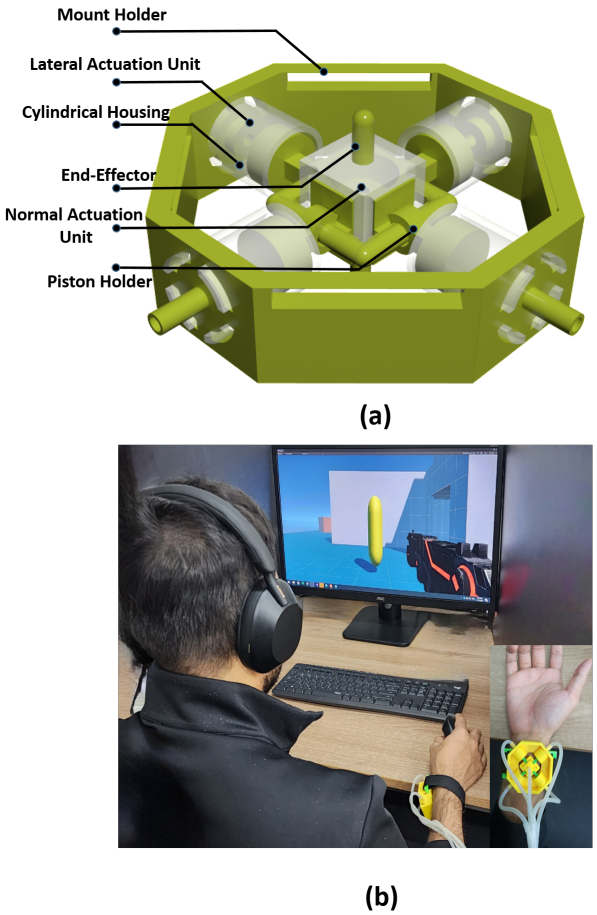

Fig. 1. (a) 3D design of the actuator. (b) Demo scenario: participant interacting with VR game while wearing the device.

A Unity-based VR scene will also be presented. In one scenario, users shoot targets and feel reactive haptic feedback. In another, participants use virtual tools and perceive tool-specific tactile cues. These demonstrations showcase the actuator's synchronized, context-aware feedback for immersive VR and training applications.

* Corresponding Author

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