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Remote Rhythms: Audience-Informed Insights for Designing Remote Music Performances

Sophia Ppali
sp815@kent.ac.uk
University of Kent, United Kingdom
CYENS Centre of Excellence
Cyprus

Max Scorer
ls790@kent.ac.uk
University of Kent
United Kingdom

Elena Ppali
elena.ppali@uef.fi
University of Eastern Finland
Finland

Boyd Branch
ad7606@coventry.ac.uk
Coventry University
United Kingdom

Alexandra Covaci
a.covaci@kent.ac.uk
University of Kent
United Kingdom



Figure 1: Illustration of different scenarios where audiences attend remotely music performances, as emerging from our data – alone (left), accompanied by virtual audiences (middle), accompanied by other audiences located in the same space (right)

ABSTRACT

This paper examines the design of technology for remote music performances, from the perspective of their audiences. In this process, we involved a total of 104 participants across the different stages of our project. Initially, we collected qualitative data from remote audiences using several methods, including surveys, interviews, and observations. Through the thematic analysis of this data, we identified four design dimensions consisting of 17 key elements that illustrate what audiences value in remote music spaces. We applied these insights in a participatory design workshop with diverse stakeholders, contributing to the development of speculative design ideas in this field. The paper concludes by presenting key design insights for future technology advancements in remote music performances. The research contributes to the evolving design space of remote music performances, offering valuable perspectives for researchers, designers, and industry stakeholders.

CCS CONCEPTS

• Human-centered computing → User studies.



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KEYWORDS

Audiences; Remote music performances; Music; Musicians; Performance; Live streaming; Music interaction

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1 INTRODUCTION

The emerging design space of remote music performances – musical events or concerts where the performers and the audience are not physically present in the same location – e.g., livestreamed music, Virtual Reality (VR) concerts – presents an exciting yet underexplored territory for Human-Computer Interaction (HCI) research. Remote music performances differ in ambience from traditional concerts, but they enable novel modes of creation, attendance and interaction, fundamentally transforming the experience of live music [12, 35, 51]. Designing technology for these events thus, requires viewing them as unique experiences, thereby opening new opportunities for artistic expression and audience engagement.

The shift towards remote music performances, which was significantly accelerated by the COVID-19 pandemic [9, 52] has enabled a global audience to participate and experience music together, albeit virtually [16, 36]. However, despite their growing appeal and relevance, remote music performances have not been extensively

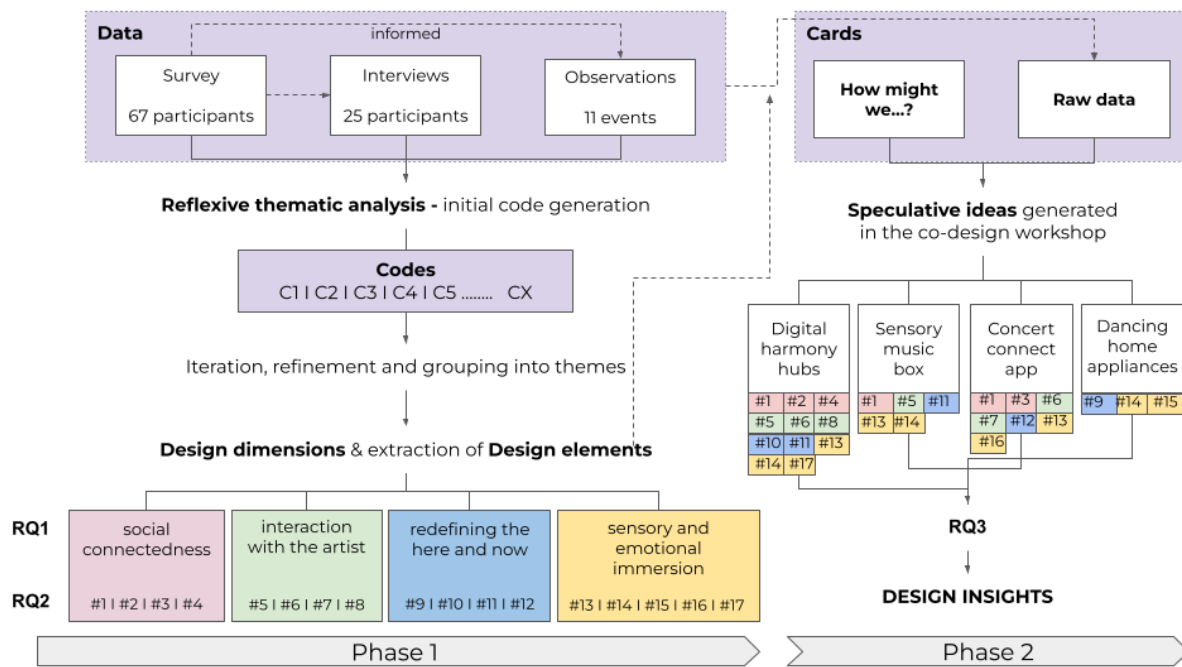


Figure 2: A detailed break down of our project phases, data analysis, and interdependencies between steps

researched, particularly from the audience’s perspective. Recent scholarly efforts have indeed begun to examine this area, yet their scope remains largely narrow. Whether it involves examining audience interactions on specific platforms such as Twitch [25, 57] and Facebook [58], studying particular events [19, 43], or evaluating distinct technological systems [64], the research tends to remain fragmented, often focusing on isolated aspects. We argue that there is a potential of broadening research in this space to encompass more than just platforms, exploring the full spectrum of experiences and opportunities that remote music performances offer. A more holistic approach could reveal how these performances are reshaping audience expectations and engagement strategies, potentially leading to more effective technological solutions. Expanding the scope of research could also provide deeper insights into how remote performances might increase their relevance. Given these considerations, with this study we aim to address the following research questions:

- **RQ1:** What are the key dimensions that audiences value in remote music performances?
- **RQ2:** How do the identified dimensions translate into specific design elements that can enhance remote music experiences?
- **RQ3:** How can the identified elements be integrated into the design of remote music performance technologies in a human-centred manner and what design insights can be gained from this investigation?

Our approach: To answer our research questions, we structured our work into two phases: Phase 1 and Phase 2. **Phase 1** was designed to answer **RQ1** and **RQ2**. For this, we collected and analysed

qualitative data from 92 remote music attendants and 11 remote concert observations. Our results identify key dimensions important to audiences attending remote music events (**RQ1**). These were further categorised into 17 recurrent design elements, each providing inspirational value for designing remote music experiences (**RQ2**). **Phase 2** builds on data collected and analysed in Phase 1 to answer **RQ3** through the results of an in-person participatory workshop with diverse stakeholders. The goal of the workshop phase was to explore how the identified dimensions and elements are used by diverse stakeholders to generate speculative design solutions for online music performances. After the ideation process, we carefully reviewed these solutions to assess their alignment with the identified elements and their potential benefits and challenges. The evaluation helped us identify any perspectives our initial analysis may have overlooked and allowed us to formulate key design insights that can guide future development and refinement of online music performance technologies – see Figure 2 for a detailed breakdown of these phases, which we detail in the next sections. Through this exploration, our work aims to serve both as a source of inspiration and a practical guide for designers and researchers venturing into the design space of remote music performances.

2 BACKGROUND

2.1 Live music, online

Over the past few decades, music consumption has increasingly shifted to digital formats [18], with technology also transforming audience experiences at live music events, influencing their engagement and preferences [12]. This transformation spans various

aspects, from the concert experience itself, to enabling global access to live performances from the comfort of home. The rise of social media, social VR, and livestreaming platforms has reshaped the cultural landscape of music consumption, by introducing new dimensions to how concerts can be experienced and accessed from home and by expanding the ways in which audiences interact with each other and with the artists. The COVID-19 pandemic has further accelerated this shift, catalysing the adoption of these digital solutions and pushing the boundaries of how we define live music experiences [48, 49, 52]. During this period, both musicians and audiences had to rapidly adapt to this new, uncertain environment [9], moving away from traditional practices toward increased digitisation and accelerated acceptance of technology in music consumption and performance [31]. Livestreaming on platforms such as Instagram, YouTube, and Twitch [38] gained momentum as spaces to hold online concerts, providing artists with new means to connect with their audiences and maintain their artistic activities [15, 26]. Some examples are renowned musicians like John Legend, who leveraged these platforms to perform for remote fans directly from their homes¹. Meanwhile, other artists such as Travis Scott, Ariana Grande or Lil Nas X took a different approach and collaborated with gaming platforms (e.g., Fortnite, Roblox) to deliver virtual concerts that attracted millions of viewers². At the grassroots level, lesser-known artists have also found these platforms invaluable. For example, independent musicians went on *Instagram Live* and *Twitch* to host intimate performances, engage in real-time interactions with fans, and cultivate a community presence [22, 53]. The continued use of these platforms³ by both high-profile and emerging artists points to a lasting change in how music is performed and consumed post-pandemic [20]. This shift requires further investigation into how digital platforms are reshaping artist-audience interactions, the economic impacts on the music industry, and the potential for new forms of artistic expression. This research can inform future technological advancements and lead to the development of policies that foster a resilient music ecosystem.

For this process to be effective, it is important to acknowledge the diversity within this space. Different platforms serve various purposes, each distinctively influencing what and how music is performed, consumed and monetised. For instance, *Twitch* offers a platform for interactive and monetisable⁴ experiences [25, 57], *Instagram Live* benefits from more versatile and intimate live streaming features, while VR-based platforms like VRChat transport users into immersive 3D environments where they can attend virtual concerts, interact with other concertgoers' avatars, and even dance to the rhythm of the music [35, 50]. New platforms, dedicated exclusively to music livestreaming (e.g., *Veeps*⁵, *StageIt*⁶) have emerged, but many have struggled to attract a significant audience and subsequently disappeared. These difficulties could be attributed to a

lack of understanding of the nuances and preferences of remote concertgoers, making it difficult to provide a satisfying experience. Thus, the future relevance of both existing and emerging platforms will largely depend on a deep understanding of user needs and demands in the online space.

2.2 Music audiences 2.0 and 3.0

Existing knowledge of audiences' behaviour in remote music performances is often limited to specific platforms (i.e., *Facebook Live*, *Twitch*, *Zoom*), events (i.e., rave concert, jazz concert, traditional folk concert) or contexts (i.e., the COVID-19 pandemic). For instance, Vandenberg et al. [58] looked at audiences' comments during pandemic livestreamed raves on Facebook Live and found that such events fostered a sense of collective consciousness and social solidarity among participants. The focus on the pandemic was maintained by d'Hoop and Pols [14], who offered an ethnographic perspective on a jazz concert, emphasising the spontaneity of the event and the unpredictable interactions that emerged between musicians and their real-time audience. Benford et al. [2] follow, through an ethnographic approach, the pandemic transition of two traditional folk clubs to online experiences via *Zoom* and *Facebook*. Rendell [43] expands on what is considered pandemic media and introduces the concept of *portal shows* which merge traditional live gigs with screen and new media. Their study analysed users' posts during three portal shows with a focus on online fan subject-positions, affect, performances and communications and suggests there is potential value in expanding the ways audiences can participate in online performances, as well as encouraging a more varied and interactive approach. Despite some commonalities across these platforms, distinct patterns of audience behaviour also emerged. For instance, Vandenberg [57] focused on music consumption on *Twitch* and found it is particularly effective in facilitating smaller-scale interactions, with many participants engaging with it as a peripheral activity. The complexity and variety of this space necessitate research across a broad spectrum of platforms. By doing so, we can uncover common behavioural patterns and also understand the unique interactions and preferences specific to different environments. This approach can enable the development of more effective engagement strategies, tailored to the evolving dynamics of the online music landscape.

2.3 Remote music performances as an emergent design space in HCI

As highlighted earlier, most platforms currently used for remote music experiences were not originally designed for this purpose but were instead appropriated from other contexts. The design space for remote participation in livestreamed music events, especially from an audience engagement perspective, remains largely unexplored in HCI. In contrast, the field of *networked music performances*, which focuses on connecting musicians over the internet to simulate playing together in the same room, is better understood [10, 44]. Although these performances sometimes include audiences, their role is generally passive, confined to watching the artists on a screen [46, 56]. However, previous research indicates that remote audiences often desire a more interactive concert experience [2]. Achieving this involves overcoming several challenges

¹<https://www.globalcitizen.org/en/content/john-legend-together-at-home-against-coronavirus/>

²<https://www.mirrorworld.media/lil-nas-x-to-travis-scott-the-biggest-metaverse-concerts/>

³<https://unitedtalent.app.box.com/v/UTACOVIDConsumerStudy>

⁴During the first year of lockdown (February 2020 to February 2021), *Twitch* saw music-related content increase by 359% (Music—Twitch Statistics and Charts n.d.)

⁵<https://veeps.com>

⁶<https://www.stageit.com>

such as internet latency, sound quality, and managing multi-user participation. These issues are addressed within the Internet of Musical Things, an extension of the Internet of Things concept applied to the musical domain. Its goal is to develop technologies that enhance two-way communication in music, not only between performers but also between performers and audiences, and among the audience members themselves [23, 63].

Recent advancements in the metaverse and immersive technologies have introduced new opportunities in this domain, already demonstrating the potential for enhancing musicians' practice [27, 39, 40, 47]. Turchet [54] introduced the concept of *musical metaverse*, a space dedicated to interactive live concerts, immersive technologies and Internet of Musical Things. Turchet [54] provided a comprehensive analysis of the opportunities and challenges in this upcoming field and discussed the potential of web-based playgrounds in this space [4]. Alongside immersive technologies, innovative interfaces were also shown to have potential in this area [5, 6, 11, 13, 25, 28]. Although there have been significant advancements and technological experimentation, research into the design of systems for remote music performances is still in its early stages. Further study is necessary to determine how the *musical metaverse* can be optimally designed to enhance engagement, accessibility, and the overall quality of remote and hybrid music performances.

3 PHASE 1 METHOD: DERIVING DESIGN ELEMENTS FOR REMOTE MUSIC PERFORMANCES

With this phase, our goal was to understand what audiences value about remote music performances, what are their challenges and the opportunities they see for technological interventions in this space. For this, as presented in Figure 2, we collected data from three different sources (as detailed in Section 3.1).

3.1 Data collection

To explore audiences' experiences across various digital platforms during remote music events, our study employed a multifaceted data collection strategy consisting of:

- A **26-question online survey** to gather insights into audience demographics, preferences, and attitudes toward remote music events. The survey featured a combination of multiple-choice questions and open-ended queries. Participants were asked about their frequency of attending music events remotely, the platforms they use, etc. Additionally, open-ended questions related to most memorable at-home music performance, detailing both positive and negative aspects and highlighting what made these experiences stand out.
- **Semi-structured interviews** to go deeper into the nuances and complexities of audience engagement through personal narratives, which could not be fully explored through surveys alone. Each interview lasted between 50 to 60 minutes. All interviews were audio-recorded and then transcribed using an online automated transcription tool. To ensure the precision of the transcripts, two student researchers meticulously reviewed and cleaned the data.

- **Observations of 11 remote music events**, totalling approximately 18 hours, across various platforms including *Twitch*, *YouTube*, *Instagram*, *Social VR*, and *Video On Demand (VoD)* – see Figure 3 for a collection of screenshots from the observed events. The observations allowed us to directly witness audience behaviours and interactions in real-time. During these events, we systematically captured data, which consisted of screenshots and annotations. All observational data were collected and organised on Miro, for visualising and analysing patterns in audience engagement across different digital platforms.

3.2 Participants

Survey participants and interview participants were two distinct groups, formed through recruitment efforts conducted at different times via our personal and professional networks and social media. The timing difference naturally resulted in varying participants for each method, thereby contributing to a broader range of viewpoints. The diversity in participation enriched our study, providing a wide array of perspectives on remote music events. All research methods and participant interactions were reviewed and approved by our Institutional Review Board, to ensure ethical standards were maintained throughout the study.

The survey was completed by 67 participants from 16 different countries, with ages ranging from 18 to over 55 years old (18-24: 27%; 25-34: 29%; 35-44: 12%; 45-54: 19%; and >55: 12%). Participants identified as 33 women, 32 men, one non-binary and one preferred not to disclose their gender. They used a variety of platforms to engage with remote music events, which included *YouTube* (59%), *television / VoD* (53%), *Instagram / Facebook* (30%), teleconferencing platforms such as *Zoom* (20%), *Twitch* (19%), *VRChat* (10%), Other (e.g., *Veeps*, *We-verse*) (15%).

We then interviewed 25 participants who had used and experimented with a combination of platforms, including some that were less represented in existing research (e.g., *VRChat*, *Engage*, specialised streaming platforms). Interviewees from 8 countries identified as 10 women, 14 men, and one individual who chose not to specify their gender, with ages ranging from 18 to over 55 (18-24: 28%; 25-34: 52%; 45-54: 16%; and >55: 4%). The platforms they used for remote music events included *TV / VoD* (24%), *YouTube* (48%), *Instagram / Facebook* (28%), *Twitch* (28%) specialised *streaming platforms* (28%), social *VR tools like VRChat or Engage* (20%) and other platforms such as *Zoom* (8%). All participants used multiple platforms at least once.

3.3 Data analysis

The data collected from the survey, interviews, and observations was analysed using reflexive thematic analysis [7, 8], with the researchers being active creators in the analysis. We employed an iterative open-ended coding process, identifying data patterns related to desires, opportunities and challenges. We started this process by analysing the survey data. First, the main researcher familiarised themselves with the data by reading the entire dataset. At this point, they documented their thoughts and took preliminary notes such as *Participants want to keep the performer in the spotlight, without*

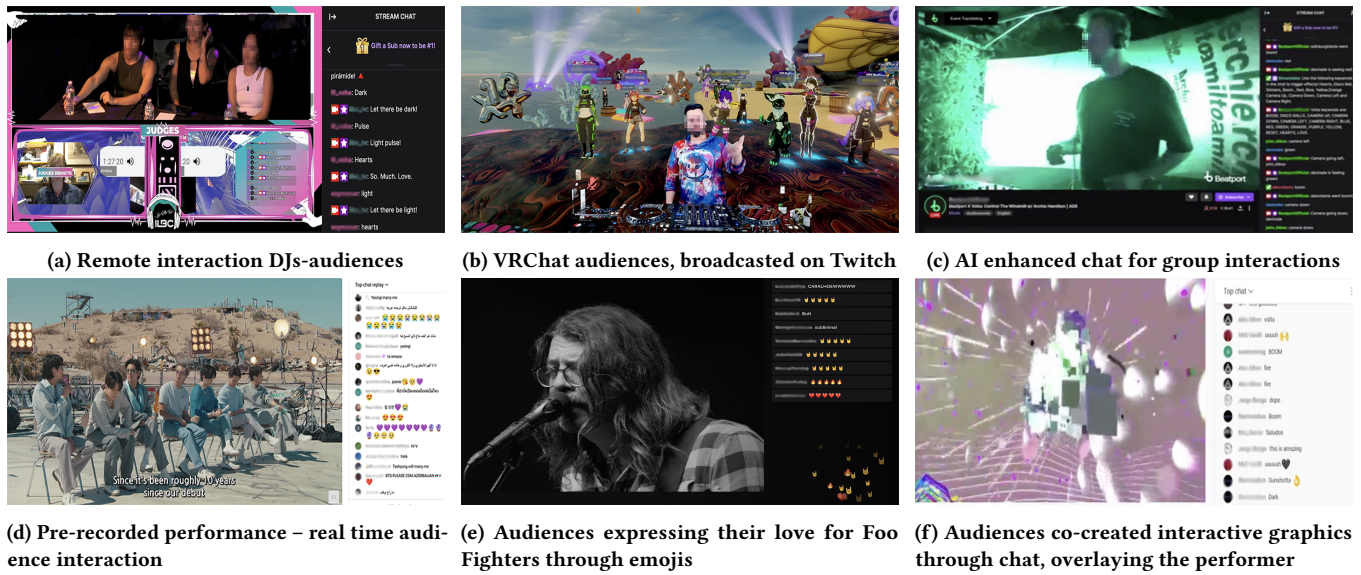


Figure 3: Selected event screenshots from our observational study

overshadowing them with technology; It appears there is a general consensus that current engagement strategies are insufficiently interactive or engaging; The concept of “live” appears fluid among participants within this digital environment, as discussions about live and recorded content often overlap; etc. Some of these notes informed the interview questions and the finalised thematic analysis. This was followed by a preliminary coding⁷ of the open-ended questions. After processing the remaining data (such as interviews and observations) in a similar manner, the main researcher refined the coding. Subsequently, another researcher collaborated with the main researcher to review and analyse the coded data, by integrating and comparing initial codes from all data sources. To ensure all other team members were aligned, detailed documentation of the initial coding and clustering processes was shared, followed by a session for discussion and feedback. Through the iterative process, the team was able to determine which codes were most useful for interpreting relevant themes, how they may be combined according to shared meanings, and which could be discarded. This led to the identification of four themes, which were further broken down in 17 design elements, which we present in Section 4.

4 PHASE 1 RESULTS: DESIGN DIMENSIONS AND ELEMENTS FOR DESIGNING REMOTE MUSIC EXPERIENCES

As shown in Figure 2, with our analysis, we aimed to answer our RQ1 and RQ2 by: synthesising our findings into a practical and actionable list of elements intended to serve as starting points for others in their creative ideation processes. We focused on the findings that had the most inspirational potential from a design perspective including: the qualities that people value in face-to-face

events but find lacking in remote settings; the unique opportunities and challenges presented in the digital space, as identified during our event observations and highlighted by participant feedback; and ideas suggested by our participants regarding their visions for the future. Reflecting audience priorities, we identified four key design dimensions that audiences find important in online music performances. The dimensions are further broken down into 17 design elements aimed at enhancing engagement and interaction. The elements provide design directions for creating more engaging and audience-centred online musical experiences. Interview participants are named as **PI01-25** and survey participants are named as **PS01-67**.

4.1 Social connectedness

Our analysis indicates that remote music events are catalysts for the emergence of a new type of online community. However, the community’s potential for fostering meaningful social connectedness is not yet fully realised, due to a lack of specialised tools designed for this purpose. Despite the utilisation of certain existing features on online platforms, such as live chatrooms and social media integration, there is a clear and pronounced desire among participants for more authentic interpersonal interactions within the musical context. Our interviews and observations revealed a keen interest from audiences in exploring each other’s musical preferences, promoting collaborative play, and nurturing spontaneous interactions. The insights complement research conducted by Onderdijk et al. [36], which investigated the role of agency, presence, and social context in enhancing participants’ experiences at virtual concerts. Our study showed the significant impact of agency and shared agency on fostering social connectedness, as well as the importance of visual and social cues. Notably, it was found that platforms enabling visual interactions among participants, like Zoom, significantly boost the sense of social presence and connectedness

⁷examples: [C1] Emotional disconnection occurs in remote viewing; [C2] Remote events offer limited sensory experience; [C3] Audio and visual elements are not completely immersive; etc.

Table 1: Key elements and design recommendations for fostering social connectedness in remote music events

#1 Tune in to 'kindred' connections
<p>Audiences reported an enriched experience when they were able to connect with others who share commonalities, whether through shared comments or digital experiences. This fostered valuable outcomes, such as user-generated music recommendations, friendly exchanges, and prolonged discussions within the online musical community. Nevertheless, on current platforms, the task of identifying commonalities and forging connections can present significant challenges.</p> <p>Participants said: <i>"The fact that other audience members can participate and say things or ask questions, or do reactions that you also might be feeling [...] I think that helps [...], you kind of connect with that reaction as well from the other person (P115)."</i>; <i>"watching it together [...] I felt like I was part of the group, in it, in the tribe (P104)."</i>; <i>"I've made so many friends (online) that I just want to hang out with [...] exactly the same reason why I would go out with friends in real life (P110)."</i></p> <p>Designers could enhance the sense of community within remote music platforms by enabling users to easily identify and bond with people who share their musical preferences. The goal is to foster a sense of camaraderie and belonging that extends beyond the duration of the performance, turning virtual concerts into hubs of shared experiences and lasting connections.</p>
#2 Orchestrate synchronised engagement
<p>A core part of the communal experience at many performances comes in the form of synchronised action. Although digital contexts lack the inherent physicality of in-person concerts, audiences mentioned appropriating existing features within digital platforms (i.e., using the same emojis simultaneously) as resourceful means to encourage synchronisation.</p> <p>Participants said: <i>"A lot of streamers have created their own emotes now to inside community jokes and stuff like that [...] Something bad happens, everyone spams an emote, they're like, making fun of everything. Something good happens, they, again, spam and hype the thing up (P102)."</i>; <i>"There's a snowflake emoji that people throw at the DJ if they really think it was a good set (P105)."</i></p> <p>Designers could amplify synchronised actions in virtual music experiences by incorporating interactive features that foster coordination among participants, either by empowering fans to initiate and coordinate synchronised actions among themselves or by providing tools for artists to initiate such actions in ways that are meaningful to their performance.</p>
#3 Encourage play
<p>There is natural inclination for audiences and artists to seek and create their own entertaining experiences during remote music performances. Audiences often appropriated features of existing digital platforms for playful interactions, engaging in impromptu activities both among themselves and with the performers.</p> <p>We observed various forms of emergent play including: spontaneous interactions such as play with words during chat conversations; emoji patterns and chants; and structured forms of play such as fans and artists creating their own games and challenges during the performance. Participants said: <i>"There's also a YouTuber [...] who asks audiences to give him three to five words and raps using those three to five words (P102)."</i></p> <p>Designers could facilitate play, perhaps by creating more open-ended and flexible features within the digital event space that allow both audiences and artists to engage in playful behaviours. This would enhance the enjoyment of the event, fostering a sense of community and shared creativity, turning the remote music event into dynamic, interactive, and playful experiences.</p>
#4 Freedom for self expression
<p>In remote music performances, attendees have a multitude of creative tools at their disposal, including avatars and pseudonyms, that allow them to explore and express facets of their personalities. Nevertheless, enhanced freedom of expression brings its own challenges, notably in managing disruptive behaviour.</p> <p>Participants said: <i>"People can definitely express themselves more [...] people who because of different reasons, don't want to go out in real life [...] can just be in a safe space basically (P540)."</i>; <i>"I can be more myself here. I have my avatar, they have their avatar, they can be a woman or a man, they can be whatever [...] it doesn't really matter (P104)."</i></p> <p>Designers could foster constructive and respectful self-expression while mitigating potential disruptive behaviours such as creative moderation tools; integration of subtle prompts within events encouraging positive interactions and discouraging disruptive behaviour; or introduction of digital etiquette guides.</p>

within the audience. Aligned with these insights, our work points to the inherent community-building potential within current digital platforms, while simultaneously identifying a critical need for innovative approaches. Drawing from our findings, in Table 1 we have identified four elements pivotal for enabling a more profound sense of social connectedness during remote music events.

4.2 Interaction with the artist

Remote settings offer unique opportunities to enhance and evolve the relationship between artists and their audiences, as highlighted by Leshem and Schober [30], who showed that empathetic concern allowed listeners of an improvised jazz concert to experience emotions similar to the performer's emotions when listening to the audio recording online, although it did not facilitate shared emotions in the live concert setting. This seems to indicate that empathetic concern may facilitate greater emotional understanding in digital environments. Currently, audiences leverage digital platform features such as live chats, reactions, and social media integration to engage with artists, and this fosters a sense of connection and agency during virtual events. Previous research identified various elements that enhance this connection. For instance, Onderdijk et al. [36] found an increased artist-audience connection when audiences hear their favourite songs or attend VR concerts. Our findings expand on these insights by identifying additional elements that contribute to deepening this bond such as providing opportunities

for co-creation, and insider access to behind-the-scenes content. While existing digital features provide a foundation for interaction, there is scope for the development of new tools and features, as revealed by our participants. The four key elements identified for enhancing the connection audience-artist are detailed in the Table 2.

4.3 Redefining the here and now

Digital platforms like Twitch, Instagram Live, and VRChat are redefining the concept of 'live' in music performances. They offer dynamic participation in live events, unbound by physical presence or traditional temporal constraints. Audience engagement varies: some viewers stay synchronised with real-time broadcasts, while others utilise the flexibility to pause or rewind. This flexibility reshapes what 'live' means, allowing to pause a live stream and dissect, discuss, and deeply engage with specific moments as they unfold. Our observation supports the idea from Hammelburg [21] that the meaning of "live" in a mediated, digital context is constantly evolving and being re-defined. The ephemeral nature of remote live music brings unique opportunities as it challenges the limitations of the physical world, but at the same time, it can make remote music events feel less memorable as they could be considered *less of an experience*. In Table 3, we present four elements that point to potential areas of intervention in the context of temporal and spatial fluidity, as emerging from our data.

Table 2: Key elements and design recommendations for fostering the interaction with the artist

#5 Intimate encounters
<p>Audiences frequently emphasised the importance of creating a sense of closeness with the artist, a dynamic they viewed as distinct from in-person events. Unlike traditional live events where the scale and setting might limit personal interaction, remote events were seen as an opportunity for fans to feel a personal connection with the artist.</p> <p>Participants said: <i>"I think the strength of remote technology for music events is exactly the creation of the feeling of a one-to-one connection with the artist and the intimacy that comes with it! (PS42)"; "It's just you and them, you see them up close and personal even if you are miles away. [...] you have your own emotional moment with the artist (PI18)."; "It actually felt really indulgent because you just had that person in your living room. It felt like a personal concert, there was no one else watering that down (PI12)."</i></p> <p>Designers could emotionally resonate with the audience and foster intimate moments between them and the performer, making each remote music event feeling like a special, tailor-made experience for every attendee.</p>
#6 Feeling 'seen' and 'heard'
<p>When attending a music performance (whether offline or online) a highly valued aspect reported by audience members is receiving recognition from the performer such as a "shout out", which could be attributed to (1) the audience's wish to feel a closer connection to the performer and (2) the desire for recognition and a sense of importance.</p> <p>Participants said: <i>"The fact I could just tap on my phone and send the artist I'm watching a message, and I know it's going to pop up in front of his face at some point. Knowing that you are almost like apprehensive about touching your phone in the wrong way, in case you accidentally send the wrong emoji or whatever. I think that was quite exciting (PI15)."</i></p> <p>Designers could enhance audience engagement by amplifying the perceived rewards of participation and deepening the perceived one-to-one connection between audiences and performers. Designers could think about introducing features that expand the variety, visibility, and scalability of shout outs from the performer.</p>
#7 Co-creation and collaborative artistry
<p>Audiences can directly contribute to the creative process, from influencing setlists to submitting original content. This collaborative approach is highly valued by audiences, as it deepens their connection with the artist, making them active participants in the artistic experience rather than passive consumers.</p> <p>We observed various forms of emergent play including: spontaneous interactions such as play with words during chat conversations; emoji patterns and chants; and structured forms of play such as fans and artists creating their own games and challenges during the performance. Participants said: <i>"Snow Patrol... had Saturday Sessions where he would... interact with the audience on Instagram lives. He would ask the audience for lyrics, and a song emerged from that, crafted from the lyrics provided by their fans (PI09)."</i></p> <p>Designers could actively encourage audience participation, integrating features that allow audiences to contribute to the performance in real-time, such as providing lyrics, influencing visuals, or even affecting the music itself.</p>
#8 Behind the scenes and origin stories
<p>Reflecting the dynamic relationship between artists and their audiences, the desire for deeper contextual understanding and interaction is evident among music enthusiasts. The digital space offers unparalleled opportunities for deepening the artist-audience connection through behind the scenes and background stories.</p> <p>Participants said: <i>"Sometimes I'd like maybe a bit more information about the artist or something. Not lots, but just something, rather than just the actual concert. A bit of background (PI12)."</i></p> <p>Designers could enable artists to share their stories and background information more easily and interactively during performances incorporating features like live chat, Q&A sessions, and behind-the-scenes content seamlessly.</p>

Table 3: Key elements of temporal and spatial fluidity in remote music performances

#9 Remote liveness
<p>The concept of liveness in remote music experiences is not a binary of "live" or "not live". Instead, it exists on a spectrum, ranging from fully pre-recorded concerts to interactive, real-time performances that can be accessed from anywhere. This significantly influences audience behaviour by offering distinct opportunities for interaction, shaping how audiences participate, connect, and derive meaning from these digital performances.</p> <p>Participants said: <i>"Once you start immersing yourself in the possibility space you have the ability to start sort of layering levels of reality on top of each other, like this sort of layering of temporally things that happened in the past happening alongside what you're experiencing right now and sort of layering on previous audiences onto the experience for example (PI06)."</i></p> <p>Designers could explore the flexibility of this space. For instance, they can enable users to leave messages, reactions, or digital artefacts for future audiences or for themselves to revisit during anniversary events, creating a layered experience of past, present, and future interactions.</p>
#10 Discovery and recommendation
<p>The broad access to digital performances can sometimes lead to an overwhelming choice for audiences. Navigating this digital terrain often requires insider knowledge, especially in platforms like VRChat. Participants in our study mentioned the need for more intuitive guides and curatorial tools that can help streamline the discovery process.</p> <p>Participants said: <i>"There was no event calendar and thousands of things are going on. That's the complaint of new users. Where do I go? [...] so the organisation of the actual interface to allow people finding events and people that they want to engage with, that's very important (PI08)."</i></p> <p>Designers could implement more nuanced discovery and recommendation systems, which strike a balance between suggesting events based on a user's established preferences and introducing them to new genres and artists, enhancing their musical exploration without overwhelming them.</p>
#11 Concept performances
<p>Participants in our study reported on attending innovative, technology-driven concept performances that transcend the abilities of live in-person events. For instance some attended Fatboy Slim's EatSleepRaveRepeat VR concert, where they were driving in a roller coaster through the artist's mind.</p> <p>Participants said: <i>"You could create these really cool concepts and then share them as an online event, which you wouldn't be able to do on a stadium tour. So, [...] if they shifted the goal to be like, okay, virtual events are going to be more technological and more conceptual and they don't have to deal with the practical issues of crowd control or rain (PS61)."</i></p> <p>Designers could allow artists to create and craft unique experiences that would not be possible in the physical space, but are distinct, memorable, and engaging in their own right, creating a new genre of digital performance art.</p>
#12 Accessible performances
<p>Digital platforms have addressed live music accessibility concerns such as costs and physical constraints, making it feasible for individuals who may have otherwise been unable to attend such events. As highlighted by our participants remote music performances democratised access to live music.</p> <p>Participants said: <i>"Live events are often held in locations that can be challenging to access[...] So you can see it whenever you are, you just a Wi-Fi connection (PI11)."</i> <i>"It is really good that we do have technology options available to make it more accessible for people that would be really anxious [...] or if there was a disability that prohibited them going (PI07)."</i></p> <p>Designers could create more inclusive digital concert experiences that cater to diverse audiences, for example by developing adaptable user interfaces that can be easily customised to meet individual needs with includes options for larger text, high-contrast colour schemes, and simplified navigation for users with visual or cognitive impairments.</p>

Table 4: Key elements and design recommendation for fostering sensory and emotional immersion

#13 Maintain physicality
While digital platforms offer convenience and accessibility, they frequently lack the tangible, physical elements and sensory experiences that are intrinsic to live music events. This also extends to a lack of tangible memorabilia like tickets or the inability to buy physical merchandise to remember the performance. Participants said: <i>"When you go to a live event, you just have print your tickets, you have the possibility to buy some gadgets or maybe just have the flyer. It's something silly, but there's a tangible proof that you were there. On online events, it's quite different because how can you have a tangible thing back? I don't know if they can improve something like you participated in this event, we're going to send you something physical, maybe some things you like a key chain or something (PI09)."</i> Designers could infuse physical elements into the digital music experience, for example by distributing specially designed kits to the audience before the event that include items that are synchronised with the performance, such as wristbands that vibrate with the bass, LED lights that change with the music's rhythm, or scented candles that correspond with the concert's theme.
#14 Engage the senses
Remote settings often fall short of replicating this level of sensory engagement, with the experience being limited to what can be seen and heard through a screen and speakers, leaving other sensory dimensions untapped. Participants said: <i>"It's more of a sensory experience with live music, online music it's more just you seeing and hearing it (PI18)."; "Watching a live stream is more just a visual and audio experience and even the visual part is just staring at a screen rather than having, I dunno, pyrotechnics, and sure, you get that on TV, but when it's in real life, you feel the heat coming from the flames (PI02)."</i> Designers could engage the audience's senses beyond sight and sound. By embracing multisensory design, designers can transform remote music events from experiences that are heard and seen into fully embodied journeys that transport the audience to a deeper level of connection with the performance.
#15 Embrace the home space
Attending a remote music event from ones own own space was considered one of the affordances of the digital space; one that in-person events can not offer. Nevertheless, participants commented on the many distractions they encounter when watching events from home which stop them from fully immersing themselves in the performance. Participants said: <i>"I watch them on the TV with the lights off and warm clothes on my couch with my blanket, which was very comfortable (PI09)."; "It's very easy to get up mid-song and go make a cup of tea if you want to, whereas you would never do that in a live performance (PI15)."</i> Designers could mitigate distractions and enhance the sense of presence and engagement during the performance for example by integrating a smart home integration system with a focus mode that limits non-urgent device notifications and suggests an optimal viewing setup, like dimming the lights or suggesting comfortable seating arrangements.
#16 From couch to the concert
Remote music events often lack this element of pre-event preparation, with attendees simply tuning in from their homes at a designated time. This ease of access can inadvertently diminish the overall experience. The absence of transitional rituals can also lead to a lesser emotional investment in the event. Participants said: <i>"So people may RSVP. They may say that they're going to go and then they forget about it in a way that you simply wouldn't do if you had bought tickets [...] You plan your whole day around that. And the sort of intangibility of the remote event means that I think it is the perceived value is less and therefore the skipability or forget ability, I won't, didn't even think to put a reminder in my calendar for it (PI06)."</i> Designers could incorporate elements of pre-event preparation to help fans transition into a performance-ready state. Designers could introduce features that encourage anticipation and preparation, such as virtual lobbies where fans can 'gather' before the show, or customisable avatars that attendees can dress up.
#17 Exclusivity matters
Digital events democratise access, offering a more uniform experience to a broader audience. However, because the content of digital events often remains available long after they have ended, this can reduce their sense of uniqueness and worth. Participants said: <i>"If there was exclusive benefits from it, maybe bonus prizes or rewards, its difficult because there is so much free content out there, that there needs to be something that stands out for me to consider paying (unless I really support the performance or am a big fan) (PI01)."</i> Designers could foster a sense of scarcity and value perhaps through availability only for a limited period or by offering extra content to a restricted number of virtual attendees. Moreover, attracting a more engaged audience willing to pay for premium experiences or tiered access could increase the revenue potential for artists.

4.4 Sensory and emotional immersion

Traditional live music at its core is a multisensory experience, immersing attendees in vivid sights, sounds, temperatures and even smells. The *scent* of a venue, *"the kick of the drums in your chest and the bass and the flow of the people"* - all these elements converge to create lasting memories. However, the digital reality of remote music events often grapples with what can be termed as 'sensory paucity', underscoring the diminished sensory richness in digital environments compared to real-world experiences. The significance of sensory information in digital environments is highlighted in the study by Phillips and Krause [37], which explores the future of classical music livestreaming, emphasising how sensory experiences enhance digital engagement. Similarly, the research in ecommerce by [24] investigates the impact of sensory language used by virtual streamers (e.g., descriptive words like "tasty" and "smooth") on consumer reactions, further underscoring the crucial role of engaging the senses in shaping online experiences. Our study's findings highlight a similar craving for immersive experiences in remote music events, where participants yearn for a depth of engagement that goes beyond listening. They seek holistic experiences that captivate their senses and emotions, mirroring the intensity and vibrancy of physical concerts. The desire for sensory and emotional immersion is a testament to the powerful impact music has when it fully engages multiple facets of human perception and feeling,

highlighting the importance of creating remote music events that are not just heard and seen, but are felt in a more comprehensive and emotionally resonant manner. Under this theme, we identified five important elements which are presented in Table 4.

5 PHASE 2 METHOD: REFINING DESIGN THROUGH STAKEHOLDER ENGAGEMENT IN A CO-DESIGN WORKSHOP

5.1 Rationale

As shown in Figure 2, in Phase 2 of our project, we conducted a human-centred co-design workshop aimed at exploring and refining the design elements for online music performance technologies that were identified in Phase 1. By engaging stakeholders directly in the ideation process, we presented them with raw data to foster creativity and gather diverse perspectives. To this end, we intentionally chose not to present the pre-identified design elements directly to the participants, in order to foster unbiased engagement with the data, encouraging stakeholders to form fresh perspectives and original interpretations. It was also intended to stimulate creative thinking and minimise confirmation bias, avoiding the influence of our analysis on the stakeholders' ideation process. More importantly, our methodology allowed us to observe whether certain elements we had identified would naturally emerge in the stakeholders' discussions, highlighting which elements were most resonant

and significant to the stakeholders, and providing a deeper understanding of the most prevalent aspects in designing for experiential engagement in remote music events. By involving stakeholders in this manner, we aimed to value their insights and foster a sense of ownership in the research outcomes, ensuring that the outcomes were organic and reflective of a diverse range of experiences and perspectives.

5.2 Participants

We recruited 12 participants (ages between 18 and 40 years old; five men, six women, one non-binary) for the co-design workshop through personal and professional networks. All participants self-declared as frequent concert-goers and had experience attending remote music performances. Moreover, their diverse involvement in the music industry, ranging from performing to organising, enriched the depth of perspectives and insights they brought to the workshop (see details about the occupation and relevance to the study of our participants in Table 5). Participants originated from eight countries—Taiwan, the UK, South Korea, China, Romania, France, Portugal, and the Philippines—and all currently reside in the UK. Two additional researchers were present at the workshop: the first author as workshop facilitator and a researcher who documented the process.

Table 5: Participants’ profile for the co-design workshop

PID	Occupation	Relevance to the study
P01	VR Researcher	Avid watcher of Twitch streams
P02	Designer	Digital Arts student, experience with remote music audiences
P03	Undergraduate student	Aspiring musician
P04	AI Music researcher/ developer	Occasional DJ, relevant research
P05	Filmmaker	Organises and documents events
P06	User Experience designer	Works at streaming platform, research on musician-audience interaction
P07	Media Studies student	In-person and remote concert goer
P08	Postgraduate student	Part-time musician
P09	Media researcher and designer	DJ and creative technologist
P10	Multisensory experiences researcher	Researches remote music experiences
P11	VR developer	Worked with musicians to develop XR experiences
P12	Engineer and developer	Former musician, Eurovision fan

5.3 Workshop materials

We designed a deck of cards building on the data we collected and analysed in our study to serve as starting points. The deck included 44 cards of two types and their content emerged from the thematic analysis of our data (as shown in Figure 2): (i) Four cards with *How might we...?* questions (i.e., How might we encourage shared audience experiences during remote music events?; How might we preserve the atmosphere of a live performance during remote music experiences?; How might we enable meaningful interactions between audiences and musicians during remote music events?;



Figure 4: Sample cards from the workshop deck

How might we make remote music events more memorable?); (ii) Five sub-groups of eight cards each, one for each of the following broad data categories: a) *challenges*; b) *opportunities*; c) *aspects to consider* when designing technology for remote music experiences; d) *technology* and e) *ideas*. On the reverse side of each card, we included curated quotes from participants⁸ – see Figure 4 for a sample of the used cards. Besides the deck of cards, various materials were available: pens, post-its and paper for the ideation; and theatre props, projectors, VR headsets, musical instruments and smell stickers for the prototyping stage.

5.4 Workshop format

The three-hour workshop began with a 10-minute *introduction*, where participants signed consent forms and were briefed on the day’s objectives. This was followed by a 10-minute *ice-breaker activity*, with participants brainstorming the worst ideas for remote performances, to encourage open dialogue and reduce self-censorship. Then, we gave a 10-minute *presentation* on the study itself presenting how the “*How might we...?*” questions emerged, as well as some of our observations from the data gathered during Phase 1. After this, participants were divided into four groups of three, each group receiving a deck of cards as described in Section 5.3. Participants had 10 minutes to browse through the cards, followed by a *crazy eights activity* where they had eight minutes to sketch eight ideas based on the data in their deck of cards, addressing the “*How might we...?*” question they received. This was done to get participants into a creative mindset. An hour long *ideation and prototyping phase* followed, during which participants suggested

⁸the workshop materials are uploaded here: <https://shorturl.at/ejDEW>

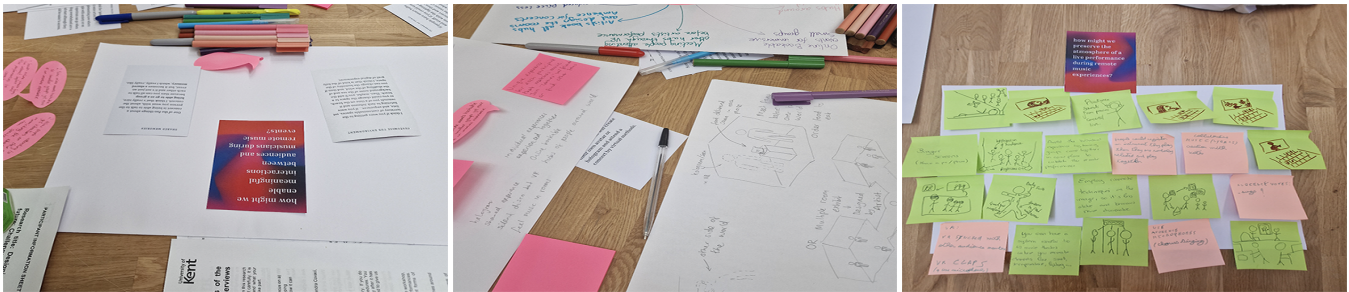


Figure 5: Images of the ideation phase and ideas expressed through post-its during the workshop

a design concept and developed it into a Wizard of Oz prototype (see Figure 5 for snapshots of this process). Besides the deck of cards, various materials were made available: pens, post-its and paper, theatre props, projectors, VR headsets, musical instruments and smell stickers. The final hour included a 30 minute *enactment session* where participants enacted their prototypes in front of the group (see Figures 6, 7), followed by a short presentation explaining their thought process. The workshop closed with an *open ended discussion*, for participants to unpack their experience during the workshop, comment on the ideas provided, and point out concerns, challenges and opportunities around the future of remote music audiences. At the end, participants were each given an empty piece of paper where they were asked to write their *final thoughts* about the day.

5.5 Data collection and analysis

Data from the workshop, including transcriptions of videos, post-it notes, drawings, and prototypes, underwent a mapping process. This method aligned the data with previously identified elements, helping to refine them and generate actionable design insights, intended to inform and guide other designers in their projects.

6 PHASE 2 RESULTS: A PORTFOLIO OF IDEAS FOR EXPERIENTIAL ENGAGEMENT IN REMOTE MUSIC EVENTS

The four experiences that emerged from the workshop are presented in the section below. We describe the design's premise, the experience, and the design features it uses. Moreover, we highlight the design elements it points to.

6.1 Digital harmony hubs

Group 1 (P01 – P03) had as a starting point the question *How might we encourage shared audience experiences during remote music events?* For this, they proposed a design for enhancing personal connections during the entire concert journey – before, during, and after the show – while also providing a sense of belonging to a broader community. Their concept promoted a *fully immersive experience*, where the *audience participates as avatars*. The design integrated the following features, which we detail below and discuss in the light of the elements resulted from Phase 1.

- **Private interconnected virtual spaces:** Users should have the option to reserve a virtual space that mimics a VIP stadium booth. This feature would allow them to experience the event alongside friends who are in different locations. Participants can attend the performance with their selected group but also have the ability to see the booths of other audiences. This would allow for smaller, more meaningful interactions between audiences and artists while maintaining the feeling of a large crowd attending the event, pointing towards elements #1 and #2. Each space should include a stage where the performance occurs, creating an intimate setting that makes each group feel as if the performance is tailored specifically for them, pointing to elements #5 and #17.
- **Custom artist designs:** The virtual spaces for each performance should be unique and based on the aesthetic of the artist performing, giving the audiences the feeling that they are stepping into the musician's world and strengthening the emotional bond between the artist and their fans (elements #8 and #11).
- **Audience lobby:** Before the performance starts, users would have the opportunity to enter a fan lobby using their avatars (element #4). Here, they can meet other fans from all over the world (element #1) and make new friends whom they might want to share their space with, thereby fostering new friendships and community ties. This space also acts as a social hub for organic discovery, where attendees can learn about new artists or performances from fellow fans (element #10).
- **Synchronised dining experience:** The concept includes a synchronised food delivery system. Before the experience, the artist curates a food menu that attendees could opt to have delivered to their homes from their local restaurants (see Figure 6a). This way even in different locations attendees can share the same food, mimicking the shared dining experience one would have at a physical venue. Moreover, this adds a tangible, real-world element (elements #13, #14).
- **Merchandise and artist interaction:** The concept also incorporates a virtual merchandise shop where audiences can buy items they like, which will then be physically delivered to their place. Here, the artist can hold signing events and meet-and-greet sessions for their fans (elements #6, #8, #13).



(a) Participant enacting their group idea (*Digital harmony hubs*), which includes food delivery while being in VR and enjoying the event



(b) A prototype of *The sensory music box* that features a projector which projects other audiences around the space

Figure 6: Stills from the enactment phase of the workshop

6.2 The sensory music box

Group 2 (P04 – P06) approached the *How might we preserve the atmosphere of a live performance during remote music experiences?* question through an experience meant to engage users on multiple sensory levels. They proposed a physical object designed for home use, which created an immersive concert experience beyond the screen (see Figure 6b). In doing so, the design sought to transform the remote music experience from a predominantly passive, observational activity into an interactive, multisensory journey. The following design features were proposed:

- **360-degree environmental projection:** The device projects a live, atmospheric environment around the user, offering a

panoramic view of the performance. Users can walk around it, engaging with the performance from various angles. They can also pause it, or replay it experiencing the same moment from different perspectives (element #5). In addition, this projection creates an immersive sound backdrop, complementing the visual experience (element #14).

- **Olfactory stimulation module:** Equipped with scent cartridges, the device releases fragrances aligned with the concert's theme, enhancing the thematic immersion. This links to elements #11 and #14.
- **Haptic feedback system:** To replicate the sensation of live music, the device integrates a sophisticated vibration system. This technology allows users to feel the music in a tactile manner, simulating the vibrations one would experience at a live venue, thus adding a physical dimension to the auditory experience and pointing towards elements #13 and #14.
- **Audience holograms:** For users desiring a more communal experience, the device can project holograms of other audience members into their space. This feature fosters a sense of unity and shared experience, crucial to live performances, by visually and virtually connecting individuals in different locations (element #1).

6.3 Concert connect app

Responding to the question *How might we enable meaningful interactions between audiences and musicians during remote music events?*, Group 3 (P07 – P09) proposed an app-based concept to strengthen the interaction between artists and their audience in virtual music events, by giving audiences a voice in shaping the concert experience. The design includes the following features:

- **Audience-driven setlists:** Through the app, attendees can use polls to vote for their favourite songs, ensuring the performance reflects their preferences (element #6, #7).
- **Co-writing music:** The chat function allows for real-time collaboration between the artist and audience with attendees being able to contribute lyrics while the musician plays, fostering a playful co-creation process where the song evolves during the performance (elements #3, #7).
- **Unique merchandise:** Unique merchandise, either virtual or physical, is available exclusively through the app. Artists can 'hand out' these items during the show, making the experience more memorable and meaningful. Physical merchandise could be delivered to the attendee's home before or after the event as a tangible memento (element #13).
- **Enhanced pre- and post-event engagement:** Leveraging the virtual format, the app offers Q&A sessions with the artist before and after the performance, allowing fans to share the experience beyond just the music, building anticipation and prolonging the post-event connection (elements #1, #6, #16).
- **Accessibility features:** Recognising the importance of inclusivity, the app incorporates features like close captioning, ensuring that the event is accessible to a diverse audience, including those with auditory impairments (element #12).

6.4 Dancing home appliances series

Group's 4 (P10 – P12) idea features an Internet of Things intervention which modifies the home space according to the concert involving the appliances one has at their home. Designed to immerse the audience in the music and enhance the connection to the virtual event, the smart home appliances become dance partners, turning the living room into a pulsating dance floor by receiving information about the show and responding to it (see Figure 7). Moreover, the concept proposes a series of multisensory abilities for the devices and a feature that randomly replays the best moments after the show. Central to this concept is the idea of engaging with things that people have at home, leveraging the physical space rather than transporting the user to a virtual environment. This way the home creates a new experience every time users attend an event, making each concert unique and memorable. The design has the following features:

- **The groovy fridge:** A fridge that has a built-in sound recognition system and a set of tiny robotic legs. When it detects music playing it starts swaying and displays colourful LED lights that sync with the music, creating an ambient light show that enhances the mood of the concert (element #14, #15).
- **Rhythmic washer and dryer duo:** These appliances are activated during remote music events and are equipped with sensors that detect the rhythm of the music, synchronising their spin cycles to match the beat (element #14).
- **Pet engagement device:** a "DJ Dog Toy" that reacts to the music, providing entertainment for pets and integrating them into the experience. These toys vibrate, light up, or play modified sounds in harmony with the concert (element #15).
- **Smart vacuum dance mode:** Event experiences are saved and whenever the user vacuums the cleaner randomly replays music from past events but also performs a dance routine, turning a mundane cleaning session into an entertaining show (element #9).
- **Selective replay control for appliances:** Each smart appliance can be individually programmed to respond to selected replay moments. For example, the user might want the Groovy Fridge to light up and sway to a particular song's chorus or release a specific scent during a memorable guitar solo (element #9).

7 DESIGN INSIGHTS FOR REMOTE MUSIC EXPERIENCES

Our investigation into audiences participating in remote music events revealed important elements that are valuable when designing technology for remote music performances. They show the challenges and unmet desires from those who attend them, but also the opportunities audiences and designers see in technology for addressing them. Moreover, they enrich the previous work through their practical value – they offer insightful and actionable information about users that could be easily considered by remote music performance designers.

During the workshop even though participants did not have access to the 17 elements themselves, we found that the features of the

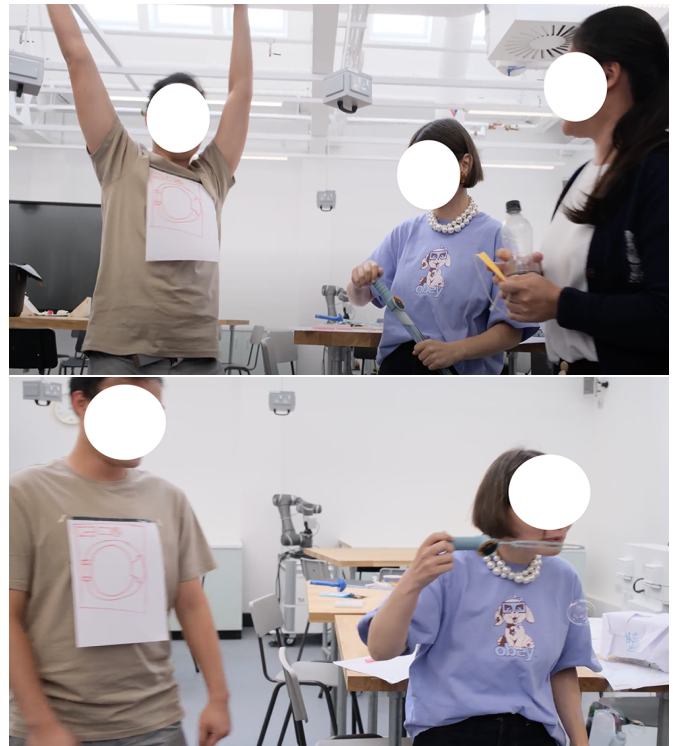


Figure 7: Participants enacting the *Dancing home appliance series*

speculative design ideas proposed invariably connected resonated with at least one of the elements, underscoring their pervasiveness and relevance. This is not to say that our list is comprehensive, but it points towards the usefulness of the elements and their potential to be used by designers. They serve as a bridge between theoretical understanding and practical application, providing designers with an audience-centric blueprint for crafting technology for remote music performances.

In the sections below we take the key inspirational outcomes of our research a step further, interpreting and articulating them as design insights, exemplifying them with our results, the discussions of the workshop as well as existing work done in the space. The aim here is to offer practical, actionable advice to designers who are committed to building meaningful, human-centric technology for remote music performances.

7.1 Design insight #1: Redefining liveness – from *real-time* to *my time*

Liveness [1] is a defining characteristic of in-person events, which captivate audiences with their raw energy. However, within the digital space, liveness becomes mediated and its meaning is constantly being re-defined by audiences [21]. With digital platforms like *Twitch*, *Instagram Live*, and *VRChat*, audiences have greater agency over their viewing experience: some stay synchronised with real-time music broadcasts, while others utilise the flexibility to pause or rewind. This means that not all viewers are experiencing

the event in the same temporal frame. In this context, *liveness* is less about temporal simultaneity and more about the depth of engagement and the shared experience, even if temporally staggered. This transformation has been outlined by Benford et al. [2], who discusses this fluidity of *liveness* in the context of the ethnographic account of two traditional folk clubs going live.

In addition, we found that even pre-recorded music performances can evoke a strong sense of *liveness* among viewers. Therefore, the perception of *liveness* becomes a combination of the viewer's belief, which is anchored by specific markers and cues within the content, and their active interactions with both the performance and other audience members. Nevertheless, this perception can vary. A viewer might feel a performance is 'live' due to real-time chat, even if the music is pre-recorded. Conversely, a lack of audience interaction or artist responsiveness might make a real-time performance feel like a replay. Yet, such discrepancies highlight the multifaceted nature of live experiences: pointing to the need to explore how audiences perceive time during a performance, whether they value synchronous interactions with fellow viewers or the artist, or how they might switch roles - from a passive viewer to an active participant. The dynamic interaction with time has the potential to unlock novel creative avenues for performers and designers and help them craft experiences that truly resonate with the audience's evolving definition of *live*. The *sensory music box* design idea capitalises on this by proposing a projected environment around the user which they can pause, walk around and replay enabling them to dissect the performance how they see fit and view it multiple times from multiple perspectives. On a more general level we encourage designers to explore and leverage this fluidity of liveness. They have the opportunity to craft experiences that, while not live in the conventional sense, still convey a sense of immediacy, connection, and shared presence. For example, designers could think about embracing the non-linear nature of digital experiences, offering viewers the ability to pause, rewind, or view asynchronously while still maintaining a sense of shared experience.

7.2 Design insight #2: Enhance audience experiences across event phases

In in-person music events, the audience's journey is a rich narrative, extending beyond the performance – from the anticipation leading up to it, the rituals of preparation, the travel to the venue, and the shared moments with other audiences. Within the event itself, there are *peak experiences* [17, 29], *the unexpected encores* [61], and the quieter reflective moments. Our study revealed that while the convenience of remote events is appreciated, the absence of a journey-like experience results in events feeling less special. The *Digital harmony hubs* idea further showcased the importance of the event journey with the team focusing on other activities before, during and after the event (e.g., audience lobby, merchandise, eating) rather than the event itself. Participants argued that the importance of the activities surrounding an event are as important as the actual performance.

To recreate the depth and richness of live events in a remote setting, designers should think of the fan experience as an expansive journey, encompassing pre-event, live event, and post-event

phases, each offering distinctive opportunities to deepen engagement and foster a sense of community [11]. In the pre-event phase, cultivating anticipation is crucial [62]. Strategies might include augmenting the multisensory aspects of the event by distributing tangible objects associated with it, or involving the target audience in a co-design process to collaboratively develop an event blueprint that can be shared in advance. During the live event phase, designers should focus on triggering peak moments that mirror the highs and reflective pauses of traditional event experiences by accounting for spontaneous interactions or unexpected surprises, coupled with spaces for individual reflection [34]. Following the live event, designers could think of including virtual lounges where attendees can interact, exclusive content releases that recount the highlights of the event, or interactive Q&A sessions with the artist.

7.3 Design insight #3: Balancing artist control and audience interaction

The bond formed between the audience and performer is important, and studies have identified it as a significant factor not only for ensuring a pleasant experience but also for enticing audiences to return to future events [32, 41]. Our findings suggest that remote music audiences long for opportunities to interact during the performance and to co-create, wanting to have an impact on the music and the experience. The *Concert connect* design idea reflected this by proposing interactive set lists and collaborative lyrics writing. Nevertheless, during the discussion at the end of the workshop, one participant asked “*But what about the artist? What about their vision?*”.

Indeed, when designing technology for remote music performances it is imperative to recognise the diversity in artists' preferences for audience interaction. While co-creation and audience participation are beneficial, there is also a risk of diluting the artist's original vision. Therefore, when designing technology for remote music performances it is important to ensure that the integration of audience interaction complements, rather than overshadows the artist's creative vision. Design solutions could offer varying levels of interactivity, allowing artists to choose how much they want to involve their audience in the creative process and how [33]. These levels can range from low-interaction formats, where the audience's role is mainly observational, to highly interactive formats, including real-time polls for song choices or collaborative creative processes. Furthermore, implementing mechanisms for feedback from both artists and audiences could help refine and evolve the level and type of interactivity offered, assisting in adapting the platform to align with evolving user needs and artistic preferences.

7.4 Design insight #4: Balancing technology and authenticity

Our participants expressed that for them, remote music events are distinct opportunities for novel engagement – with the other audiences, the artist and the performance itself. Our findings indicate that technology is not just an enabler, but rather a driving force for delivering extraordinary and seemingly impossible experiences [59]. Moreover, for artists themselves, technology presents an opportunity to overcome the constraints of the physical environments (e.g., venue size, logistical challenges, or budget constraints). This

transformation is particularly valuable for smaller artists or those performing from home, who may have previously been restricted in their ability to deliver visually captivating performances.

Despite this, our audiences also yearned for the emotional depth and authenticity of in-person events, frequently making direct comparisons and highlighting the limitations of technology in capturing the feeling of live music. Their perspectives underscore a critical observation: technology, for all its advancements, is still often perceived as *intermediary* – a lens through which we access experiences rather than a space where authentic, standalone experiences reside [42].

For designers, this brings a multifaceted challenge. While there is merit in curating technologically advanced and highly polished performances, there is also a need to embrace spontaneity and imperfection. As found in [41], authenticity and how “believable” and “real” a performance feels, plays a huge factor in audience engagement and satisfaction. Instead of replicating in-person experiences, designers should aim to craft novel, authentic digital experiences that celebrate these imperfections and spontaneous moments.

7.5 Design insight #5: Creating *magic circles* in home settings for remote music experiences

Our study’s exploration into remote music experiences highlighted the need to redefine the role of physical space in enhancing audience engagement. Traditionally, music events serve as liminal spaces - thresholds between the ordinary and the extraordinary - where attendees transition from their everyday reality into a shared, heightened sensory world. Our participants noted that while remote settings (i.e., homes) offer a comfortable and cocooning environment for music enjoyment [3], they often lack the distinct boundary between the ordinary (e.g., home chores, distractions, daily routines) and the extraordinary (the music event) that in-person events provide.

The shift towards remote music experiences necessitates rethinking how audiences interact with their physical surroundings during a concert, perhaps focusing on transforming the audience’s home into an integral component of the performance. The goal is to turn ordinary spaces, like bedrooms or living rooms, into *sacred*, immersive environments that transcend the typical associations these spaces might have with daily routines or distractions. Interestingly, three of the four design ideas proposed ways to transform this physical space either by fully changing it into a virtual space (*Digital harmony hubs*); by augmenting it (*The sensory music box*); or by using existing elements of the environment such as electronic appliances (*Dancing home appliances series*). By deploying advanced technologies such as augmented reality, designers can enable audiences to dramatically reshape their surroundings, turning the familiar into a dynamic backdrop for extraordinary musical encounters.

7.6 Design insight #6: Designing for multisensory immersion

Our Phase 1 data showed a need of audiences for deeper immersion that engages multiple sensory modalities beyond traditional audio-visual formats. Moreover, during Phase 2, all four ideas generated by participants in our workshop included various elements of sensory immersion irrespective of the *how might we* question they were

given to address. From a technological standpoint, the quest for deeper immersion suggested by participants can be met by creating innovative technology-mediated audience participation systems that go beyond mere screen interactions. This approach is supported by emerging research in *multimedia* [13], which explores the integration of touch, taste, and smell with sight and sound, thereby transforming the media consumption landscape. Designers are now challenged to leverage this multi-multi perspective, where multiple types of media engage multiple senses, to significantly enhance the quality of experience for audiences. This shift not only promises more engaging and immersive remote music experiences but also sets a new standard for how designers can create environments that fully captivate the audience’s sensory faculties. For example, designers could consider integrating immersive lighting control with smart systems that dynamically adjust to the music’s tempo or emotional tone, using interactive dance mats that allow users to interact with the performance, and incorporating scent diffusion systems that release fragrances aligned with the mood or theme of the music can add an olfactory dimension, making the event even more immersive and memorable, via systems like the ones described in [45, 55, 60].

8 LIMITATIONS

Our research, while providing valuable insights into the design space of remote music performances from the lens of audiences, has certain limitations that need to be acknowledged.

Scope of study and sample size: Remote music events are diverse, with countless ways for individuals to engage. Our study’s limited sample size means we have not captured all possible experiences.

Cultural differences: We acknowledge that cultural differences can influence music experience and preferences significantly. The selection of participants in our study was based on who was available and willing to participate. This approach has inherent limitations, but it still provides insights into the diversity of audience experiences with remote music events.

Wider study: The results presented here are part of a wider investigation into remote music performances so the elements are presented in a summarised format, resulting in not capturing all the nuances of each element within the text.

Platform limitations: We focused on specific digital platforms, which do not encompass the entire landscape. This might leave out nuances from unexplored platforms. Moreover, since our study was about the broader design space, there might be some platform-specific aspects we did not explore.

Generalisability: Our findings might not be necessarily universally applicable, as the elements we identified and the resulting speculative design ideas are grounded in the existing practices of our participants and the events we observed. Some might not apply beyond the contexts where they were found, and there could be more elements on our list had we explored other remote music performance settings.

Demographic limitations: Despite our efforts to engage a varied demographic, most participants were adults embedded in Western context with good digital access and familiarity. This demographic profile means that the insights and concerns that emerged from our study are, to a certain extent, a reflection of their socio-economic privileges. While these participants are among those more likely to

access and attend remote music events, it's crucial to understand that their experiences might not be representative of the broader global audience.

9 CONCLUSION

In this paper, we took an exploratory approach, where we focused on remote music audiences, to start investigating the design of technology for remote music performances. Our findings point out insights and design directions, which we hope could provoke designers and researchers to explore this area. We see value in sharing this work now, when the research landscape remains relatively unexplored but interest in this space is nevertheless evolving rapidly, especially after the transformative shift brought by the COVID-19 pandemic. Our scope of this study was broad, covering a wide range of audiences, necessitating future work that is perhaps more targeted to certain types of events. Moreover, in this work, we focus on audiences rather than the artists themselves. Therefore, there is an opportunity for future research to build on ours by investigating the design space from the musicians' perspective and bridging the two key stakeholders of remote music experiences.

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