Beyond Applause: A Collaborative and Interactive Experience in Piano Concerts

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Abstract. *Classical piano concerts traditionally position audiences as passive observers, limiting their emotional expression and participation primarily to applause after the performance. This passive stance contrasts sharply with modern interactive events, creating a gap between audience expectations and classical concert formats. This study explores how the audience can collaboratively contribute to shaping an interactive scenic environment in piano concerts without disrupting the musician's performance. By leveraging the FeelIt application, we introduce a novel approach that enables real-time audience participation through non-intrusive digital interactions, allowing spectators to express their emotions through visual reactions without interfering with the artistic execution of the performance. The user engagement scale (UES) results highlight positive aspects of the tool's aesthetic appeal and rewarding nature, reinforcing its potential to enhance the audience experience. This study contributes to research on interactive technologies in performing arts, offering insights into how digital tools can transform traditionally passive audience experiences into more dynamic and participatory events while maintaining artistic integrity.*

Resumo. *Concertos de piano clássico tradicionalmente posicionam o público como observadores passivos, limitando sua expressão emocional e participação principalmente ao aplauso após a performance. Essa postura passiva contrasta fortemente com eventos interativos modernos, gerando uma lacuna entre a expectativa do público e os formatos clássicos de concerto. Este estudo explora como a audiência pode contribuir colaborativamente para a construção de um ambiente cênico interativo em concertos de piano, sem interferir na performance do músico. Ao utilizar o aplicativo FeelIt, introduzimos uma abordagem inovadora que permite a participação em tempo real do público por meio de interações digitais não intrusivas, possibilitando que os espectadores expressem suas emoções por meio de reações visuais sem comprometer a*

execução artística da apresentação. Os resultados da Escala de Engajamento do Usuário (UES) destacam aspectos positivos da estética e da natureza recompensadora da ferramenta, reforçando seu potencial para aprimorar a experiência da audiência. Este estudo contribui para a pesquisa sobre tecnologias interativas nas artes performáticas, oferecendo insights sobre como ferramentas digitais podem transformar experiências tradicionalmente passivas em eventos mais dinâmicos e participativos, mantendo a integridade artística.

1. Introduction

The interaction between audience and artistic performers has been widely explored focusing on intensifying audience engagement in live events, such as cultural, musical, and performative experiences. Since the 1990s, interactive methods have significantly expanded, applying to a variety of contexts, including educational events [Salovaara et al. 2021], musical performances [Oliver Hödl 2020], sports events [Martins et al. 2023], and cultural festivals [Vasconcelos et al. 2018, Martins et al. 2021]. Instead of a unidirectional experience where the audience acts as observers, interaction fosters a shared experience, where the spectator takes on the role of co-creator of the event [Jacucci et al. 2007].

With the advancement of interactive technologies, audience participation and engagement in events have been transformed, enhancing the spectator's experience [Lee et al. 2019]. In cultural events, interactive systems enable participants to express their emotions and influence the event's narrative or environment [Martins et al. 2021]. Technological tools promote engagement in educational contexts by encouraging student collaboration and active participation [Salovaara et al. 2021]. In sports, digital interactions provide a more immersive and connected experience to spectators [Veerasawmy and McCarthy 2014]. Thus, adopting interactive technologies in different scenarios has enhanced how the audience relates to the event.

In the case of arts and entertainment events, such as musical performances, the audience often manifests their emotions through active behaviors, such as singing along, clapping, or verbally expressing excitement [Otsu et al. 2021]. The literature has already documented the use of technologies to enhance audience engagement in these events, promoting interactions that enrich the spectator's experience [Burns 2016]. However, in more formal musical performances, such as orchestra concerts or solo piano recitals, audience participation tends to be more passive, given the traditionally structured nature of these performances.

Designing participation strategies for piano events involves balancing engagement with respect for the musician's performance. Unlike a rock concert or an interactive festival, where the audience's active expression is encouraged, a piano recital requires concentration and technical refinement. Any audience participation mechanism must be carefully designed to avoid negatively interfering with the performance.

Given this scenario, the following research question arises: *how can the audience collaboratively contribute to shaping an interactive scenic environment in piano concerts without disrupting the musician's performance?* To address this question, we utilize FeelIt, an application that enables the audience to co-create the visual atmosphere of the event through reactions represented by emojis and short expressions, such as *"bravo"*, *"surprising"*, and *"emotional"*.

The FeelIt application was used during a performance at the International Piano Forum at Federal University of Amazonas. After the application's presentation and use, the audience was invited to answer a questionnaire based on the User Engagement Scale (UES) instrument. The collected data were analyzed, and the results indicate a positive reception of this type of application. In general, the audience appreciated the ability to express their emotions in real-time during the event. However, as a primary negative aspect, participants highlighted that the application's visual design could be more appealing.

In this paper, we explore this collaborative experience and investigate how these interactions can transform the audience experience without compromising the musician's execution, offering an innovative approach to audience participation in traditional musical performances. Thus, we contribute to interactive technologies in the context of musical events, discussing the implications of designing systems that balance participation, engagement, and respect for the aesthetics of artistic performance.

2. Related Work

Audience participation in musical performances has been extensively studied, with various approaches exploring how technology can enhance engagement and interactivity. Traditional concerts often treat audiences as passive spectators. Still, recent advancements in human-computer interaction and interactive music systems have challenged this notion, introducing innovative ways for audiences to participate in performances actively.

One example is Open Symphony [Wu et al. 2017], which enables audiences to influence live music performances by voting for different musical modes. This system facilitates real-time collaboration between performers and audiences through mobile technology and data visualization, allowing spectators to become co-creators of the musical experience. Similarly, the Crowd in C system [Lee et al. 2019] incorporates social interaction to sustain engagement in large-scale participatory music performances. Using mobile music instruments, the system enables audiences to collaboratively create musical pieces while exploring the impact of social dynamics on engagement.

Another approach to audience participation in live music events is using smartphones as interactive tools. Hödl et al. (2020) investigated large-scale audience participation using smartphones, highlighting the potential of mobile devices to serve as both musical instruments and interaction platforms. Their findings suggest that while smartphones provide new opportunities for engagement, maintaining artistic control remains a critical challenge. Additionally, Araújo et al. (2021) introduced a collaborative experience where audiences influenced the sequence of musical pieces during a scientific event's networking session. This work emphasized the importance of real-time interaction and engagement in informal musical settings.

Despite these advances, challenges remain in designing interactive music experiences that balance audience engagement with the integrity of a performance. Many existing systems focus on direct audience manipulation of sound or musical structure, which may not be suitable for more structured or classical settings, such as piano recitals. Our work differentiates itself by exploring how audience reactions, represented through emojis and short expressions, can collaboratively shape the visual ambiance of a live piano concert without disrupting the musician's performance. By leveraging the FeelIt application, we provide a novel approach to audience participation that preserves a classi-

cal performance's aesthetic and technical demands while enhancing engagement through real-time interactivity.

2.1. Feelit

To explore how the audience can actively shape an interactive scenic environment in piano concerts without disrupting the musician's performance, we developed FeelIt, an application designed to enable real-time interaction between performers and spectators. Traditional classical music concerts often feature passive audience behavior, with engagement limited to applause at the end of a performance. Advances in interactive technology offer new ways to enhance audience participation while preserving the integrity of live performances. FeelIt was created to address this need, allowing spectators to express their emotions visually and dynamically throughout a recital, fostering a more immersive and participatory experience.

FeelIt was developed as a Web/Mobile application designed to provide an intuitive and seamless way to communicate spectators' emotions during a musical performance. The system consists of two interconnected modules: the Spectator Module and the Feedback Module. The Spectator Module serves as the primary interface for audience interaction, enabling users to select from emoticons and predefined words that best represent their emotions at any moment. This module is accessible to the spectators, who can use it on their mobile devices. The spectators select the reactions in the app, which are sent in real-time to the Feedback Module. This module processes and casts the reactions onto a display in the concert environment. The Feedback Module ensures that audience emotions are visually represented in a way that enhances the performance without distracting the musician, creating a balanced integration of audience participation. Figure 1 illustrates both Spectator (A) and Feedback modules (B).

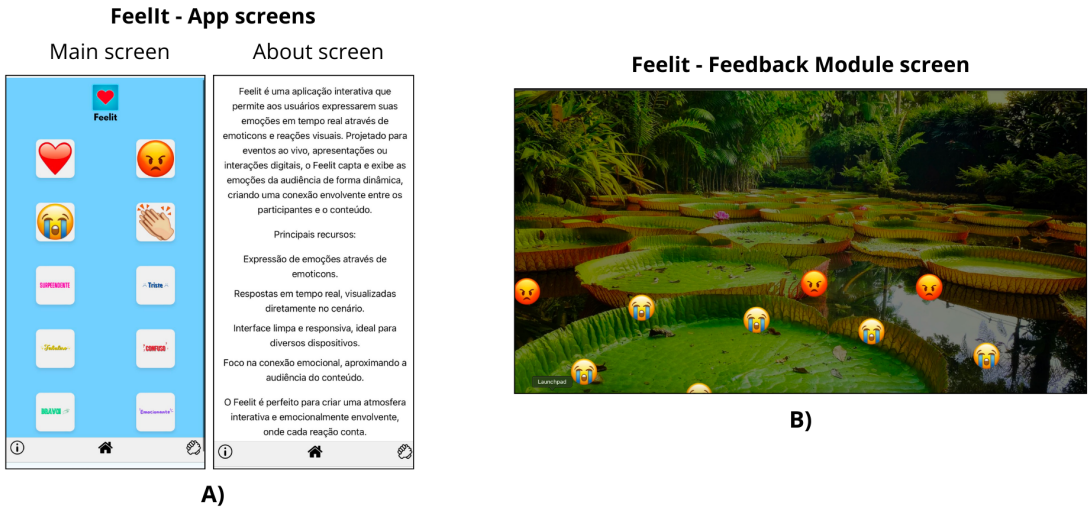

Figure 1. Screens of the FeelIt application. Figure A presents the Spectator Module. Figure B shows the Feedback Module.

Four emoticons were selected to represent key emotions: Love (Heart), Anger,

Applause, and Frustration. Additionally, six words were chosen to express further audience sentiment: Fabulous, Surprising, Brave, Emotional, Confused, and Sad. These emoticons and words were selected to capture a broad range of emotional responses, allowing audiences to engage meaningfully with the event.

By integrating these two components, FeelIt transforms the traditionally passive concert experience into an interactive and immersive event while maintaining the formal nature of classical music. The following section details the methodology used to evaluate the system and assess its impact on audience engagement.

3. Case Study: International Piano Seminar

This study investigates how the audience can collaboratively contribute to shaping an interactive scenic environment in piano concerts without disrupting the musician's performance. We conducted a case study using the FeelIt application during a live piano concert at the International Piano Seminar & 2nd National Seminar on Arts Memory in the Amazon (2024). This setting allowed us to examine how interactive audience participation through FeelIt influences engagement while maintaining the integrity of classical music performance.

The study followed an exploratory case study design, as recommended by Yin (2009) , which is particularly suited for answering "how" and "why" questions when researchers have little control over ongoing events. A single-case embedded design was chosen, with the unit of analysis being the audience's interaction with the application during the performance. This approach enabled us to investigate real-time engagement and participation without interfering with the musical execution.

The study took place during a live piano performance followed by a speaker's presentation on arts and technology. The session began with a presentation on innovative technologies for audience engagement, providing attendees with insights into technological solutions designed to foster interactive experiences. Participants were then introduced to FeelIt, and a QR code was provided for easy access to the application. A brief tutorial was offered to explain its functionalities before the performance commenced.

Participants were encouraged to express their emotions freely using FeelIt during the live piano recital. The app does not limit the number of reactions the users can submit, and their responses, represented by emojis and short text expressions, were projected in real-time as part of the concert's interactive scenic environment. This setup enabled an immersive and collaborative experience, aligning with the study's objective of analyzing audience engagement through technology. Figure 2 illustrates the moment when FeelIt was used during the study, showcasing audience reactions projected in the background as the pianist performed.

To ensure methodological rigor, data collection incorporated both quantitative and qualitative methods. Following Yin's (2009) principles, multiple sources of evidence were used to enhance validity, maintain a chain of evidence, and create a structured case study database. The primary data sources included direct observations of audience behavior, responses from a questionnaire based on the short version of the User Engagement Scale (UES) [O'Brien et al. 2018], and open-ended feedback collected from participants regarding their experience with FeelIt. A total of 55 participants attended the session, and 23 completed the feedback questionnaire.

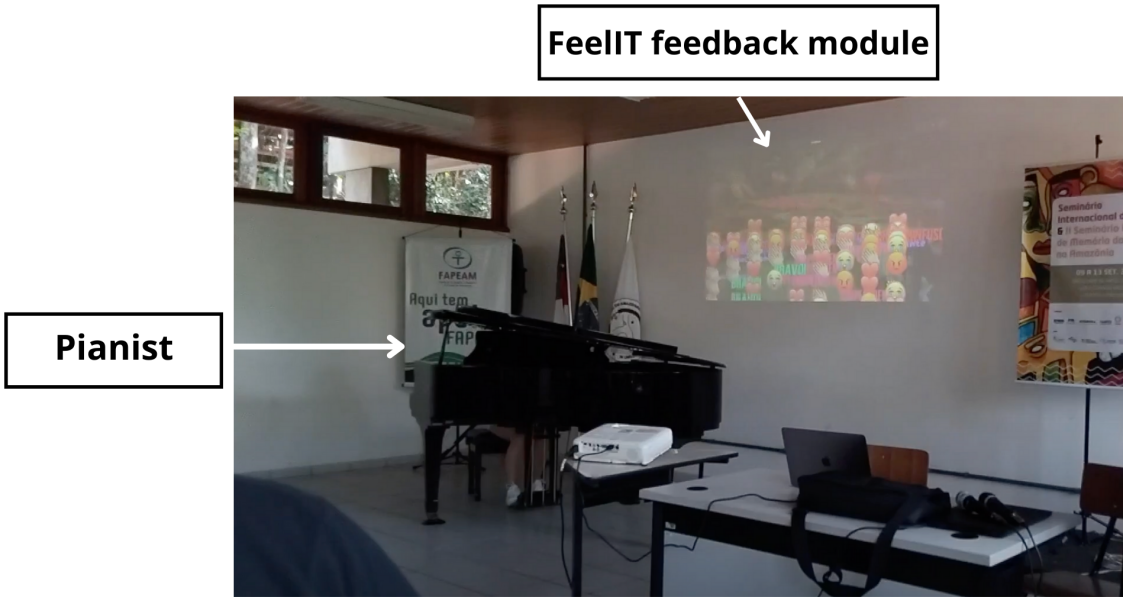

Figure 2. Moment of FeelIt usage during the pilot study. The pianist performs while the audience's emotional reactions are displayed in the background.

Data Analysis: Data analysis employed a mixed-method approach, integrating quantitative and qualitative analyses to provide comprehensive insights. Quantitative data from the User Engagement Scale (UES) questionnaire were analyzed using descriptive statistics, including frequencies and percentages, to identify engagement patterns across different dimensions (Focused Attention, Perceived Usability, Aesthetic Appeal, Reward Factor). This allowed us to assess the overall engagement level quantitatively and pinpoint specific strengths and weaknesses of the application.

Qualitative data obtained from open-ended feedback were analyzed. The qualitative analysis enriched our understanding by providing context and depth to the quantitative findings, allowing a clearer interpretation of participant perceptions, motivations, and suggestions for improvement.

4. Results

The analysis of the User Engagement Scale (UES) and qualitative feedback provides a detailed understanding of how participants interacted with FeelIt during the piano performance. The findings highlight aspects related to engagement, usability, aesthetics, and the rewarding nature of the experience while identifying areas for improvement. The UES questionnaire data were analyzed and are presented in Figure 3. We structure our results based on the four dimensions of UES.

4.1. User Engagement Scale (UES) Analysis

In the Focused Attention dimension, responses indicate that engagement levels varied among participants. When asked whether they "lost themselves in the experience," 12 participants strongly disagreed, 6 disagreed, and 3 remained neutral. On the other hand, 4 participants agreed, and only 1 strongly agreed, indicating that while some users experienced immersion, the majority did not. Similarly, for "The time I spent using FeelIt just

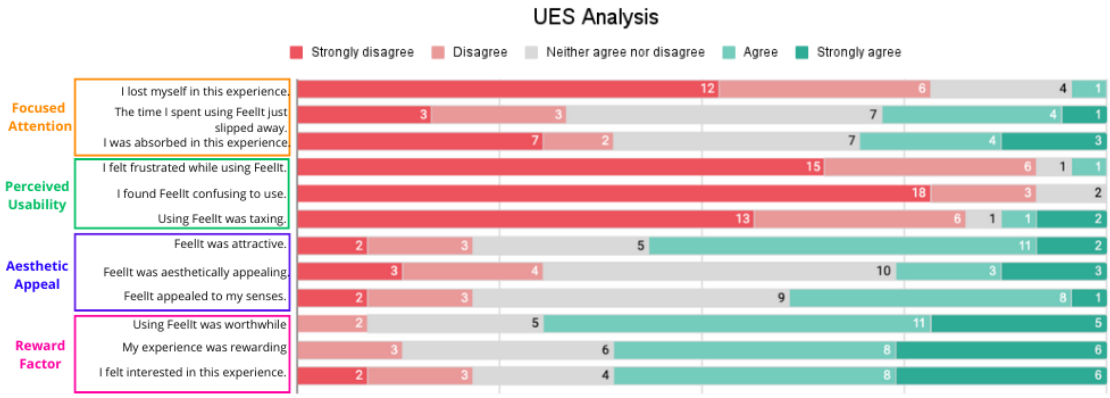

Figure 3. UES Analysis

slipped away," 7 participants neither agreed nor disagreed, 3 disagreed, and 2 strongly disagreed, while 4 agreed and 1 strongly agreed. In the statement "I was absorbed in this experience," 7 participants remained neutral, 4 agreed, and 3 strongly agreed, but a considerable portion (9 participants) disagreed or strongly disagreed. These results suggest that while FeelIt engaged some users, it did not fully capture the attention of the majority, as a significant number of participants did not experience deep immersion.

The Perceived Usability category revealed notable usability challenges. The statement "I felt frustrated while using FeelIt" received strong disagreement from 15 participants, disagreement from 5, and only 1 agreement, showing that while most users did not find the tool frustrating, a few struggled. However, in "I found FeelIt confusing to use," 18 participants strongly disagreed, 3 disagreed, and no one agreed, reinforcing that most users had difficulties navigating the interface. The statement "Using FeelIt was taxing" also reflected similar concerns, with 13 participants strongly disagreeing, 6 disagreeing, and only 3 showing some level of agreement. These findings highlight that although many users did not perceive FeelIt as overwhelming, some areas still require usability improvements.

In contrast, Aesthetic Appeal received predominantly positive responses. When asked whether "FeelIt was attractive," 11 participants agreed, 2 strongly agreed, 5 remained neutral, 3 disagreed, and only 2 strongly disagreed. In the statement "FeelIt was aesthetically appealing", 10 participants neither agreed nor disagreed, 3 agreed, 3 strongly agreed, 4 disagreed, and 3 strongly disagreed. In "FeelIt appealed to my senses," 8 participants agreed, 1 strongly agreed, 9 neutral, 3 disagreed, and 2 strongly disagreed, demonstrating that the application's visual design was generally well received. These results suggest that despite usability issues, participants appreciated the aesthetic and visual aspects of FeelIt.

The Reward Factor also showed strong positive feedback. When asked whether "Using FeelIt was worthwhile," 11 participants agreed, 5 strongly agreed, 6 remained neutral, and only 2 disagreed. Similarly, in "My experience was rewarding", 8 agreed, 6 strongly agreed, 6 were neutral, and only 3 disagreed. In "I felt interested in this experience", 8 agreed, 6 strongly agreed, 4 were neutral, 3 disagreed, and 2 strongly disagreed.

These findings indicate that despite usability concerns, most users found FeelIt to be a valuable and rewarding tool for engagement during the event.

4.2. Qualitative Feedback Analysis

The qualitative feedback reinforces these findings while offering deeper insights into user experiences. Most participants described FeelIt as user-friendly, with comments highlighting its simplicity and intuitive design (e.g., "It was simple and easy to use" - P05, "Easy to understand" - P23). However, some reported technical difficulties, such as challenges scanning the QR code ("Reading the QR code was difficult" - P10, "I couldn't scan the QR code" - P16) or typing responses due to interface constraints ("It was somewhat difficult to type" - P13). Additionally, internet connectivity issues occasionally affected user experience ("At the moment, my network was slow, but that has nothing to do with the application" - P20).

Participants consistently reported that FeelIt significantly enhanced their engagement. Users noted the application encouraged active participation ("It made everyone participate" - P02, "It made me feel like I was actually participating" - P12) and provided valuable insights to performers regarding audience reactions ("It helps presenters understand the audience's opinion" - P16, "It helps see what the audience is feeling" - P06). Several participants expressed that the application made the event more enjoyable and interactive ("Fun" - P07, P20, "Exciting" - P23). Nonetheless, some experienced confusion regarding their visible impact on the collective display, noting difficulty recognizing their contributions amidst many simultaneous reactions ("There were too many reactions at the same time, and I couldn't tell if mine was going through" - P21, "I took some time to understand that it would appear on the front screen" - P17).

Users provided actionable recommendations for improving the application's usability and enhancing overall engagement. Many suggested clearer visual feedback when selecting reactions, such as implementing animations or visual cues to confirm their interactions ("The reaction button could interact in some way, blinking or something similar" - P12, "An animation on the emojis would make it more fun" - P08). Participants also recommended refining the overall interface to increase visual appeal ("A more attractive interface" - P16, "Improve the app's design" - P23) and allowing reaction customization to enhance user confidence in participation ("Customize reactions so the person can be sure they are participating" - P21). Layout improvements were also suggested, including enlarging reaction buttons and enabling landscape mode for improved usability ("The words are quite small; it could be used in landscape mode" - P15). Additionally, participants recommended adding features for user interaction, such as commenting capabilities and user-to-user interaction ("Comment option" - P10, "Interaction with other users" - P10), and conducting test runs before live events to ensure smoother experiences ("Do a test before it officially counts" - P17).

The results indicate that FeelIt was well received in aesthetics and rewarding engagement. However, usability remains an area for improvement, as some users reported difficulties with navigation, real-time feedback visibility, and interface design. While the application successfully engaged many participants, the findings suggest that future iterations of FeelIt should focus on optimizing user experience by enhancing visual feedback, refining the interface, and incorporating additional features to ensure a seamless and interactive experience.

5. Discussion

The core contribution of FeelIt lies in its ability to transform the traditionally passive audience experience into an active, collective interaction that complements the musical performance. Unlike classical concerts, where audience responses are largely restricted to applause at predetermined moments, FeelIt facilitated a continuous and dynamic engagement. Through real-time reactions projected onto the stage, spectators collectively influenced the concert's visual atmosphere. This aligns with previous studies on interactive performances, such as Open Symphony [Wu et al. 2017], which emphasize that audience participation, when structured effectively, enhances engagement without disrupting artistic integrity.

However, the degree of collaborative immersion varied among participants. While some users reported feeling deeply engaged in shaping the scenic environment, others remained neutral or uncertain about the impact of their contributions. This aligns with findings from Wu et al. (2017), which suggest that audience engagement in interactive performances is maximized when participants can perceive how their actions influence the event. The lack of immediate and individualized feedback in FeelIt may have contributed to this disparity, as some users reported difficulties recognizing their participation within the collective display. Addressing this challenge through enhanced visual feedback mechanisms, such as interactive animations highlighting individual contributions before integrating them into the collective display, could strengthen users' sense of unity in the collaborative experience.

Another essential aspect of audience collaboration in FeelIt was its ability to create a shared emotional expression during the concert. The reactions projected onto the stage represented individual sentiments and formed a collective narrative of how the audience experienced the music. This form of emotional synchronization aligns with research on digital participation [Edelman and Singer 2015], highlighting that audience engagement increases when spectators perceive themselves as part of a more extensive, interconnected experience. Future iterations of FeelIt could explore mechanisms to enhance this aspect, such as grouping reactions into thematic visual patterns that evolve dynamically based on audience input, reinforcing the idea of a collectively shaped concert environment.

Despite the positive reception of FeelIt's collaborative aspects, usability challenges impacted the fluidity of participation. Some users reported difficulty perceiving whether their reactions were registered, which may have limited their confidence in contributing to the experience. This issue reflects broader challenges in designing interactive audience systems, as discussed by Veerasawmy and McCarthy (2014), who emphasize that the effectiveness of participatory systems depends on the clarity and immediacy of feedback. To address this, future improvements should include real-time feedback indicators, such as temporary highlights on selected reactions, and an improved user interface that allows participants to track their contributions in the scenic projection better.

5.1. Implications for Design

The findings from this study highlight several implications critical for the design of interactive systems in performing arts contexts. Firstly, ensuring clear and immediate feedback is vital, enabling users to quickly and confidently recognize their contributions. Secondly, designing intuitive interfaces that minimize technical barriers such as QR code scanning

difficulties or text input limitations is essential for enhancing accessibility and usability. Additionally, considering variations in technical infrastructure, such as inconsistent internet connectivity, should inform the design of robust, adaptive systems. Finally, incorporating adaptive visual strategies to manage large numbers of simultaneous user interactions could significantly improve user experience and engagement.

A key takeaway from this study is that collaborative audience participation in classical concerts can be successfully integrated when designed as an augmentative, rather than disruptive, experience. FeelIt demonstrates that by providing structured yet flexible mechanisms for audience expression, spectators can meaningfully contribute to shaping the concert atmosphere without affecting the musician's performance. This differs from interactive performances that allow direct manipulation of musical elements, as explored in Open Symphony [Wu et al. 2017], and instead offers a model where the audience's role is to enhance, rather than alter, the artistic delivery.

Future research should explore how different concert settings, audience sizes, and cultural contexts affect collaborative engagement through FeelIt. Additionally, investigating the potential for adaptive interaction models, where audience reactions influence scenic elements in more nuanced ways (e.g., tempo-sensitive visual transformations), could further expand the impact of interactive audience participation in live music performances. By refining and optimizing its collaborative framework, FeelIt paves the way for a new paradigm of audience engagement in classical concerts, transforming spectators into active participants in the artistic experience.

5.2. Threats to Validity

While this study provides valuable insights into audience engagement in interactive concerts, several threats to validity must be considered. Below, we identify these threats and discuss how we mitigated them.

One potential threat is the novelty effect, where participants may have been excited about using a new technology rather than responding to the actual effectiveness of FeelIt. To mitigate this, we ensured that our analysis included quantitative and qualitative data, allowing us to capture long-term engagement indicators beyond initial enthusiasm. Additionally, we examined whether users reported usability issues that could hinder engagement rather than assuming a positive response was purely due to novelty.

The study was conducted in a single event with a specific audience demographic, which may limit generalizability to other types of performances or cultural contexts. To address this, we compared our findings with related literature on audience engagement in interactive concerts [Jacucci et al. 2007, Wu et al. 2017], ensuring that our observations align with broader patterns in the field. Future studies should apply FeelIt in different musical genres and settings to further validate its effectiveness.

Another possible threat is response bias, where participants may have provided socially desirable answers rather than their genuine opinions. To reduce this risk, we included anonymous surveys and open-ended questions, allowing participants to express positive and negative feedback freely. The balance of supportive and critical responses in our results suggests that participants felt comfortable sharing honest opinions.

Given that the study involved subjective user experiences, there is an inherent

challenge in ensuring consistency in responses. To enhance reliability, we used the validated User Engagement Scale (UES) [O'Brien et al. 2018] structured measurement and complemented it with qualitative analysis to gain deeper insights into user perceptions. Repeating similar studies in future iterations of FeelIt will help confirm whether these findings remain consistent across different contexts.

By addressing these threats, we aimed to strengthen the validity of our findings and provide a more robust understanding of how FeelIt contributes to interactive audience participation in live concerts. Future work should build on this foundation by expanding the scope of the study and refining the methodology to further enhance generalizability and reliability.

6. Conclusion

This study explored how the audience can collaboratively contribute to shaping an interactive scenic environment in piano concerts without disrupting the musician's performance. By leveraging the FeelIt application, we introduced a novel approach that enables spectators to engage in real-time, expressing their emotions through visual reactions without interfering with the artistic execution of the performance.

The findings indicate that FeelIt effectively facilitated audience engagement, with many participants appreciating the opportunity to interact with the concert dynamically. The User Engagement Scale (UES) results highlighted positive aspects of the tool's aesthetic appeal and rewarding nature, reinforcing its potential to enhance the audience experience. However, usability and real-time feedback perception challenges emerged, with participants suggesting improvements in interface design, reaction visibility, and interaction mechanics.

Compared to previous research on interactive musical experiences, FeelIt offers a unique contribution by focusing on non-intrusive audience participation. Unlike systems that modify the musical structure or directly influence the performance, FeelIt enhances engagement while maintaining classical music concerts' formal and technical integrity. This aligns with prior studies on digital audience interaction but extends their applicability to traditionally passive performance settings, such as piano recitals.

Future work should address the usability challenges identified in this study by refining visual feedback mechanisms, expanding reaction customization options, and exploring different performance contexts to assess the tool's adaptability. Additionally, further studies could investigate the long-term impact of interactive audience experiences on musical performances and the potential for integrating machine learning techniques to personalize engagement strategies.

By bridging the gap between active participation and artistic preservation, FeelIt presents a promising avenue for enhancing audience engagement in live performances. As digital interactivity shapes cultural events, tools like FeelIt pave the way for more immersive and inclusive musical experiences, fostering deeper connections between performers and audiences.

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