Playing With Yourself: How Electrical Muscle Stimulation Can Turn Your Body Into A Playful Interface

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Imagine a game where your body is both the controller and the game. Our work explores how body-actuating technologies, such as Electrical Muscle Stimulation (EMS), transform the body into a playful interface, bridging physical and virtual worlds. While digital bodily games typically rely on external displays – creating a disconnect between the player's body and the virtual experience – we introduce the "Body as a Play Material" approach, where players loan control of their body to a computer via EMS. Building on the idea of self-competition, we designed three games in which players face off against their own EMS-actuated hand. In a seven-day study (n=12), players embraced loaning bodily control, enjoyed the ambiguity of computer-controlled movements, and were captivated by their hand's involuntary motions. By turning the body into a playful interface, this work opens new possibilities for interactive play that blurs boundaries between physical embodiment and virtual engagement.

CCS Concepts: • **Human-centered computing** → **Interaction paradigms**.

Additional Key Words and Phrases: bodily games, movement-based play, wearable interaction, integrated play, hand games, electrical muscle stimulation, body as a play material

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1 INTRODUCTION

Digital bodily games, such as those using Nintendo Wii and Ring Fit, promote physical activity [1] and foster bodily awareness [8], yet their reliance on external displays can create a disconnect between players and the virtual world [5]. Recent work calls for systems enabling body-actuating play – where the body serves as both input and output [7, 10].

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Table 1. Summary of themes, sub-themes, participant experiences, and related design considerations for creating engaging EMS-based gameplay experiences.

Theme	Sub-theme	Summary	Related Design Considerations
Loaning bodily control to a computer	Learning to adapt the body to turn it into a playful material	Participants adapted to EMS control, relaxing muscles and breathing to enhance actuation.	Encourage user relaxation and provide guidance for adapting their body to EMS control to enable seamless play experiences.
	Influence of the EMS hand's movement speed on gameplay	Speed of EMS movements affected playability and engagement; slower movements in some games caused challenges.	Design EMS movements to balance responsiveness and comfort, accounting for different game demands (e.g., fine vs gross movements).
Playfully engaging with the integrated computer	Varied attitudes towards the computer-controlled hand when playing games	Participants treated the EMS hand as a separate entity or competitor, fostering unique interactions and experiences.	Foster social play by enabling personalisation of computer-controlled body parts, including auditory and visual cues.
	Various ways to engage with the body during gameplay	Participants preferred some games and gestures over others; changing electrodes was tedious but varied engagement strategies were employed.	Simplify hardware setup and provide flexibility in engagement methods to reduce friction and maintain flow.
Playing with the ambiguity of computer-controlled body parts	Dealing with incomplete movements of the computer-controlled hand	Ambiguity in movements led to fun through prediction and adaptation, though calibration issues arose.	Leverage ambiguity to enhance engagement by designing systems that allow prediction and support multi-sensory feedback.
	Predicting the computer-controlled hand's gameplay	Participants enjoyed predicting EMS actions and worked as a team with the EMS hand in some scenarios.	Incorporate multisensory cues (e.g., sound) to improve prediction accuracy and enhance gameplay dynamics.
Bodily awareness when loaning bodily control to a computer to play	Reflecting on one's body due to the computer-controlled hand's performance	Participants became more aware of their body, linking play to mindfulness and reflecting on past bodily activities.	Design games that promote bodily reflection and mindfulness through simple, repetitive gestures and rhythmic patterns.
	Leveraging sensory cues and rhythmic movements to reflect on the body	Rhythmic movements and sensory cues helped participants focus and prepare for EMS control, enhancing bodily awareness.	Use rhythmic and sensory cues to guide user focus and create moments of bodily reflection, integrating these into gameplay loops.

We address this call by proposing the "Body as a Play Material" approach, which leverages Electrical Muscle Stimulation (EMS) to allow players to loan control of their body parts to a computer [6, 9, 10]. Drawing inspiration from the rhythmic, involuntary movements of EMS-controlled hands – reminiscent of rock-paper-scissors – we designed three games that enable players to compete against their own EMS-actuated hand. To investigate this, we developed three games and conducted a seven-day field study with 12 participants [2], uncovering four key themes (see Table 1) [9]. Intriguingly, participants often became so captivated by the involuntary movements of their EMS-controlled hand that they paused gameplay to observe and predict its actions.

This work contributes novel games, empirical insights, and actionable design considerations to bridge the gap between the physical and virtual worlds [4, 11]. Beyond entertainment, the "Body as a Play Material" approach holds promise for applications in fields such as motor rehabilitation, where it can support recovery and enhance bodily engagement [3].

2 CONCLUSION

In this work, we introduced the "Body as a Play Material" approach, where players use their body as both input and output via a body-actuating technology, such as Electrical Muscle Stimulation (EMS) [10]. By designing three games we demonstrated how players can engage in single-player bodily play, competing against their own body parts, controlled by a computational EMS system. Our findings highlight the potential of EMS to create engaging, playful experiences while promoting bodily reflection and mindfulness. Ultimately, by unifying the physical body and the virtual world, our work invites researchers and designers to explore the body as a central element of play, paving the way for more immersive and meaningful bodily experiences.

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