

Battle of Infections: Exploring Face-Adjacent Wearable Controllers for Embodied Play

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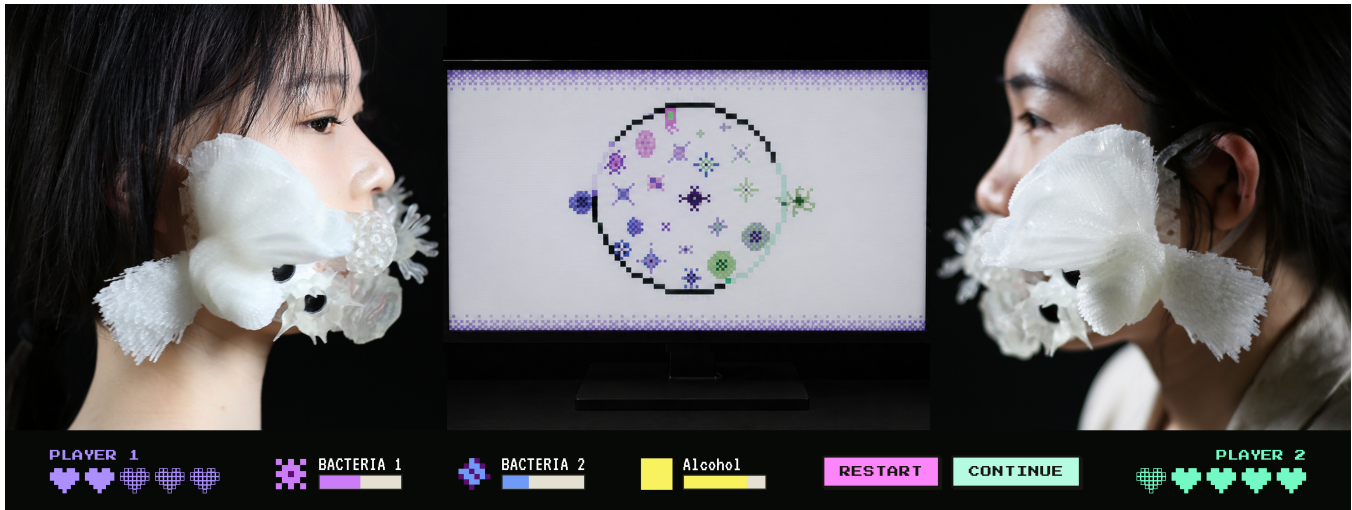


Figure 1: *Battle of Infections* connects two masked players with a pixel-based circular game interface, transforming cough-like sounds and near-face hand gestures into embodied game controls.

Abstract

Wearable games offer opportunities to move beyond handheld controllers by transforming the body itself into a site of playful interaction. In this paper, we present *Battle of Infections*, a wearable mask-based game prototype that explores cough-like sounds and near-face hand gestures as game controls. The project reframes socially awkward, face-adjacent bodily actions as speculative play: cough-like sounds trigger attacks, while near-face hand gestures steer bacteria-like agents in a circular game arena. The prototype combines a soft 3D-printed mask, embedded sound and distance sensors, and a pixel-based game interface, allowing players to connect bodily performance with in-game contagion mechanics. Through this early-stage prototype, we reflect on how wearable game interfaces can leverage semi-voluntary gestures, productive awkwardness, and controller-as-costume to expand the design space of embodied play.

*Both authors contributed equally to this research.

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CCS Concepts

• **Human-centered computing** → **Human computer interaction (HCI)**; *Interaction design process and methods*; *Gestural input*.

Keywords

Wearable games, embodied interaction, playful interaction, speculative design, mask interface, face-adjacent interaction

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1 Introduction

Digital games have long relied on handheld controllers, keyboards, touchscreens, and motion-tracking devices to translate bodily action into game commands. While these interfaces are efficient and familiar, they often reduce the body to discrete hand movements, button presses, or trackable gestures. Prior work in embodied interaction argues that interaction is not merely abstract input, but situated and socially meaningful action [3]. For games, this perspective opens a design opportunity: game control can be embedded directly onto the body, turning bodily expression, social visibility, and physical performance into part of play.

In this work, we focus on cough-like and face-adjacent actions as an underexplored design space for wearable game interaction.

Unlike button presses or joystick movements, coughing and near-face gestures are audible, visible, and socially charged. They can be intentional or accidental, exaggerated or suppressed, humorous or uncomfortable. We see this ambiguity not as a limitation, but as a productive material for designing playful wearable interfaces.

To explore this design space, we designed *Battle of Infections*, a two-player wearable game controlled through mask-based interfaces. Cough-like sound events trigger attacks, while near-face hand gestures control the movement direction of bacteria-like agents in a pixel-based circular arena. The mask combines a flexible 3D-printed base, embedded sound and distance sensors, and speculative biological aesthetics. It functions not only as a controller, but also as a costume and a physical extension of the game interface.

This paper presents an early-stage wearable game prototype that translates cough-like sounds and near-face hand gestures into embodied game controls. Through this case, we contribute design insights on semi-voluntary bodily gestures, controller-as-costume, and productive awkwardness in wearable play.

2 Related Work

2.1 Embodied Play and Wearable Games

Embodied interaction frames interaction not as abstract input to a system, but as situated and socially meaningful action. In games, this perspective has motivated a shift from controlling digital content through standardized devices toward designing experiences in which the body itself becomes part of play. Mueller et al. describe this shift as moving from using bodies to play with digital content toward experiencing the body itself as digital play [7]. Wearable games extend this design space by embedding interaction directly onto the player's body. Prior work on gaming wearables has shown that wearable interfaces can support performativity, sociality, role-playing, movement-based interaction, and bioadaptive play [2, 6]. Xiao et al. further show that wearable gaming interfaces shape not only control, but also comfort, agency, social experience, and game feel [9].

2.2 Alternative Controller Design

Prior work has explored reconfigurable controllers and textile game controllers as ways to probe how physical form, material affordances, and embodied manipulation can shape gameplay [4, 5, 8]. Mask-based interfaces have also been explored for discreet facial gesture input. For example, DUMask uses a face mask form factor to capture facial gestures through the tongue, lips, and cheeks [1]. These works suggest that controller design is not only a matter of input efficiency, but also a way of constructing the player's bodily relationship to the game. Building on this work, *Battle of Infections* explores wearable game control through semi-voluntary and face-adjacent bodily actions. Rather than treating the wearable controller only as an input device, we use it to connect bodily performance, role-play, and game mechanics.

3 Design Concept: *Battle of Infections*

3.1 Coughing as a Socially Charged Attack Metaphor

The design of *Battle of Infections* began with a socially charged bodily moment: coughing near another person. In everyday social

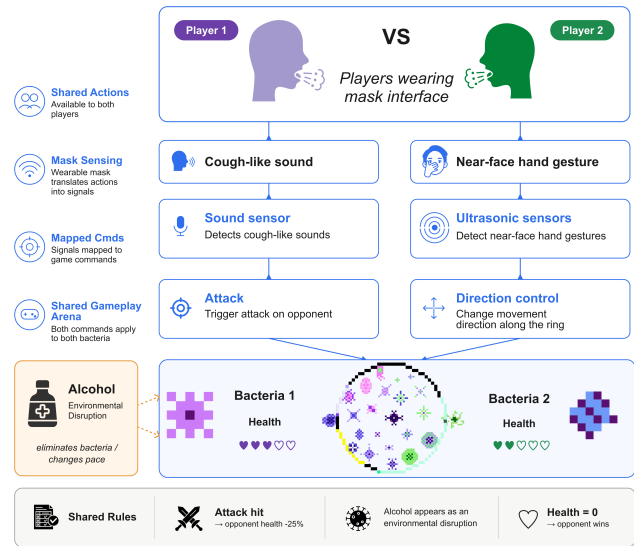


Figure 2: Interaction logic of the wearable mask interface. Cough-like sound events trigger attacks, while near-face hand gestures control direction changes.

life, coughing can feel awkward, visceral, or even threatening, especially when another person's body is nearby. As an embodied action, coughing is audible, visible, bodily, and sometimes involuntary or semi-voluntary. These social and embodied qualities make it an unusually expressive action for a competitive game, where each performed cough can become both a control command and a theatrical gesture of attack. Building on this association, we turn coughing into a playful form of attack: each cough-like sound event is mapped to an attack, as if the player were projecting bacteria outward toward the opponent.

This metaphor also led us naturally to the mask as the interface form. The mask sits directly at the site of breathing, coughing, and mouth-adjacent action, making it an appropriate wearable form for translating cough-like sounds into gameplay. By wearing the mask, players do not simply control bacteria on a screen; they physically perform a fictionalized version of contagion through their own bodies. The mask therefore connects the biological fiction of the game with the social reality of coughing and mask-wearing.

Through this design, we position the playful experience within a post-pandemic context in which coughing and masks carry heightened social meaning. A cough can be humorous, exaggerated, accidental, uncomfortable, or stigmatized; a mask can signal protection, vulnerability, intimacy, or strangeness. *Battle of Infections* does not aim to trivialize illness or public health concerns. Instead, it re-frames an uneasy and often suppressed bodily action as speculative play, asking how discomfort, contagion, and social awareness might become materials for embodied game interaction.

3.2 Gameplay Logic and Embodied Control

The core gameplay loop is intentionally simple. Each player controls one bacteria-like agent moving around a circular arena. A cough-like sound event triggers an attack against the opponent. A near-face hand gesture changes the movement direction of the player's

bacteria, enabling tactical repositioning along the ring. Alcohol appears as an environmental disruption: when a bacteria collides with alcohol, it is eliminated and the player must relaunch another bacteria from the starting point. Each player has a limited number of relaunch chances, represented through the health indicator. When one player's health reaches zero, the opponent wins.

As shown in Figure 2, the interaction design follows direct mappings between bodily action, sensing, and game mechanics. First, cough-like sounds are detected by the sound sensor embedded in the mask and mapped to attack actions. Second, near-face hand gestures are detected by ultrasonic sensors and mapped to direction control. These mappings create a small interaction zone around the player's mouth and cheeks, where sound, proximity, and near-face movement become playable resources.

This design makes the mask more than a passive wearable object. The player does not control the game through an external device, but through actions performed around the face: coughing, gesturing, reacting, and facing the opponent. The game therefore transforms breath-adjacent and face-adjacent actions into tactical resources. Players must coordinate the rhythm of their bodily actions with the timing of the digital game, turning semi-voluntary respiratory performance and near-face movement into part of competitive play.

3.3 Circular and Pixel-Based Interface

The game is designed around a simplified circular arena. Two bacteria-like agents move along the boundary of a ring-shaped cellular environment and compete through movement, timing, and attacks. This simplified structure supports the wearable interaction design. Because players control the game through cough-like sounds and near-face hand gestures, the digital game itself needs to remain legible and easy to parse. Instead of asking players to navigate a complex two-dimensional map, the circular arena focuses attention on two core actions: triggering attacks and changing movement direction. This allows the unusual bodily input to remain central to the experience.

The visual style further reinforces this design choice. The game interface uses a pixel-based aesthetic, with bacteria, alcohol, and cellular elements represented as simple, brightly colored forms. This style makes the microscopic environment visually playful rather than clinically realistic. It also contrasts with the tactile, organic, and translucent qualities of the physical mask, creating a tension between a low-resolution digital ecology and an expressive wearable artifact.

4 Wearable Mask Controller

In *Battle of Infections*, the mask functions as a controller, a sensing platform, and a visual extension of the game interface. By wearing the mask, players do not simply control bacteria on a screen; they physically take on a fictionalized biological persona. This section describes how the mask is constructed and how its functional and aesthetic design connects bodily action in the physical world with events in the digital game.

4.1 Layered Structure: Combining Sensing and Aesthetics

The wearable prototype consists of three layers (Figure 3). The bottom layer is a flexible 3D-printed TPU mask base that rests on

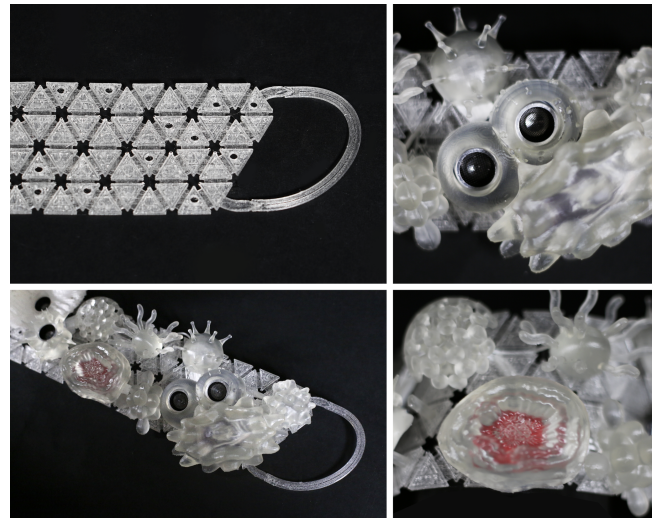


Figure 3: The mask consists of a flexible base layer, embedded sensing layer, and modular virus-like aesthetic layer.

the wearer's face and holds the electronic components. We designed the base with a modular structure, leaving openings where sensing modules can be inserted or repositioned. Although the current prototype uses a small set of sensors, this structure leaves room for future extensions, such as additional proximity, motion, or biosignal sensors that could support more complex game interactions.

The middle layer contains the sensing and wiring components, including one sound detection sensor, two ultrasonic distance sensors, and an Arduino Micro controller. The sound sensor captures cough-like sound events and maps them to attack actions, while the ultrasonic sensors detect near-face hand gestures and map them to direction control. At this stage, the prototype prioritizes interaction exploration over sensing robustness. The goal is not to develop a medically accurate cough detector, but to prototype an alternative bodily control vocabulary for wearable games.

The upper layer consists of modular virus-like shells that encapsulate and visually integrate the sensors. These shells help transform the electronic components into part of the mask's biological aesthetic. The visual language draws from microbial growth, translucent biological forms, and speculative fashion masks. Rather than hiding the interface, we designed it to be visibly strange, organic, and excessive. The semi-transparent material, modular virus-like forms, and sensor encapsulations create an artifact that appears both biological and synthetic.

Together, these layers allow the mask to operate as both a technical device and an expressive wearable object. The mask makes the player appear partially infected or transformed, reinforcing the game's contagion metaphor. At the same time, its visible strangeness creates a performative and slightly awkward social situation, which becomes part of the playful experience. In this project, the wearable interface is not designed to disappear; it is designed to be seen, performed, and negotiated.

4.2 Physical Extension of Game Interface

Beyond serving as a controller, the mask also extends the game interface into the player's physical space. The digital game presents

a microscopic arena where bacteria move, attack, and collide with environmental hazards. The mask brings this same biological fiction onto the player's body. Its form, sensors, and visual language make the player's face part of the game system, so that coughing and near-face gestures feel connected to the bacteria's actions on screen. This connection helps bridge the physical and digital layers of play. When a player coughs, the action is not experienced as an abstract button press; it originates from the body, is sensed by the mask, and appears as an attack in the game. In this case, the mask creates a continuous and smooth path from bodily performance to digital response.

As the game is designed for two players, this mask interface helps shape the shared play space. Players are facing each other. The mask makes control input visible to the opponent: coughing, gesturing, and reacting become part of the social scene of gameplay. As a result, the game interface is distributed across the screen, the wearable artifact, and the interpersonal space between two masked players. The mask therefore helps make the transition between real-world bodily action and in-game biological fiction more legible, embodied, and playful.

5 Design Discussion

We reflect on how wearable game controllers can turn socially charged or semi-voluntary bodily actions into embodied play:

Semi-voluntary gestures as input. Cough-like actions are different from conventional game inputs such as pressing a button or moving a joystick. They are bodily, audible, socially noticeable, and sometimes only partially voluntary. Even when performed intentionally, they carry associations of discomfort, vulnerability, and loss of control. By mapping such actions to attacks, the game turns an ambiguous bodily signal into a tactical game resource. This creates a tension between control and exaggeration. Players must intentionally perform an action that normally belongs to involuntary or socially suppressed bodily behavior. The result is not seamless interaction, but a form of embodied play that makes the player aware of their own body.

Awkwardness as play. Wearable interfaces are often evaluated through comfort, invisibility, and seamlessness. Our prototype suggests another possibility: awkwardness can be productive when it supports play, humor, reflection, and bodily awareness. The mask is intentionally visible and strange. It asks players to negotiate how they look, sound, and move in front of others. Rather than minimizing the social visibility of the interface, *Battle of Infections* uses it as a resource for playful performance.

Controller as costume. In many games, the controller remains external to the player's identity: it is a tool used to manipulate an avatar. In *Battle of Infections*, the controller is worn on the face and visibly transforms the player. This changes the relationship between player and game character. The player does not simply command a virus-like agent; they become visually implicated in the biological fiction of the game. The mask therefore functions as a costume as much as a controller. It invites players to perform the role of an infection agent through both appearance and action. This suggests a broader design opportunity for wearable games:

controllers can be designed not only for input efficiency, but also for identity transformation and role embodiment.

6 Limitations and Future Work

This prototype has not yet been evaluated through a formal user study. Future work should conduct playtesting sessions to understand how players experience agency, embodiment, awkwardness, social performance, and fun when using the mask interface. A comparative study between mask-based control and conventional handheld control could further reveal how wearable input changes players' sense of bodily involvement and role immersion.

The current sensing approach uses simple sound and distance sensors. While sufficient for prototyping the interaction concept, the system may not robustly distinguish cough-like actions from speech, laughter, or environmental noise. Future iterations could explore more nuanced audio classification, multimodal sensing, or adjustable thresholds.

Face-worn interfaces also raise practical concerns around comfort, hygiene, breathability, and shared use. Future designs should explore lighter materials, removable or washable components, and more comfortable attachment mechanisms, especially if the system is used in public or multi-user settings.

Finally, the biological and infection-related framing should be further refined. While infection provides a strong metaphor for territorial competition, future versions could explore broader microbial, ecological, or respiratory metaphors to reduce potential discomfort while preserving the project's embodied and speculative qualities.

7 Conclusion

Battle of Infections explores how wearable game controllers can move beyond hand-based input toward more intimate, visible, and socially charged forms of bodily interaction. By transforming cough-like sounds into attacks and near-face hand gestures into direction control, the project investigates face-adjacent action as a design space for embodied play. The mask interface functions not only as a sensing platform, but also as a visible costume and a physical extension of the game interface, connecting players' bodily performance with events in the digital game. Through this early-stage prototype, we argue that wearable games can productively engage actions that are awkward, semi-voluntary, and socially noticeable rather than treating them only as usability challenges. By reframing coughing, mask-wearing, and contagion as speculative play, *Battle of Infections* opens up questions about how discomfort, role embodiment, and physical-digital continuity can become materials for designing future wearable game experiences.

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