



Microbe-HCI: Introduction and Directions for Growth

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ABSTRACT

Microbe-HCI is a community whose works implicate microorganisms in HCI. This special interest group is a venue for the first gathering of the community, offering an opportunity for networking and structured discussions. It encourages participation from both active and new researchers to microbe-HCI, with the objective of acquiring an overview of people, themes, trends, and prospective research pathways for the community.

CCS CONCEPTS

- **Human-centered computing** → **Human computer interaction (HCI)**; *Interactive systems and tools*; *Interaction design theory, concepts and paradigms*; • **Hardware** → Bio-embedded electronics;
- **Applied computing** → Education.

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1 INTRODUCTION

Described as organisms that are (usually) too small to be seen with a naked human eye, microbes include well-recognized types such as bacteria, fungi, and yeasts, as well as those that are not so, amongst which also include various animal species (e.g., nematodes, tardigrades, mites, etc). And as the most abundant and diverse group of organisms that accompany us on Earth [25], microbes profoundly shape the way we live, interact, and experience the world. With advances in applications stemming from fields such as synthetic biology, the microbe-human entanglements will not only continue, but will do so with added technological dimensions.

Recognizing microbes' significance, the last few years have seen a notable rise in HCI-related publications that implicate the organisms in design. They fall into a spectrum of often overlapping genres including, but not exclusive to: Interactive installations [1, 20, 21], games [12, 14, 17, 30], biofabrications [31, 33, 34], educational tools [6, 8, 9, 11, 19], wearables [24, 32], critical designs [5], interfaces [23, 29, 35], robotics [27], sensors [16], and self-trackers [3].

Together, they belong to microbe-HCI, a community whose works integrate, fabricate, theorize, and educate biology in HCI, articulated through a microbial, microscopic lens.

2 MOTIVATION

Our rationale behind designation of a microbe-specific community within HCI, is motivated by the need to provide a recognizable space for not only 1) knowledge sharing and support, but also for 2) discussing implications of microbial integration in HCI; with sufficient depth and distinction:

As agents (and materials) of interaction, microbes bring a unique set of functional, practical, and ethical ramifications to interaction design. These emerge from microbes' inherent genotypic, phenotypic, and semantic idiosyncrasies, many of which may be absent in larger animals. For example, microbes embody distinct attributes in terms of scale, temporality, (non-)sentience, genetic modifiability, and socio-cultural meanings.

The existing, general "bio-" and "animal-" premises used historically in HCI: *Moist Media* [2], *Empathetic Living Media* [4], *Biological Imperative* [26], *Human Biology Interaction (HBI)* [21], *Biological-HCI* [28], and *Animal Computer Interaction (ACI)* [22], as they continue to offer valuable grounding for biological and non-human investigations, researchers may further benefit through specialized conversations with added granularity and nuance, that acknowledge the microbe-specific implications.

Therefore, the main goal of microbe-HCI community is to grow its intellectual space, to help its researchers to develop and position their work more effectively within HCI.

3 OBJECTIVES FOR CHI 2021

Our Special Interest Group (SIG) session's main objectives for the conference is two-fold. First is to "tangibilize" microbe-HCI: For the first time, we aim to bring active and prospective members of the community *in situ*, to introduce one another and their works. We call this part of the objective *introduction*. Second, which we call *directions*, is to collectively figure out what the current priorities and areas of excitement are in microbe-HCI, and to open dialogues for future research and collaborations.

4 SIG SESSION STRUCTURE

4.1 Pre- and Post-SIG (on Discord)

Although not mandatory, attendees will be provided an option to join a *Discord* chat group, a couple of days prior to the main event. This will offer an opportunity to make informal introductions before the main session, and to continue conversations after. For the organizers, this will help to gauge attendee expectations, and to pre-assign them to Zoom breakout rooms according to their domain preferences (see *Section 5*).

4.2 Main Event (75 mins, on Zoom)

10 mins. *Opening* from the session host, explaining the objectives and structure of the SIG, followed by voluntary self-introductions from attendees (who may not have joined *Discord* group and/or prefer a live introduction).

35 mins. *Breakout Groups.* Attendees will be allocated to one of the parallel breakout rooms, which are assigned under one of the four major domains (*Section 5*) through which microbe-HCI currently operate: *Interactive systems*, *Design Theory*, *Materials*, and *Education*. The allocation will be based on attendee's preference. Here, each attendee will be asked to spend around 5 minutes, to share any one or more of the following in relation to the domain: 1) Completed or on-going research projects, 2) Research challenges and opportunities, and 3) Future projects or ideas under development. The remaining time of the breakout session will involve group discussions around the individual presentations. Each group session will be moderated by one of the SIG organizers, who will be experienced and/or familiar with the domain. **5 mins.** *Short Break.* The session host will relocate all participants back to the main Zoom lobby.

25 mins. *Plenary Debrief and Discussion.* Representative speaker(s) from each breakout group will summarize their session, highlighting main outcomes of the conversations. This will be followed and concluded by discussions of the outcomes by the whole group.

5 OPERATIONAL DOMAINS OF MICROBE-HCI

Microbial investigations in HCI can take various forms. We embrace this diversity, and we are open to discussing a wide range of species, research objectives/agenda, philosophies, and methodologies. And to maintain focused and orientated conversations, the SIG session will involve parallel, moderated discussions according to four major, interconnected HCI domains, under which many of microbe-HCI works currently operate. These domains are briefly described below, with highlights of selected works that may (or may not) serve as prompts or points for dialogue.

5.1 Domain I: Interactive Systems

These systems (e.g., installations and biotic games) facilitate live human-microbe interactions through computer mediated interfaces and/or environments. Some of the existing discussions in this domain include 1) distinct user/player experiences that could be derived from interacting with living microbes that may not be induced through simulations (e.g., [11, 13, 21]), 2) ethical subtleties underlying the design and usage of systems between non-sentient microbes and sentient animals [10], and 3) emerging and often unexpected design lessons from system testing [11, 15, 17].

5.2 Domain II: Design Theory

This includes conceptual frameworks and design heuristics, which can help designers to contextualize microbial integration in HCI. Notable existing theories include *Human Biology Interaction (HBI)* [21], which 1) describes three-way interaction potential formed between humans, the digital world, and non-human living agents,

and 2) highlights the richness of design space created from such set-up [7]. Furthermore, *Biological-HCI* concept [28] proposes biology (e.g., microbes) as design material for HCI, while *Human Microbe Interactive (HMI)* [18] and *Living Bits* [29] are some of the latest concepts proposed to start bringing microbial perspectives to traditional interaction design frameworks.

5.3 Domain III: Materials

Driven by sustainable fashion, textiles, and product design initiatives (e.g., [33]); microbes (e.g., algae, mycelium, and bacteria) and microbe-derived compounds (e.g., bacterial cellulose) have been increasingly deployed as bio-fabricated design materials. They harness distinct aesthetics and physical properties stemming from different stages of microbe's life cycle and growth outputs. Notable examples of such design, which allow for encasement and/or embedding of various electronic components, include hybrid products [34], e-textiles [24], wearables [32], and "growable robots" [27].

5.4 Domain IV: Education

Emergence of microbe-HCI has created a new scope for microbiology education and training in HCI, to cater for those who may be unfamiliar with microbiological concepts and their potential applications. Notable examples of educational tools, especially those that encourage hands-on, live microbiological experimentation, include *Interactive Cloud Experimentation Lab* [11], *LuduScope* [12], *PlayScope* [19], *Open Liquid Handling* [8], and *My First Biolab* [6].

6 TARGET AUDIENCE

Both active researchers of microbe-HCI, and newcomers who wish to work with microbes in HCI, are welcome.

7 JOINING INSTRUCTIONS

Email with CHI registration ID, to Raphael Kim (r.s.kim@qmul.ac.uk), who will respond with two links: 1) *Zoom* invite for the SIG session, and 2) *Discord* invite for pre- and post-SIG chat (optional).

8 SIG OUTCOMES AND DELIVERABLES

The session outcomes will be documented, summarized, and shared in two stages. First, the lead organizer will internally circulate a *YouTube* link containing raw data, i.e., recorded audiovisuals and group chat archive of the Zoom session (both from the main lobby and the breakout rooms). The link will only be accessible to the SIG attendees. Second, we will write targeted publications that are directly visible to the wider HCI community. The writings will be submitted to the following venues. 1) *ACM Interactions* magazine, as an informal blog post, and 2) *Human-Computer Interaction Journal (Taylor & Francis)*, as an academic paper that further articulates the emerging microbe-HCI community, its open research questions, and potential use cases for each domains of its operation.

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