



A solution for immersive, interactive EDM live performances that are controlled remotely

Author : Christos Constantinou

Supervisor : dr.ir. E.C. Dertien (Edwin)

Critical Observer : dr. D.B.W. Postma (Dees)

University of Twente, Enschede, Netherlands

Abstract

BLOCK // SYSTEM is an alternative way of conducting an Electronic Dance Music (EDM) live performance. What differentiates it from a traditional EDM live event is that in addition to being performed remotely inside a 360-projection mapping room, this project features possibilities for direct crowd interaction with the music and visuals that are displayed. The goal of this research is to examine what makes such a performance immersive and satisfactory to the audience. The lack of academic input on evaluating EDM live performances is apparent. Therefore this research examines a new way of measuring crowd immersion in the context of an EDM live show by introducing the concept of the "clickers". In addition, the original concept of BLOCK // SYSTEM doubles as an art installation since all the music and visuals that are featured in the event were created from the ground up. Lastly variations of the original idea are also tested and evaluated in parallel which reveal a variety of different opportunities for future development of the project.

Key words: immersion, art installation, live performance, live show EDM, interactive rave, audio visual immersion, music concert setup, remote music live, audience participation, interactive audience participation

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1.Introduction

Audiovisual live experiences are a wildly popular form of entertainment. Attending an event that features live music invokes a truly special mixture of feelings that is extremely difficult to recreate in a pre-recorded or remote context (Tarumi et al.,2017). Such events commonly take the form of live music shows or interactive installations which put heavy focus on immersing the audience member in an audiovisual experience.



Figure 1 EDM Live Performance, Excision (RUKES, 2018)

1.1 Context

PLANETART is an artist initiative based in Enschede and act as the main stakeholders of the project. One of their past projects is the 360LAB, a square room that features 8 beamers and a built-in audio system located in Spacebar (Enschede). (PLANETART, 2022)



Figure 2 The 360LAB, located in Spacebar, Enshcede (PLANETART,2020)

Furthermore, they are the hosts of GGOBOT, an annual festival focusing on art & technology that features installations based around a certain, pre-determined theme that changes from year to year.

1.2 Goal

The goal of this project is to design an interactive audiovisual live show for PLANETART, that will take place inside the 360LAB and will be showcased during the GGOBOT festival.

The final design should satisfy the following conditions:

- It's an immersive experience to the audience that features original audiovisual content that relates to the theme of GGOBOT.
- It's interactive, meaning the audience can participate and influence the show in real time.
- It can be controlled remotely.

The minimal viable product should satisfy all 3 conditions in the lowest functional degree.

By the end of the graduation project (~20 weeks), the installation should be in the stage of a working prototype, with all the necessary research to back up the design choices that will be applied to the final product.

1.3 Research Questions

In order to achieve the goal of the project, four main questions need to be answered through research. The questions are:

- A) How can immersion be created in a physical, interactive environment?
- B) What is the state-of-the-art in the field of interactive and/or remote-controlled live music performances?
- C) What are the desires of the target audience of such experiences?
- D) What are some existing projects or material that can act as a source of inspiration for this installation?

The questions are to be answered using mixed research since both quantitative and qualitative data will be examined, however the latter will be more dominant throughout the paper. The data will be collected from past research, expert interviews, surveying, and testing.

1.4 Structure

The first part of the paper will focus on gathering relevant data on target audience and previous research on closely related projects.

The second part will primarily be focused on the construction of the final installation that will be based on a lo-fi prototype from phase one.

2.State of the art

2.1 Background Research

2.1.1 Literature Review on immersion

Immersion is a term that does not have a fixed definition. The concept varies depending on context and circumstances. However, by examining a handful of relevant academic papers that have immersion at the forefront, a framework that fits the specific context of the research can be defined. Immersion can be identified in the scope of audiovisual experiences. In their paper Agrawal et al. (2020) reach the overarching conclusion that immersion is simply a shift in one's attentional state that often causes disassociation from reality. This is caused by the individuals cognitive processes which have to be enabled by heavy mental investment in the situation. Since immersion is a mental process, it can take place either with or without sensory stimulation as long as the aforementioned effects are caused to the individual.

Nevertheless, the definition of the term varies significantly based on the context. In his research Seo, (2022) explores immersion from a broader perspective. Therefore, he splits the concept into 3 categories: Interactive Art, Physical Environment and New Media. For this research the first two categories are most relevant, however examining immersion in new media can of course help when trying to grasp the full picture of immersion. Immersion in interactive art is described as a spatial, temporal experience, that surrounds the participant in a discrete and panoramic space which is also combined with computational components. In a physical environment experience is defined as a space where the viewer can experience imagination evoking feelings (such as awe) and inherent or internal body senses. This is accomplished through materials that affect with perceptions of dimension. Lastly in new media immersion is defined as an experience where absorbs and provokes a process, a change, and a passage from one mental change to another. Awe is often seen as a core component of transformative experiences such as immersion. Quesnel et al., (2018) define that feeling as a sense of belonging and greater purpose. They go on to describe that as the direct and initial experience or feeling that is triggered when confronted with something amazing, incomprehensible, or sublime. Through the aforementioned, it can be deduced that immersion is a strongly mental process where the participant often experiences feelings of disassociation and awe. This state can be reached in multiple ways, with or without sensory stimulation but when trying to achieve this in a contained environment, materials that affect the perceptions of one's dimension are crucial.

By understanding what defines immersion one can begin examining methods of creating and communicating this feeling to an audience. The first stage of this process is to detect and quantify the variables that can affect immersion. Agrawal et al. (2020) support that in audiovisual immersion the system, content, environment, individual factors, and interaction between the individual and the experience are identified as the five factors that are of influence. The notion that immersion consists of bodily, spatial, and contextual consciousness compliments that quite well since all those characteristics can be linked with the aforementioned five factors. In interactive media the active involvement of the participant is also required since immersion can be created from perceptual cues, while in physical spaces manipulating the relationships between body, mind and world is a crucial factor in crafting such experience (Seo, ,2022). Adding to that Quesnel et al. (2018) note that when tackling this task, artistic practices must be blended with proper RBD

(research-based design) practices in order to reach the maximum possible result in terms of immersion.

The second stage is to explore different means that can be used to control those variables as well as techniques that are successful for an audience to absorb immersiveness. Again, Agrawal et al. (2020) present a variety of different methods that this can be achieved in the audiovisual realm. Presenting a narrative, through a storyline for example, can have that effect. Moreover, confronting the audience with tactical and/or strategical challenges is an additional way of reaching this goal. Finally, creating the subjective feeling of being surrounded which is linked to multisensory stimulation can also inflict the sense of immersion. In a more practical sense, Quesnel et al. (2018) suggest that HMD (Head Mounted Devices) such as VR headsets alone are not enough since the participant is still aware of their external environment. Hence a solution involving the use of a physical mixed-reality environment is proposed, where the user is wearing an HMD while being located at a physical location which is set up in a way that compliments the overall experience that is presented through the device. Seo J. (2022) agrees that a solution could entail interplay between real media and virtual contents and adds that physical spaces that attempt to inflict immersive feelings ought to put immense focus on physical material, which should be simple and direct to the user. On immersive interaction, he notes that artists and designers have more possibilities than ever through the modern available programming tools. Likewise, both agree that artistic media, such as emotion-evoking audio and visuals, is key to not only physical environments but immersive experiences overall.

2.1.2 GOGBOT

For GOGBOT 2022 the theme will be "From Solarpunk to MetaFuck". Solarpunk refers to an art movement, which generally foresees a future where we live in coherence with nature in a sustainable and egalitarian world. (Smith, 2021). MetaFuck refers to the Metaverse, a place parallel to the physical world, where you spend your digital life through your very own avatar that can interact with other avatars that controlled by real life users. Large technology companies like Facebook/Meta, Microsoft, Apple and Google are actively trying to make that concept a reality (Shamani, 2022). This potentially drives us towards a world where the metaverse is monopolized by tech giants and thus this version of the future can be seen as bleak and elitist, or in other words the opposite of what the solarpunk movement conveys (hence the condescending "-Fuck" characterization).

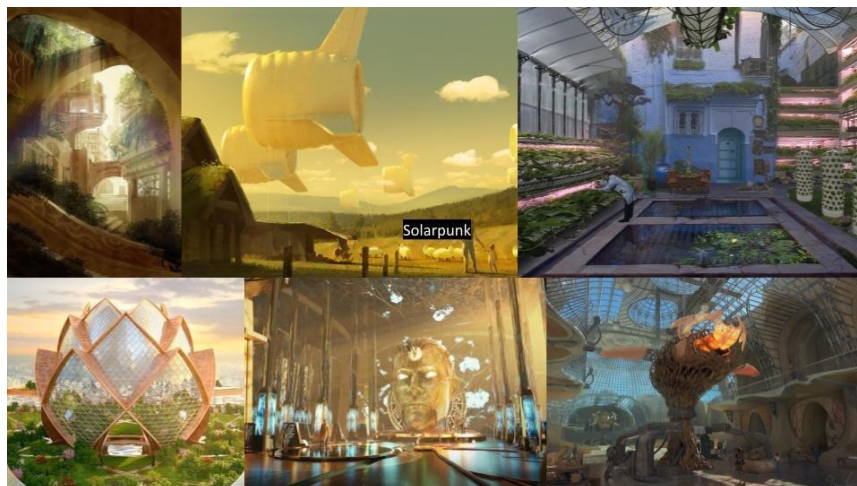


Figure 3 Solarpunk Moodbord (Binoodha Kunnath & Ghazal (Q) Jenab,)

Essentially the contrast between these two concepts is what the theme of GGOBOT 2022 will be all about, therefore the storytelling element of the project will be heavily influenced by this.

2.1.3 Design Process

Findings on past research and related work act as a starting point, which gives the project a sense of focus that will allow for constructive ideation and lo-fi prototyping. The lo-fi prototypes will be self-tested and self-assessed. By the end the most efficient prototype will be chosen for extensive development. This procedure will follow the non-linear five step design thinking process, a method used by prestigious companies and taught in many high-level institutes around the world (Dam & Siang, 2019). The five-step design thinking process will also be used while designing the final prototype; however, the steps will be executed in order to improve and fine-tune the specific prototype that was picked in the end of the first stage.

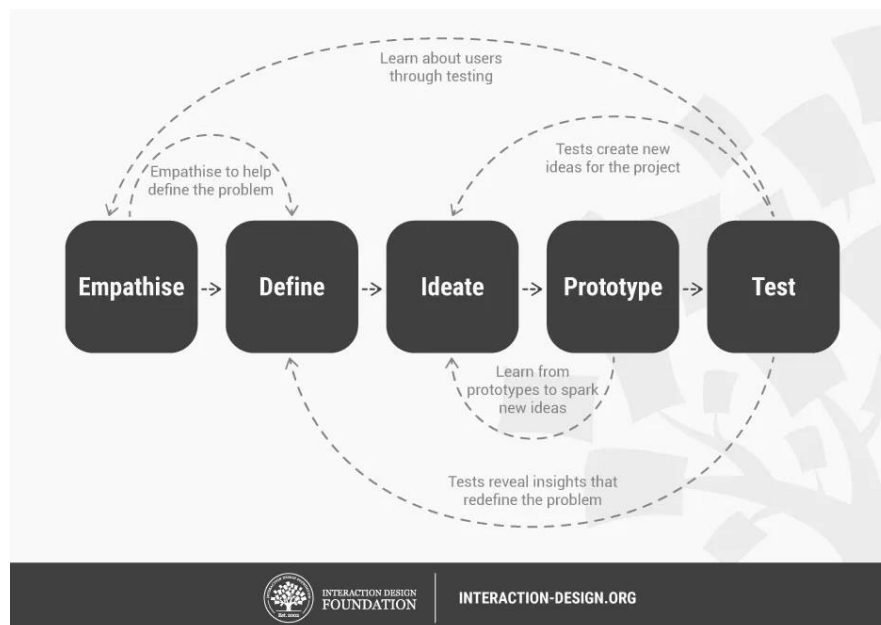


Figure 4 Five step design thinking process (Dam & Siang, 2019)

2.2 Related work

2.2.1 Audience participation

In the context of a live music performance, two types of crowd interaction are proven to be the most satisfactory; audience with audience and audience with performer (Radbourne et al., 2009, as cited in Zhang et al., 2016). In this research the latter will be explored in more detail. Zhang et al. (2016) acknowledge the fact that when considering a large audience, it's difficult for individual members to interact with the performer. They go on to propose a solution where audience can collectively vote on different musical elements that make up a live music performance via their mobile phones such as volume intensity, pitch tone, tempo, or even different pre-composed music sequences. Essentially this worked as an effective communication tool between the performer and the audience since the former still maintained the freedom to either comply with the voting poll or not. This choice was made in order to maintain a balance between audience participation and musical quality.

Past research on group interaction and relevant design projects proposes different techniques that allow an audience to participate in a shared experience. Each technique of course has both advantages as well as drawbacks and limitations which may vary depending on the context. In their paper on interactive audience participation, Maynes-Aminzade et al. (2002) examine different techniques on how an audience can control onscreen shared entertainment experiences:

Audience Movement Tracking

By using a live camera feed the movement of the audience can be captured and used as input for various interactive activities. They specifically refer to a system that does not track each audience member individually, but rather the audience as a whole. The overall conclusion is that using the movement of the audience to trigger events in a live performance setting is an effective technique, even though some technical issues have to be overcome during the calibration phase which in their case had to take place before each performance.

Real-time sound processing

Real-time sound processing (pitch shifting, EQ-ing, bpm manipulation etc.) is a technique that offers a lot of audience participation opportunities. Dannenberg et al. (1997) reference a pattern that combines it with real-time sound recording by positioning microphones around a space for the audience to interact with. This can lead to applications such as call-and-response type games, audience polling and sing-along interaction.

Object shadow tracking

This technique takes advantage of the shadow that an object casts when placed in front of a projection beamer. In this case the shadow of a beach ball which is let free for the audience to bat around the space of the performance is tracked via a camera that faces the projection. The shadow of the ball is used as a cursor for the audience to collectively control in order to interact with various onscreen events. Tracking the shadow instead of the ball is an efficient technique since it requires less calibration and can be used no-matter the color and style of the ball. Since this is accomplished by detecting dark regions within an image, one drawback is that the content around the shadow needs to be highly

saturated in order to establish the contrast between the game and the shadows. Most of the focus is put on tracking the shadow of a beach ball since they are commonly bat around in events that feature large crowds, however it is mentioned that other objects can be equally as effective.

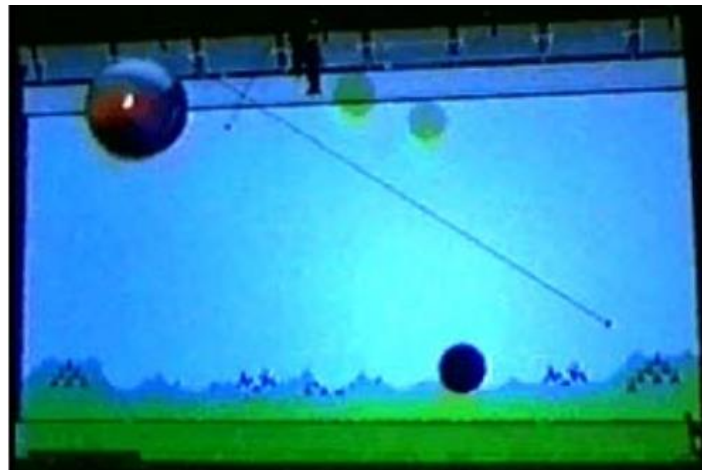


Figure 5 Missile Command using beach ball (Maynes-Aminzade et al., 2002)

Laser point tracking

This is yet another effective technique when dealing with large crowd interaction. When laser pointers are distributed to an audience, a variety of activities that track onscreen laser pointers become available such as collaborative painting, audio sample mixing and trivia where the audience can vote on each question. While the technique yields promising results some drawbacks are very noticeable, mainly the danger of eye damage while dealing with such equipment. Another issue that was observed is difficulty in the audience differentiating their own pointer, since the screen can easily become cluttered. This can be partially resolved in activities such as trivia by having only a portion of the audience using the lasers while the rest can vocally express their opinion. Another workaround for non-trivia activities is differentiating the pointers by either having different lenses or colors available, however this assumes that the system can register the various types of laser pointers as well.

It is worth mentioning that some of the techniques mentioned above do not fully comply with the findings of Seo (2022). He supports that the use of interactive material in a contained environment is key for physical immersion, something that is not necessary for the application of audience movement tracking or real-time sound processing. However, this does not act as a way to filter out the aforementioned techniques since proper audience participation is a priority, therefore while physical immersion is something to consider it should not act as a limitation in the design phase.

2.2.2 Remote live performances

According to Tarumi et al. (2017) there are four key values that live show experiences can provide to the audience: i) Unusualness, ii) Sense of unity, iii) Viewpoint and iv) Tired feeling. In their paper they concluded that unusualness is impossible to reproduce in a remote environment since it requires physical proximity between the musician and the audience. Attempts have been made to capture the sense of unity through VR and while they were partially successful it was noted that overall VR fails to provide the same level of satisfaction compared to a physical live show setting. Viewpoint and tired feeling were two values that were also difficult to reproduce technically.



Figure 6 Remote virtual live house (Kaneko et al., 2018).

It is worth mentioning that previous research in remote setups mainly assumes that each individual member of the live show including the performer participates remotely. In this paper this is not the case since the audience is considered its own entity, therefore the remote interaction will just be between the crowd and the performer.

A variety of different protocols are available for communication between devices which is crucial when considering remote applications. The NDI (Network Device Interface) protocol is often used in video transmission over network (NewTek, 2022) while the VBAN protocol is mainly used for sound related network applications (VB-Audio, 2022). When considering actions that simply rely on data exchange such as in-software clip triggering or audio playback the MIDI (Musical Instrument Digital Interface) and OSC (Open Sound Control) protocols are common, with the former being common in local settings while the latter being more prominent in applications where data gets transmitted over network.

2.2.3 Client interview

An interview with Gustav "Gus" Eckrodt, the internship coordinator at PLANETART and one of the supervisors of the project was conducted in order to get an insight on previous work and a better understanding of what exactly they are looking for.

According to Eckrodt, there were 2 major installments that made use of the 360LAB in the past. "Synesthetic Synthesis", a project created by Bas Arkes & Deev Bennes was an audiovisual experience that let the user come up with their own sound and visuals via a game controller. Eckrodt noted that the project was a big success.

The second project was unfortunately left unfinished. The concept behind it was to utilize motion, specifically dancing in order to generate sounds and visuals in the 360LAB. A handful of techniques were tested including wearable technology and motion capture through the Kinect but ultimately the project collapsed through technological limitations. Specifically, the PC that was available at the 360LAB had lower specs than the project required causing input delay issues. According to Eckrodt this could have been avoided if the research at the hardware was done properly.

Apart from the 2 major projects they sometimes rent out the space to local VJs that often play visual shows for a small crowd (no more than 5 people).

When asked what he didn't want to see he replied that another audio visualizer, specifically one that is fully controlled by the user was something he ideally wanted to avoid. In his experience this is something that is not very efficient so a more passive solution as far as the user is concerned is preferred. After briefing him on the idea of a remote-controlled audiovisual performance he agreed that something along those lines was more fitting for PLANETART since it gives the user a more concise and bulletproof experience. He referenced CLUSTER, an audiovisual installation at GogBot 2020 as a potential source of inspiration.



Figure 7 CLUSTER (GOGBOT,2020)

Even though he was happy with the main concept of this project and didn't seem to have many concerns he pointed out that the connection between the music and visuals is something difficult to capture. "When listening to music we mostly focus on the big picture, often overlooking the smaller details that a composition contains" he explained. By expanding on that point of discussion the conclusion that the installation should make the connection between music and visuals as satisfying as possible was reached.

2.2.4 Synesthetic Synthesis

Synesthetic Synthesis is a project of Bas Arkes and Deev Bennes created in 2021. The project utilized the 360LAB to create an interactive, audiovisual experience which allowed the user to navigate through different levels, while creating sounds and imagery that relate to a digital environment. A key difference is that the experience was controlled by a single user at a time (via a game controller) as opposed to an audience, however the common grounds with this research were vast enough to justify a one-on-one interview with Arkes, one of the co-creators of the experience.

Arkes explained that the installation was essentially their attempt to capture and evoke the feeling of sound-to-image synesthesia, a condition where a person is able to see shapes of colors when they perceive audial cues, to the user (Nelson, 2018). This was achieved by allowing the user to synthesize their own sounds and visuals within the 360LAB using a

wired game controller. The experience consisted of 4 worlds for the participant to explore. He also elaborated on the design-oriented characteristics of the project. Resolume Arena 7 (Resolume, 2022b), a popular VJ program in combination with VCV Rack (VCV Rack, 2022), a digital modular synthesizer, were the core software that was used in order to craft the experience. The former was utilized for the visuals while the latter was used for the sound. Both were running on the PLANETART PC that is permanently mounted on the ceiling of the 360LAB, which is also connected to the projector beamers and speakers that are in the room. Arkes stance against resource demanding software such as blender (Blender Foundation, 2019) or Unity (Unity Technologies, 2019) for real time displaying was clear, since in his opinion the available PC is simply not powerful enough to run such programs, especially if the installation requires real-time user interaction. He later added that the PC specifically often acted as a limitation and warned against using software that are heavy on the machines GPU (Graphics Processing Unit). During their research additional methods of user input were also tested. Initially the user should have been able to interact with movement which was meant to be captured by a Microsoft Kinect that was mounted on the ceiling of the room. This ultimately failed since the range of Kinect wasn't large enough to capture the space required for the user to interact. Additionally, the lightning in the room made it hard for the device to capture movement in a reliable manner. When asked if there was something that he wished was done differently on the project he replied that the users had trouble figuring out the controls, even with a controller scheme. A potential way this could be resolved according to Arkes was by implementing a video or animation of how the controls work before the user gets the chance to start the experience.

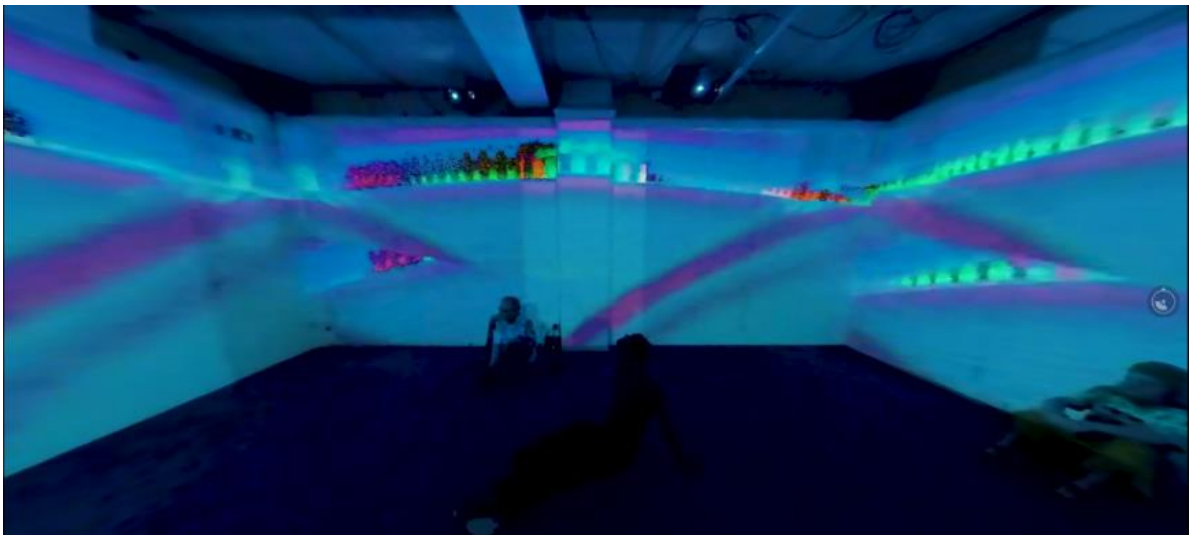


Figure 8 Synesthetic Synthesis (Bas Arkes & Deev Bennes ,2021)

2.3 Target audience research

2.3.1 Survey on audiovisual shows

In order to get a better understanding on the past experiences, opinions and desires of the target audience, an online survey was conducted. In an attempt to invoke qualitative data from the target demographic, the survey consisted of mostly open-ended questions which revolved around the topic of live electronic dance music (EDM) performances. The survey was shared with the intended users of the installation, which were people over 18, who frequent live EDM shows either as a member of the audience or as a performer. 13 responses have been recorded; however, the respondents were free to choose which questions to answer, therefore not all questions have 13 responses (Appendix).

The first and only closed ended question was regarding what the target audience finds most important in such events, which presented the respondent with 11 different choices.

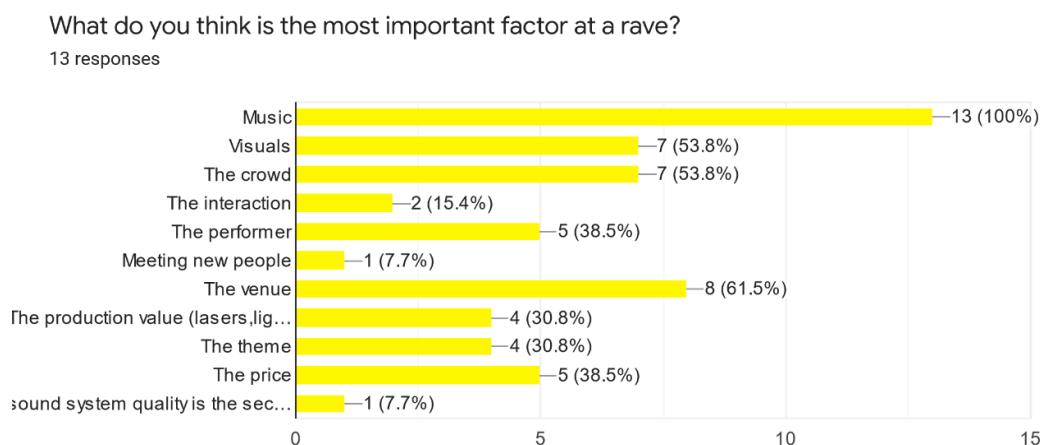


Figure 9 Survey Question 1 Results

It's clear that event attendees value the quality of the music above everything else, followed by the venue. The quality of the crowd and visuals are the third most sought after factor with ~53% (7/13) of the survey answers in its favor.

This statistic is reflected to the open-ended questions. When asked "Why do you attend raves?" 9 of the 13 answers directly mention that listening to music live is one of the most prominent reasons for attending such events. Some answers elaborate on that a bit more on the reason live music is exciting. Discovering new music, loudness and hearing unreleased music are all reasons that were used for justification. Four responses also mention dancing. While not being a popular choice in the first question, meeting other people is mentioned more in this question with five answers mentioning that. Lastly three answers also talk about the atmosphere of raves. Mainly the underground feeling of raves, the crowd energy and being around people with similar interests are referenced.

In order to get a better understanding of what type of music the target audience desires the following question was included "What type of music do you typically look for at raves? Why?". Most responses mostly list off their preferred genres with 9 out of 13 answers directly mentioning techno which was by far the most prominent genre. One response goes into more detail, saying that even though there are elements of techno they enjoy it quickly becomes boring to them so variation in music (and visuals) is something they're looking for. This stance was echoed by another response as they list of drum and bass, a genre that got three mentions, and go on to explain that their reasoning

is that it's a diverse genre that doesn't feature a lot of repetitiveness. Furthermore, all answers that mention expect for one techno also list of diverse variations of genres such as house, downtempo, dubstep, electro, psychedelic and acid. Unlike the rest of the responses, one answer does not explicitly mention a genre, it does however point out that having musical low and high points in a performance is key since it evokes a positive crowd reaction.

A similar question was asked on what type of visuals attendees look for in raves. The answers were more versatile, and not as specific. Synchronization with music and minimalism in visuals were mentioned twice, making them the only characteristics that were listed more than once. In the case of the latter, there was a response that had an opposite stance since their preference was for the visuals to be excessive. Other responses describe their preferred styles as creative, liquid, psychedelic, hypnotizing with nice colors and "eye fucks". One response mentions dancing naked women, while another lists off music genres such as electro, nu disco, techno etc. The latter will not be taken into consideration as clarification is missing and can be a potential mistake.

When the respondents were asked about their favorite personal experiences 11 diverse responses were recorded, including multiple events and locations. Various experiences are recalled such as names of large EDM festivals (Rampage, Blackout, Tomorrowland etc), locations where raves took place (desert, Enschede, Madrid etc) and more relatively unknown small-scale events (illegal parties with friends and illegal warehouse raves of the 90s). When asked for examples of raves the respondent would like to attend the 10 answers included a similar level of range.

This degree of diversity is carried over when asked for elaboration on why the aforementioned events were mentioned in the first place. The importance of an attractive lineup which often is related to the type of music played was referenced throughout the responses. While the importance of the environment was mentioned in 6 out of the 10 responses different factors are being linked to what makes the atmosphere great. Some point to the production value which can include stage production and sound system while others relate their satisfaction on the setting and theme of the event. The behavior of the audience was mentioned too, as crowd that is energetic and friendly seems to contribute to the overall experience. One person just states "xtc", likely refereeing to the substance ecstasy which is often linked to EDM events. The question "What do you NOT like about raves?" evoked answers revolving mostly around the logistics such as the condition of the bathrooms, crowdedness, and low production value.

All responses agree that the crowd plays a major role in such shows with many pointing out the importance of the audience-performer relationship. Interaction according to the answers can also be achieved when this relationship is strong, with some answers also adding that this can be enhanced by digitalization or an intimate setting such as a lounge area for example. One answer also points out that this often is built on a chain reaction where the performer passes their energy onto the crowd and vice versa. Another answer suggests polls before or during the show where the audience has a say in what music is being played.

When considering EDM events around Enschede a lot of answers include shows hosted by PLANETART. Finally, when asked on what a dream rave would look like, most answers echoed what was previously stated, with a strong atmosphere and diverse music being at the forefront, however some unrealistic answers were given as well such as a skydiving rave or dancing unicorns which even though non-viable can act as visual inspiration.

2.4 Inspiration

As the project's nature mainly focuses on design, already existing audiovisual footage will be used as concept art, reference, or inspiration throughout the process. This type of content can be split into two categories: i) Content related to the physical installation and ii) Content related to the projected footage and storytelling.

i) Content related to the physical installation: This mainly consists of imagery that relates to the physical 360LAB installation. Some examples may include the pictures referenced below, however this is not limited to real life physical installations. This type of content is used in order to indicate some level of direction of this project.



Figure 10 Immersive Room Concept (The Incredibles 2, 2018)

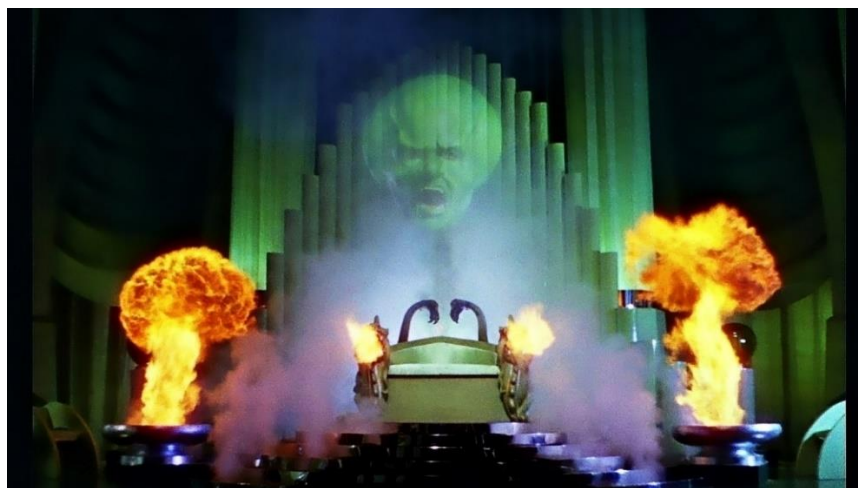


Figure 11 Floating head (The Wizard of Oz, 1939)

ii) Content related to the projected footage and storytelling: This is artwork that will influence the type of music and visuals the audience will be able to experience in the final product. The solarpunk theme will of course be a main source of inspiration as well since it is directly linked with the stakeholders' vision.

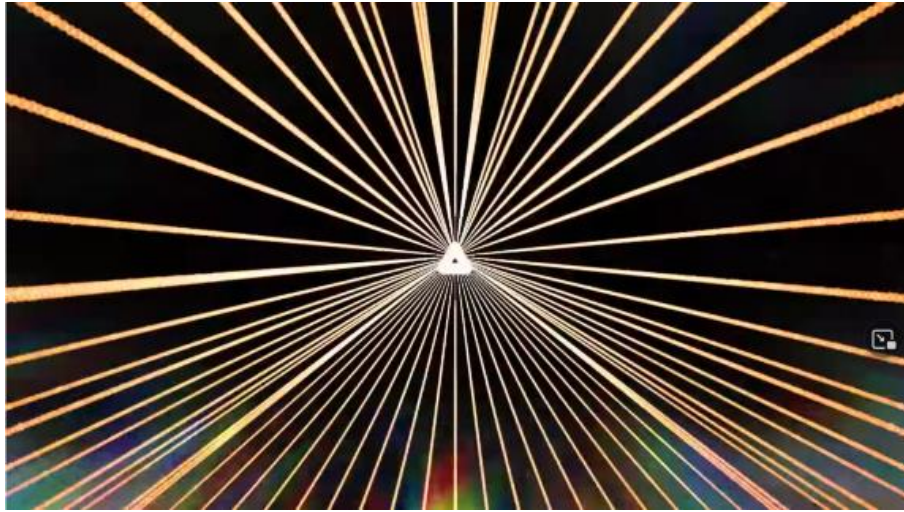


Figure 12 Daft Punk - Alive 2007 (Visualization Video) (Xero Foxx)

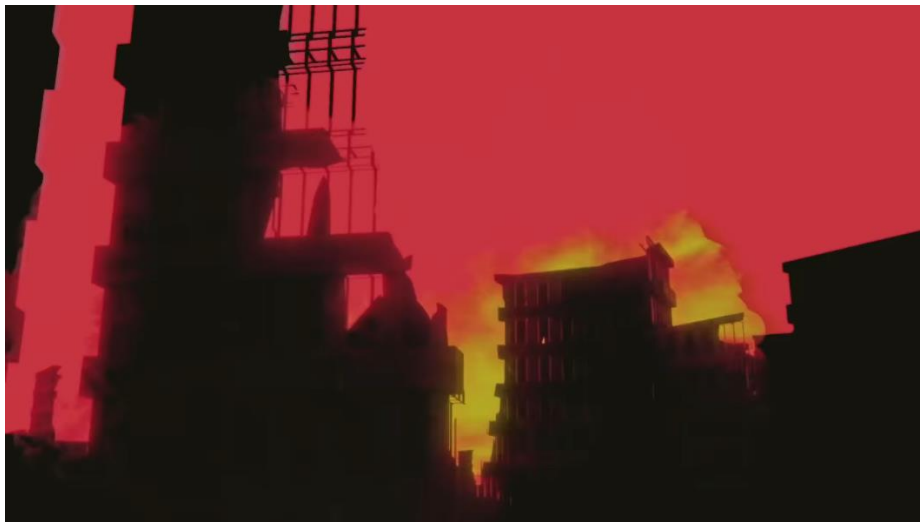


Figure 13 Vaultage 003[audio&visual mix] (Slider, 2021)

Some projects act as inspiration in both categories, mainly live EDM performances such as HOLO (Eric Prydz & Res media, 2019) and In Concert (Cosmic Gate, 2020) generated a huge amount of success and positive reactions. Closely examining and taking inspiration from such immersive-focused performances would be a part of this research.

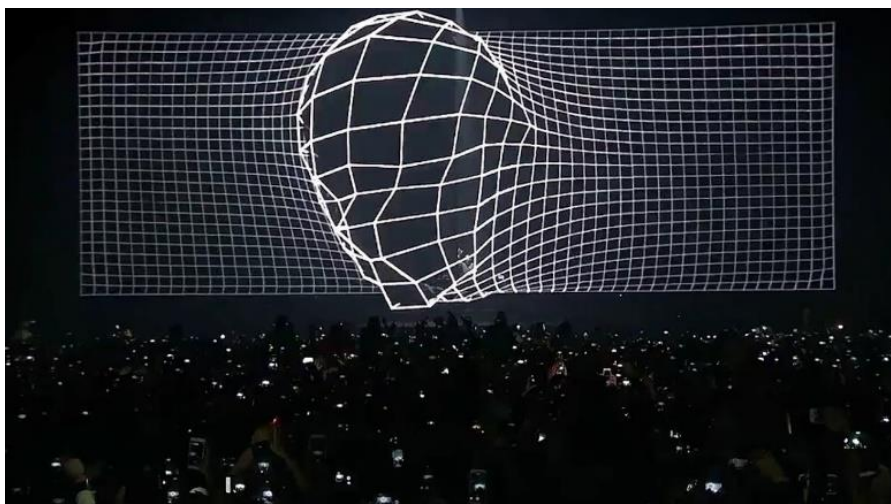


Figure 14 HOLO (Eric Prydz, Res 2019)



Figure 15 Cosmic Gate In Concert at Temple House, Miami (03.10.2020)

"Shitposting" refers to nonsensical, surreal, and ironic content that can be created and shared by anyone over the internet (Manavis, 2021). According to Kees de Groot, lead director of PANETART, this type of content is directly related to the theme of the 2022 version of the GOGBOT festival since posts like these, act as an additional element to the protest against the Metaverse that the festival will promote therefore it will act as an additional form of inspiration for the final design.

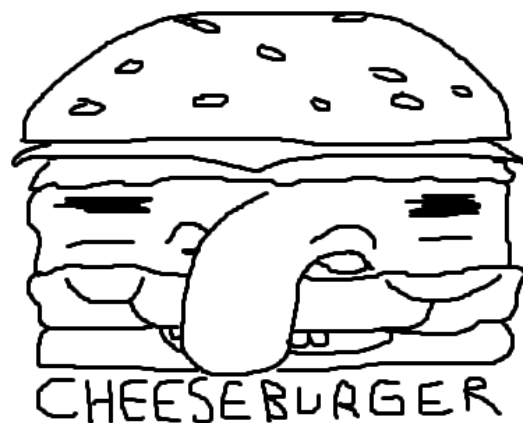


Figure 16 Shitposting example

2.5 Requirements

As mentioned in the introduction the final design should satisfy the following conditions:

1. It's an immersive experience to the audience that features original audiovisual content that relates to the theme of GGOBOT.
2. It's interactive, meaning the audience can participate and influence the show in real time
3. It can be controlled remotely:

The minimal viable product should satisfy all 3 in the lowest functional degree. This implies that a handful of requirements should be fulfilled that would allow the final design to comply with the aforementioned conditions.

The installation will potentially take the form of either a scheduled live music event or an open exhibition, depending on the success of each form in the testing phase. In case of the former a time frame for the event has to be decided. After examining the 2022 set timetable for the ULTRA, a popular EDM live festival, it was observed that most acts lasted between 60 and 90 minutes, a timeframe which is common among single acts in the EDM scene (ULTRA Music festival, 2022). As the installation is essentially an EDM performance, the aim is to have the duration of the act be lower than 60 mins. The exact time frame will be decided during testing. The final design should also be able to host approximately 20-30 audience members simultaneously. The exact number will be decided during the testing phase; however, this approximation was reached after discussions with PLANETART.

Heavy focus will be put in the relationship between graphics and music, as well as the overarching storytelling elements that the performance will contain. As per Agrawal et al. (2020) this will enhance the experience in terms of immersion. The majority of audiovisual content should therefore be created from scratch in order to ensure that it satisfies these conditions and fits within the specific scope of the experience. In case that content that was created outside of the project is used it will be properly credited. The audience should be able to interact with the visuals or sounds that are emitted.

Maynes-Aminzade et al. (2002) propose a set of principles that installations using audience interaction should fulfil. The principles cover three scopes which are System Design, Social factors, and Game Design:

System Design:

- Focus on the activity, not the technology
- You do not need to sense every audience member
- Make the control mechanism obvious

Social Factors:

- Play to the emotional sensibilities of the crowd
- Facilitate cooperation between audience members

Game Design:

- Vary the pacing of the activity
- Ramp up the difficulty of the activity

In this paper the aforementioned principles are not hard requirements. Instead, they act as guidelines when considering meaningful audience interaction.

Due to limitations within the 360LAB having a setup for the performer within the room is not possible. Therefore, a solution where the entertainer is able to perform outside of the space is required. This however arises the issue of physical proximity between the performer and the user that was discussed by Tarumi et al. (2017). Some possible solutions are to stream live footage of the performer within the 360LAB or have them perform somewhere close by so that the audience can still be able to physically interact with them.

These requirements are analyzed using MoSCoW, a technique where the design requirements are put into four different categories (Must, Should, Could, Won't) with descending order based on prioritization:

MUST HAVE <ul style="list-style-type: none">- Controlled remotely- Audiovisual content- Audience participation/interaction	SHOULD HAVE <ul style="list-style-type: none">- Performer can see the crowd
COULD HAVE <ul style="list-style-type: none">-Performer presence via camera-Performer microphone-~30-60 minutes runtime-Set up as an installation	WON'T HAVE <ul style="list-style-type: none">-Human recognition AI-Motion detection-Acoustic proofing

3. Design

3.1 Ideation

3.1.1 Brainstorming

The ideation process was done in parallel with the lo-fi prototyping and research phases. Plenty of ideas inspired from the research phase were documented and some examined further in the lo-fi prototypes. Frequent discussions with dr. Edwin Dertien, supervisor of this research, generated a lot of useful resources in the ideation process. One example is the formation of 3 pillars that act as a focal point for the overall experience: storytelling, audio-visual elements, and interaction. In the final design all elements should harmonically coexist, forming a strong relationship which acts as a backbone for the experience.

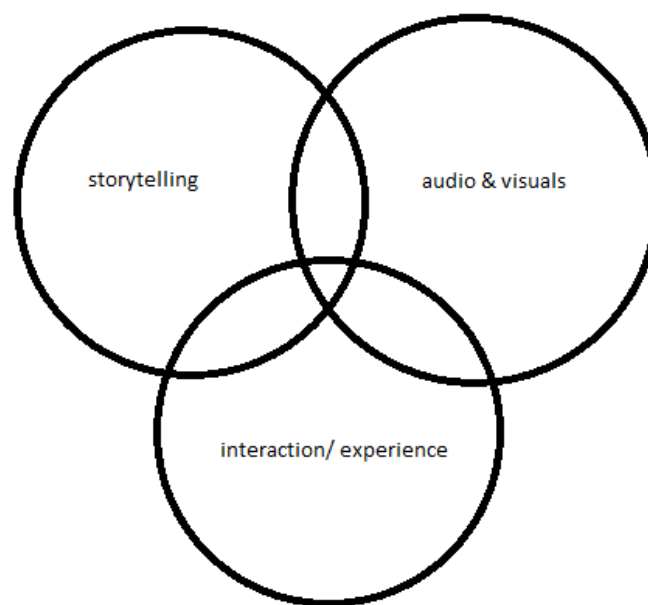


Figure 17 The three pillars of the experience

The ideas generated in the brainstorm sessions were influenced from the research findings or supervisor discussions and were used to create concepts for lo-fi prototypes. As mentioned, the 5-step design processes followed is non-linear, meaning the concepts were refined while prototyping, testing, empathizing, and defining were taking place in parallel.

3.1.2 User Personas

User personas are simulated models of specific potential users of a product whose goals and motivations can represent a larger part of the target audience. This practice helps emphasize with the target demographic and therefore make design choices that cater towards it (Faller, 2019). Three user personas that mean to reflect the target audience were created based on the answers of the survey and the culture around PLANETART. The personas are grounded on the target audience research that was explained in section 2.3. The images of the personas were generated using an AI (this-person-does-not-exist, 2022).

Julian, 29 years old, sound engineer

He is a DJ/music producer that attends raves to both get inspired and enjoy live music. He listens/makes mostly techno and acid. He attends music events of different scales at least 1-2 times a month. At raves he does not dance a lot but instead he finds enjoyment in taking in the music and observing the performance, therefore he values a good sound system and a visually interesting setup above everything else. He's involved with the local artist scene therefore a lot of events are either he or his friends performing

**Stacy, 22 years old**

She is a chemistry undergrad at the University, in her free time she enjoys partying and hanging out with friends. She attends raves once every while and she sometimes does "party drugs" such as ecstasy. She listens to almost everything EDM, but she has a preference towards psytrance. Her dream rave is Tomorrowland, and her favorite experience was an illegal forest rave in Barcelona where she was under the influence of ecstasy. In raves she usually enjoys dancing, meeting new people and having new experiences

**Mariette 20 years old**

She is a computer science undergrad. In her free time, she enjoys videogames and making animations. She does not attend raves often, but she exclusively attends DnB (Drum n' Bass) raves since she is very much into this specific genre. In raves she likes to dance, be around people with similar taste and enjoy the visuals since she is an animator. Therefore, she values the style of music above everything else as well as the visual element of the experience. Her dream rave is rampage in Belgium since it's the biggest DnB rave in Europe and the production value/setup is top tier in her opinion.



3.2 Lo-fi Prototyping

3.2.1 Prototype #1



Figure 18 Voting-based performance prototype

Description:

A lo-fi (low functional) prototype was a choice-based live performance. The performer is located in a remote location and controls the music and visuals displayed in the 360LAB for an audience. At certain points during the performance 4 different types of music are displayed via text on each side of the 360LAB. The crowd can vote on what genre will be played next by walking towards their desired side. The performer can also see live feed of the room and decide on what to play based on the audience's choice. Essentially the genres are translated to pre-recorded music sequences the performer can launch.

Goal:

The goal is to create a participatory EDM experience inside the 360LAB in which a movement-based voting system acts as the main point of crowd interaction. This would hopefully have an effect on the immersion and overall satisfaction of the experience.

Design:

On the technical side this is achieved by having the PC which powers the 360LAB run Resolume Arena 7, a VJ software that is used to render and display visuals inside the 360LAB in real time. The same software is running on a separate laptop that the performer would use to play on. The 2 devices are connected via network using the OSC protocol which allows for the actions taken within Resolume 7 to be mirrored from the laptop to the PC with almost no delay. The music is mixed in a DAW (Digital Audio Workstation) running on the laptop, specifically Ableton Live 11 (Ableton, 2019). Within this software MIDI data can be placed at certain points in the music clips that are being played out or even triggered in real-time which is then sent to Arena, through a virtual MIDI port that can be created with a software such as loopMIDI (Erichsen, 2022), to act as a trigger for visual clips, therefore allowing for the possibility for the visuals to be on perfect sync with the music. The audio is also streamed via network from the laptop to the PC and then to the four speakers that are placed in the top corners of the 360LAB. The VBAN protocol is used since it allows for audio to be transmitted over network with very minimal lag and quality loss. A USB camera is connected to the 360LAB PC. The footage can be transmitted over network to the laptop that the performer uses via the NDI protocol.

Motivation:

The voting system is inspired by the prototype of Zhang et al. (2016), where they use a phone-based voting method, as well as one suggestion from the target audience survey

where they propose that voting throughout the performance would make for some nice audience interaction. This is combined with the findings of Maynes-Aminzade et al. (2002) where they discover that audience movement can be an effective tool for audience interaction. This idea can be expanded to make the choices include other elements than music sequences, such as intensity, pitch tone or tempo all elements that yielded positive results in a voting-based system in the research of Zhang et al. (2016). The choice of having 2 devices has two main benefits; firstly, it makes the performance fully remote controlled and secondly it allows more performance heavy tasks to be executed since as Eckrodt and Arkes both pointed out the specifications of the 360LAB PC are quite low. Lastly, giving the option to the audience to choose the genre of the next track is in line with the user personas of Stacy and Mariette since they enjoy some genres of music more than others, therefore allowing them to participate in choosing the next genre could potentially result in a more enjoyable show.

Observations:

Self-tests were conducted with this concept in the 360LAB. The tests only included voting choices based on the genre of music that will follow and the test performance was made up by four ~30 second audiovisual clips that were characterized by 4 EDM music genres : House, Techno, Dubstep and Downtempo. The user could choose a genre by walking towards one side of the wall and the performer would trigger the respective audiovisual clip. Technically the prototype worked well, the content was responsive and there were no noticeable delays or lag within the network.

A limitation of this prototype is that the camera feed did not cover the entire room since that would require extra hardware such as a USB extender and perhaps a second camera. In case of further development this would be more closely examined.

Interpretations:

Although the prototype functioned well in a basic level, the interaction was not as prominent as originally envisioned. The lack of physical devices the crowd can interact with may be a possible reason. Moreover creating 4 different audiovisual clips for every voting moment could be an excessive amount of work given the deadlines of this project.

3.2.2 Prototype #2

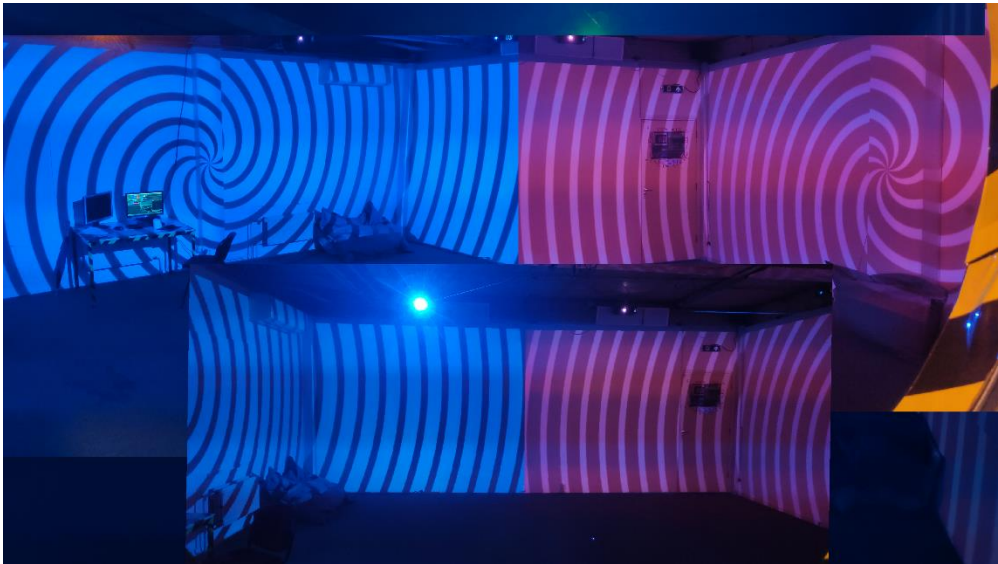


Figure 19 Call-and-response prototype

Description:

A second prototype was a call-and-response type game. Call-and-response is a musical concept where a vocal or instrumental phrase serves as the call which is then answered by another musical phrase that acts as the response. In a sense the concept is similar to a conversation (MasterClass, 2019). In the context of this prototype call and response takes place between a small audience and the performer who each take up one side of the room. Both are given a wireless physical device, in this case a PS4 controller, that can playback pre-recorded sounds and alter the visuals of the opposite side. The performer has more call-related sounds such as a drum kick or the first section of a growl bass while the audience has sounds that resolve the call such as a snare drum or the second section of the growl bass. This allows for a musical conversation between a performer and an audience. A solo version where a single person could interact with the entire room was also created, however it did not make use of the call-and-response pattern. This version was codenamed "WOB" and showcased in the "Museum of the Future", an exhibition hosted by PLANETART.

Goal:

To create an interactive call-and-response EDM live performance between the crowd and the performer that takes place inside the 360LAB.

Design:

In this prototype all the software used is running on the 360LAB PC. Resolume Arena 7 is used to display the visuals while Ableton Live 11 is responsible for the sound and MIDI output which is again communicated to Arena to trigger visuals via a virtual MIDI port created in loopMIDI. The PS4 controllers are connected to Live to produce the MIDI signal in real time. The connection is established through a combination of DS4Windows, a software which allows for ps4 controllers to be connected and modified in windows machines and GamePad to MIDI v1.0, a Max for live device created by Kaskobi (2020) that allows game controllers to be used within Live 11.

The music and visuals used in the first two prototypes were either created from scratch (in Adobe After Effects, Photoshop (Adobe, 2022), Resolume Arena 7 and FL Studio 20 (Image-Line, 2022)) or were reused assets from the project *chris_to_os* (Constantinou, 2022). A limitation at this point was that the audio-visual footage available wasn't enough to provide a performance that was over 5 minutes nor had any storytelling elements.

Motivation:

The call-and-response technique is referenced in the research of Maynes-Aminzade et al. (2002) when examining crowd interaction in a live setting. The design choice of a game controller also complies with the findings of Seo (2022) since his research shows that a physical material is important in physical immersiveness. Heavy focus was put on the synchronization between music and visuals as a strong relationship between the two elements is highlighted in the literature review on immersion, the interview with Eckrodt, the target audience survey, and the inspirational material. Furthermore, having a coherent, synchronized audiovisual experience fits with the user profile of Julian which can represent the subgroup of the target audience which invested in the production value of the content.

Observations:

Apart from self-testing during the development cycle, the prototype was internally tested with 2 members of PLANETART which portrayed the role of the performer and crowd, respectively. Each member possessed a PS4 controller which could trigger audiovisual clips in the 360LAB. As mentioned, the content was either call or response type, depending on who was triggering it. Some variations of the prototype were tested as well: a version where flashing prompts and rhymical sounds acted as a metronome as well as a version where buttons in the form of text displayed in each side that if followed created a coherent performance.

It was observed that this prototype required constant user input for the performance to be continuous.

Some issues were noticed with the game controllers. Firstly, the Max for Live device used had some bugs which made the controllers unresponsive at times. Secondly, the controllers used had a limited battery capacity which would typically be drained in under an hour, making it less than ideal for a long testing session.

Interpretations:

Overall reactions from the internal testers were good. On the audiovisual cues the testers agreed that although useful for the musically inexperienced, any type of prompts acted as a distraction and made the experience less enjoyable overall.

Input inaccuracies resulting in audiovisual incoherency were common. A strong correlation between the crowd and the performer should be present in order for a fully continuous live show to take place which is a highly unrealistic expectation to have. While this prototype could very well exist as a non-continuous but interactive installation that could have the potential to trigger immersion, this concept is not that closely related to the purposes of this project.

3.2.3 Prototype #3



Figure 20 Crowd-performer collaborative performance prototype

Description:

The main idea behind this prototype is to give the audience the ability to have a direct impact on some audiovisual elements of an EDM live performance, making the act essentially a collaborative effort between the crowd and the performer. The performer is located in an external room and can control the audio and visuals that are displayed remotely while a small crowd is present in the 360LAB. Physical devices where the crowd can influence the sound and image are located in the room. In this prototype the crowd can add effects such as bit crush, chorus, bass boost and beat repeat on the audio. The effects are also represented in the visuals (for example having a bit crush effect on makes the visuals pixelated etc.).

Goal:

The goal is to have a remote controlled EDM live performance in the 360LAB where the crowd can have a direct interaction on the music and visuals.

Design:

In technical terms the setup is identical to lo-fi prototype #1, however a physical device is added to this prototype. Specifically, a Launchpad S (Novation, 2022) is connected to the performers device that allows for actions such as audio effect triggering and altering the visuals. Moreover, the software AutoMap (Novation, 2022) which has native Launchpad S support was used as a middleman between Ableton Live and the input/output of the device. At this point a single device is used, however the prototype can be expanded to allow for multiple devices that can have different type of influence on the audiovisual spectrum of the performance. The device sends MIDI signals to both Ableton Live 11 and Resolume Arena 7 that trigger audio and visuals, respectively.

Motivation:

This is inspired by the real time sound processing technique that was originally mentioned on the research of Maynes-Aminzade et al. (2002) on crowd participation in music live shows. Furthermore, it is an attempt on establishing a strong crowd-performer relationship since according to Zhang et al. (2016) and the results from the survey on the target audience, this relationship is key in creating a both satisfactory and interactive experience. The design choice to have a MIDI controller was also done with intent. Apart

from being an efficient way to directly make changes to the performance, physical devices can add an extra layer of physical-environment immersion according to Seo (2022). The influence that the crowd has on the performance is kept at a low level. When working on a digital orchestra for children, Constantinou (2021) observes that allowing for too much freedom in interaction can potentially create a performance that is too musically chaotic and by result less enjoyable (p.11-12).

A variation of the idea is to have the devices located in the room where the performer is, which is made to be accessible through the 360LAB. A benefit of this variation is that a lounge-type area where the audience can both use to interact with the performance and other people complies with the user profile of Stacy which represent the users in the target audience who enjoy the socializing aspect of raving. A remark on the target audience survey points out importance of the chain reaction that can over time enhance the overall excitement of the crowd, which is important to keep in mind when designing this prototype since having this type of interaction happen in the same space where the audience is located can potentially interfere with that. This is another place where this variation has a benefit over the original concept. The downside however is that the interaction may be less direct, therefore not only making it harder for the user to experience their influence but less immersive as well since Quesnel et al.,(2018) and Seo (2022) both support that directness is linked with immersiveness. Another downside can be the potential issue of balance between the two rooms as having one of the rooms full of people whilst the other one is empty is not how the installation is meant to be experienced. In case this prototype or its variation are selected for further development these, and other negative aspects have to be resolved.

Observations:

This prototype was self-assessed, and it was observed to function as expected both conceptually and technically. A ~5min test performance that combined custom made with pre-existing music and visuals was created and used for evaluating this prototype. A very small delay was noticed between the physical input and the launchpad. AutoMap, the software used for controlling the Launchpad was limited since it allowed only a few amounts of input/output functions to be loaded on the device

Interpretations:

Overall, this prototype seemed very promising, and it immediately became the favorite for extensive development. Although the input delay that was noticed was minimal, it could potentially be noticeable in a larger scale. Furthermore, a more flexible way of controlling the launchpad would be favorable in case of extensive development.

3.3 Hi-fi Prototyping

3.3.1 Overview

A single Hi-Fi (high functional) prototype was created since having a product that fulfills all the requirements mentioned in section 2.5 is vital for testing and evaluation purposes. The design of the Hi-Fi prototype was based on Lo-Fi prototype number 3. After, self-testing and discussing all the lo-fi prototypes with the supervisor of the project the conclusion was reached that number 3 would be the best option to further develop and test with a small crowd. Even though all 3 lo-fi prototypes fulfilled the remoteness requirement, and all had the possibility of projecting music & visuals that are in-line with the theme, the third design has clear and accessible interaction that is satisfying and crowd friendly making it the prime contender for further development. The main argumentation which referenced previous research provided in section 3.2.3 still applies for the Hi-Fi prototype.

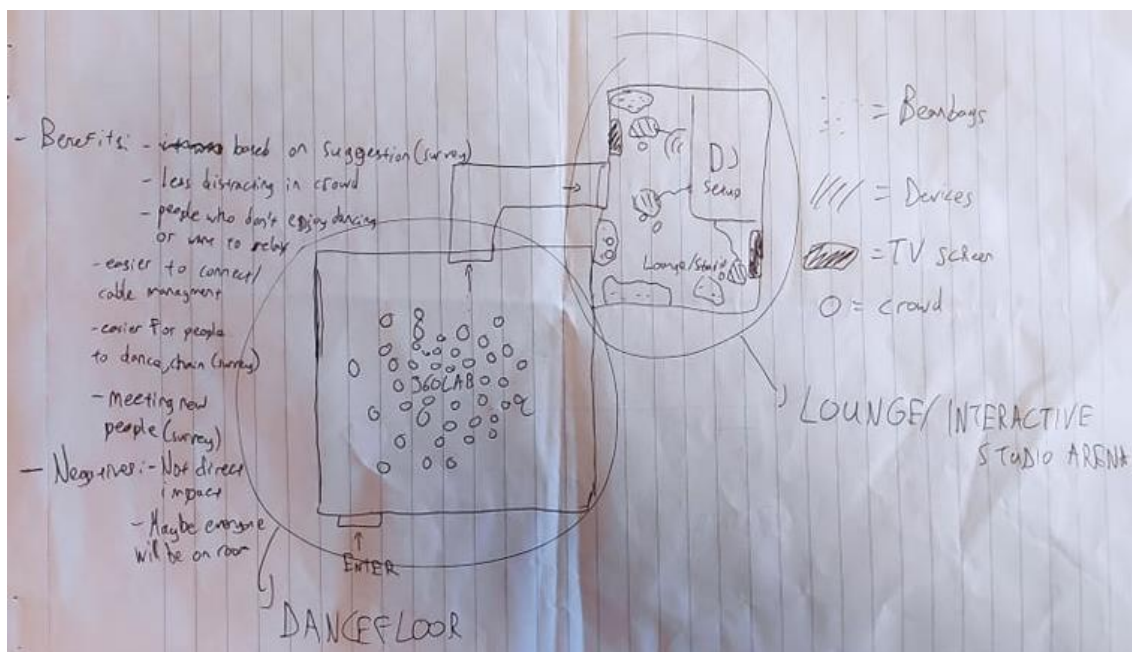


Figure 21 Lo-Fi prototype concept (Prototype #3)

3.3.2 Physical Environment & Hardware

As shown in Figure 22, the design requires two rooms, a main dancefloor, and a small studio area. The dancefloor is the area in which the audiovisual performance is displayed, and the majority of the crowd is expected to be located. In this case the dancefloor is the 360LAB which as mentioned is a 360° projection room that uses 8 beamers and a quadrophonic sound system to project audiovisual content. This equipment is connected to a main PC via eight HDMI cables and a speaker amplifier, respectively. The PC is mounted on the ceiling of the room for conventional purposes. A camera, specifically the Microsoft Kinect 2.0 is also placed on a high viewpoint inside the 360LAB, in order to record and stream the performance in real time. The device is connected to the main PC via USB. The PC is not connected to a monitor or any control surface such as a keyboard or mouse directly, however a second PC can be used to control the main PC remotely. In this case a laptop is used for this purpose. The laptop along with the performer is placed inside the studio area which in this scenario is accessible through the dancefloor. In

addition, the studio area hosts three MIDI devices, specifically three Launchpads. The specific models are two mk2s and one model S. By making the studio accessible through the dancefloor, members of the crowd have the choice to walk in the studio at any time and interact with the music and visuals via the three Launchpad devices. In order for the crowd to see and hear their impact on the performance, a second sound system as well as a monitor are installed in the studio area. Both are connected to the laptop of the performer which outputs the live music and the stream of the Kinect on the studio sound system and monitor, respectively.



Figure 22 Physical Environment Layout

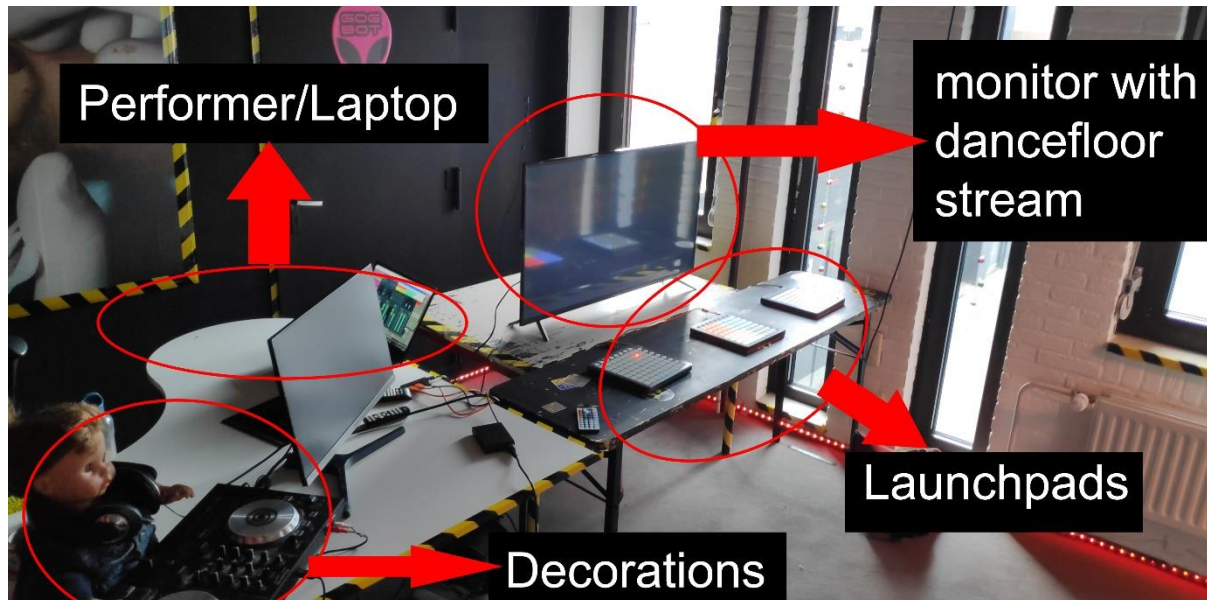


Figure 23 "Studio" Area

3.3.3 Software

Both music and visuals were created in advance, however they were mixed in real-time during the live performance. FL Studio was used for creating the music while After Effects, Photoshop, blender, Aseprite (Capello, 2022), Cinema4D (Maxon, 2022) and Resolume Arena were used to create the visuals. Resolume Arena was also used to output the visuals in real time by communicating with Ableton Live, which was used to mix the music live, via

the “Max for Live Resolume Patches” pack (Resolume, 2022a). Specifically, the “programmable clip” patch was used which allowed an automation clip in Ableton to trigger different clips in Resolume over network via the OSC protocol. The automation clip should be in-sync with the music clip that is being played back in order to ensure that music and visuals are synchronized. The max for live patch also ensures the BPM (beats-per-minute) between Ableton Live and Resolume Arena is in-sync. Since this process is executed remotely in the performers PC, a good network connection is necessary. The music is also transmitted to the 360LAB PC over network via the VBAN protocol, therefore VB-Audio’s Voicemeeter is used for this purpose. This solution was inspired by Julian Gray’s tutorial on this exact topic (Gray, 2021).

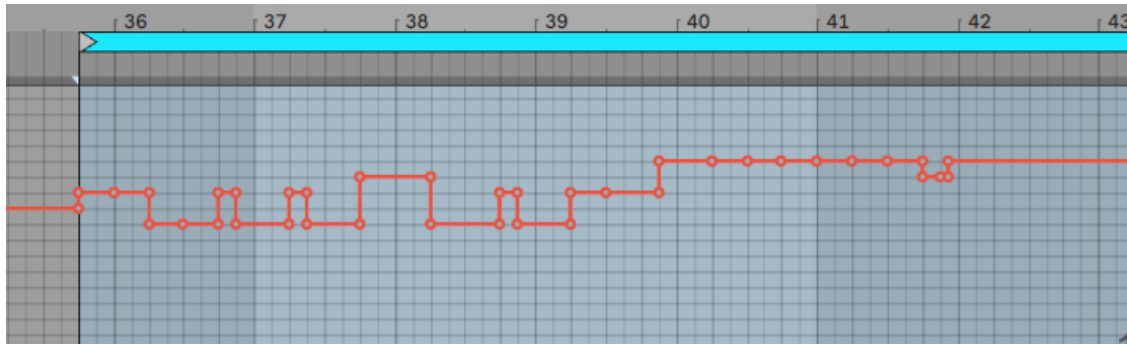


Figure 24 Example of an automation clip being used to trigger visual clips

A custom piece of software was written in Python for the MIDI devices. This was done not only to ensure all 3 Launchpads behaved in the exact way that was desired but also to prevent users from doing unintentional actions. The launchpad-py and python-rtmidi libraries were used to control the input/output of the Launchpads and send the input as raw midi data to Ableton Live respectively. The midi data was sent to Ableton Live via a virtual MIDI port created using loopMIDI and it was used to trigger clips and enable/disable audio effects in Ableton Live as well as trigger visual effects in Resolume arena via the “FXsBypass” device from the already mentioned Resolume patches pack. The code enabled each Launchpad to act as follows:

- a) FX Launchpad (Model S): Every second a single random button lights up on the Launchpad. If the user presses or holds down the button, the color of the button changes from red to green and one of the following five effects is being applied to the music/visuals: “bitcrush/lo-fi”, “flanger/wavewarp”, “bass boost/edge detection”, “phaser/color explosion” and “redux/flashing white”. The effect is chosen at random and lasts as long as the user holds down the button or the performer stops it.
- b) CHAOS Launchpad (mk2): 4 buttons are always lit up with a white light while a decorative line (which color is determined by the point of the performance, section 1 is red, section 2 is blue, section 3 is yellow, and section 4 is mixed) scrolls through them during the show. Each one of the four buttons can be pressed by the user which results in random decorative lights being displayed on the launchpad and the music/visuals going into “chaos” mode. This mode is simply a beat retrigger effect for the audio and a shake/fragment effect for the visuals which in combination give the feeling of chaos without however disrupting the performance. There are 4 different presets assigned to each button and the effect lasts as long as the user holds down the button or the performer stops it.
- c) Control Panel Launchpad (mk2): During the show, the performer can allow the audience to progress the performance via this launchpad. The performer can

control the launchpad using a pop-up window that shows a time map of the performance. By clicking a certain timepoint of the performance on the popup window the launchpad can “jump” to that state. On the launchpad the already completed parts of the performance are represented by solid horizontal lines (again, the color depends on what section the performance is at) while the option to advance is represented by pulsing buttons. In some points there are even multiple options which give the option to the user to choose a certain path for the performance to take. The performer can also use the popup window to enable or disable the FX and CHAOS launchpads in order to regulate their use.

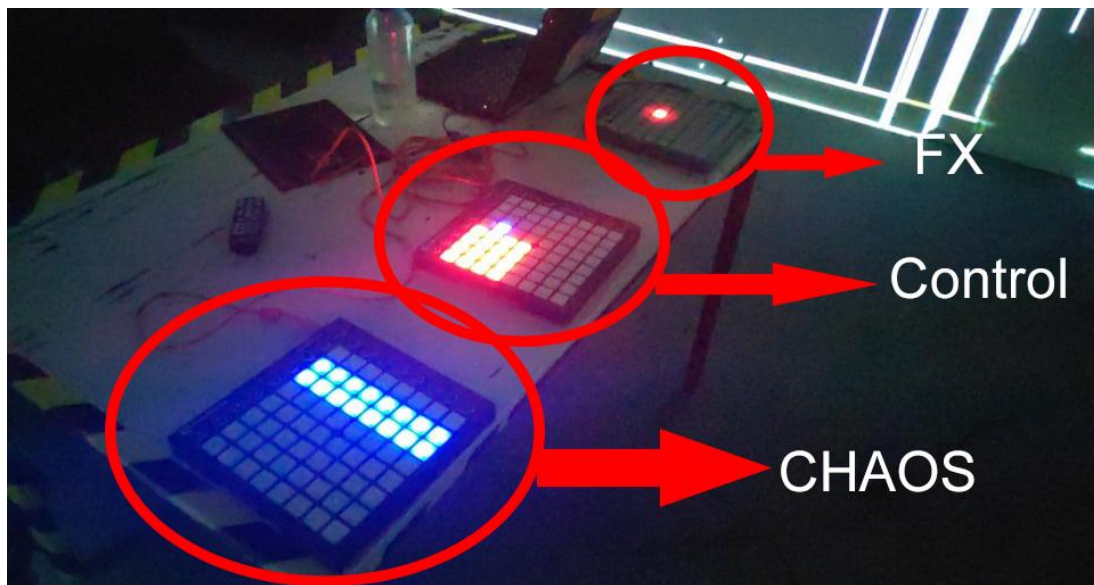


Figure 25 The 3 Launchpads running the custom code

Lastly OBS (Open Broadcaster Software, 2012) was used for capturing and streaming the live footage of the dancefloor to monitors in the studio room.

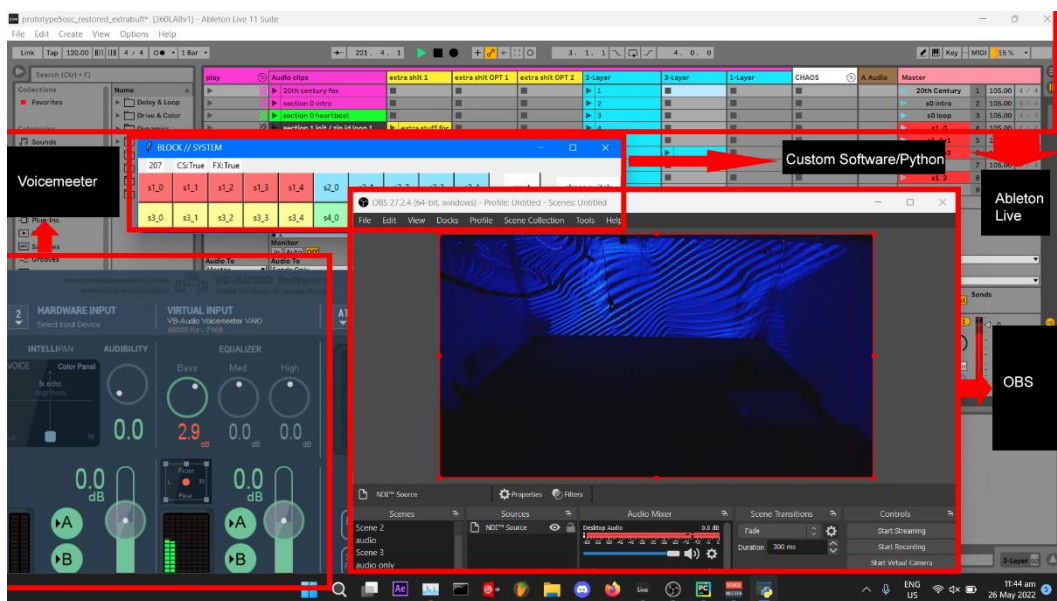


Figure 26 All software running on the performer's PC

3.3.4 Pipeline

The pipeline or structure of the live performance can be summarized in the scheme below:

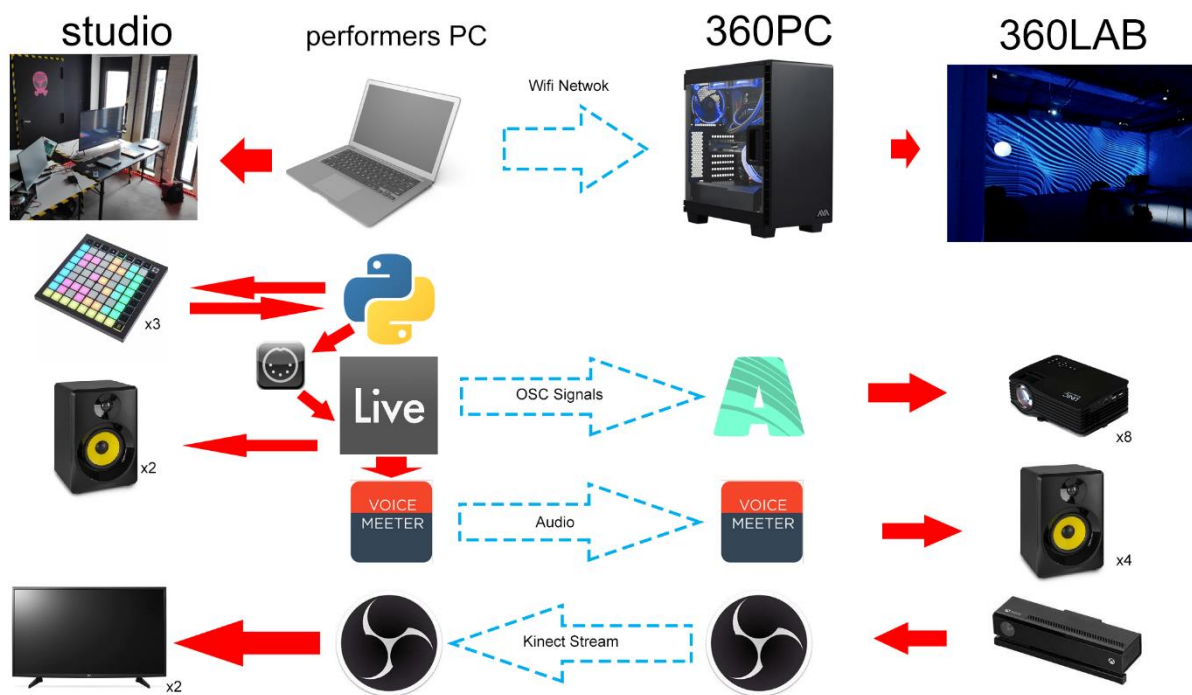


Figure 27 Live performance pipeline

As mentioned, two PCs are being used; The performer's that is in the studio room and the 360PC which is mounted on the ceiling of the 360LAB. The performer's PC is running the custom python code which not only controls the output of the 3 Launchpads but also receives their input which is translated to MIDI and passed into Ableton Live via a virtual MIDI port (loopMIDI). Ableton Live is responsible for mixing the music live and sending the output to the sound system of the studio and the 360LAB. The former is achieved via a simple AUX cable while the latter is achieved by a network transmission using the VBAN protocol (Voicemeeter running on both PCs). Furthermore, Live is responsible for sending OSC signals that can trigger visual clips in Resolume Arena which runs in the 360PC. Those signals are either pre-programmed automation clips that match the music or spontaneous launchpad inputs that are being translated from MIDI to OSC and therefore allow enabling/disabling visual effects in Resolume Arena. Lastly OBS is running on both PCs. Since the direct capture is being recorded on the 360 PC, the NDI protocol is used to stream the footage to the OSC running on the performer's PC over network. The footage can then be displayed on the studio monitor via an HDMI cable. The red arrows represent a direct connection between hardware/software while the dotted blue arrows represent a connection over network. The direction is simply the way the data flows.

3.3.5 Audio & Visuals

A ~25-minute mix of audio and visuals was created for the performance. While some of the music was collaborative with other artists (mainly ZIN, emplexx, sol! And Talurre), all the work was fully original. As mentioned, a variety of different software was used to create and play back the content live. The music as well as the visuals were a sequence of small clips that were able to be played back while maintaining continuity. Some light story-telling elements existed in the mix. For example, the performance was split into four ~5-minute sections which were differentiated by the dominant colour of the visuals and the genre/tempo of the music. The sections were:

- a) Section 1: Red visuals, 100-110bpm, downtempo/glitch hop



Figure 28 Section 1

- b) Section 2: Blue visuals, 120-130bpm, electro house

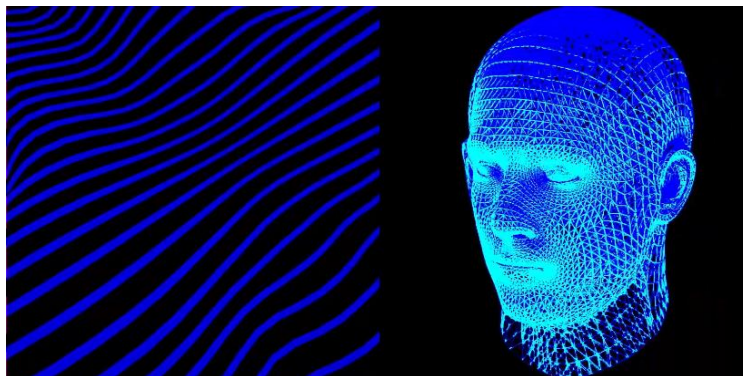


Figure 29 Section 2

- c) Section 3: Yellow visuals, 140-150bpm, trance/dubstep

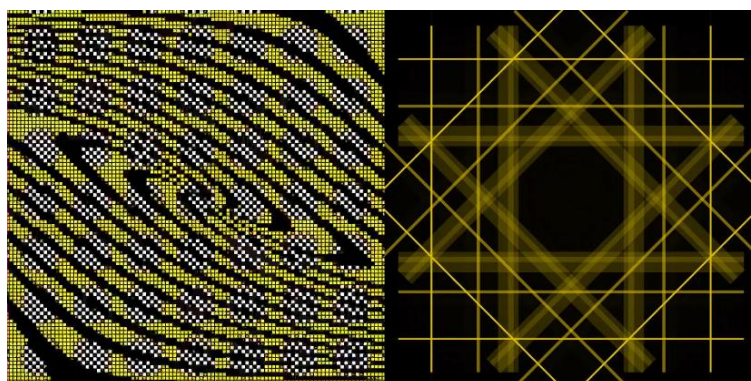


Figure 30 Section 3

d) Section 4: Multi-coloured visuals, 150-175bpm, dubstep/drum n' bass/trance

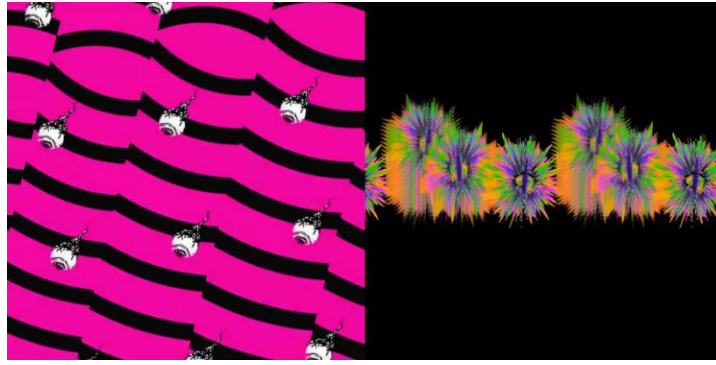


Figure 31 Section 4

The crowd had the option to progress the performance using the “control” launchpad. This was made possible by splitting each section to 4 subsections. At the end of every subsection a pulsing button on the launchpad became available to the participants. Pressing it would make the mix enter the next subsection. The music/visuals were quantized accordingly to make the transition between subsections smooth. As stated before, at some points the user could choose between multiple subsections, which featured unique music/visuals. A looping mechanism was in place at the end of every subsection to ensure that the performance was dynamic in case the audience decided to not progress it immediately. The mix used can be found in the appendix. The original resolution was 8382x800, the wide aspect ratio made possible for the visuals to be wrapped around the 360LAB, however for personal viewing purposed this was adjusted to 1920x1080.

4. Testing & Evaluation

4.1 Promotion

Before testing a promotional campaign was conducted. An Instagram account under the handle @block_sys was created solely for this project that featured pictures, videos and announcements all about the event "BLOCK // SYSTEM". The content used during the promotional phase was all custom made while after the event, content from the attendees was reposted after getting their consent.

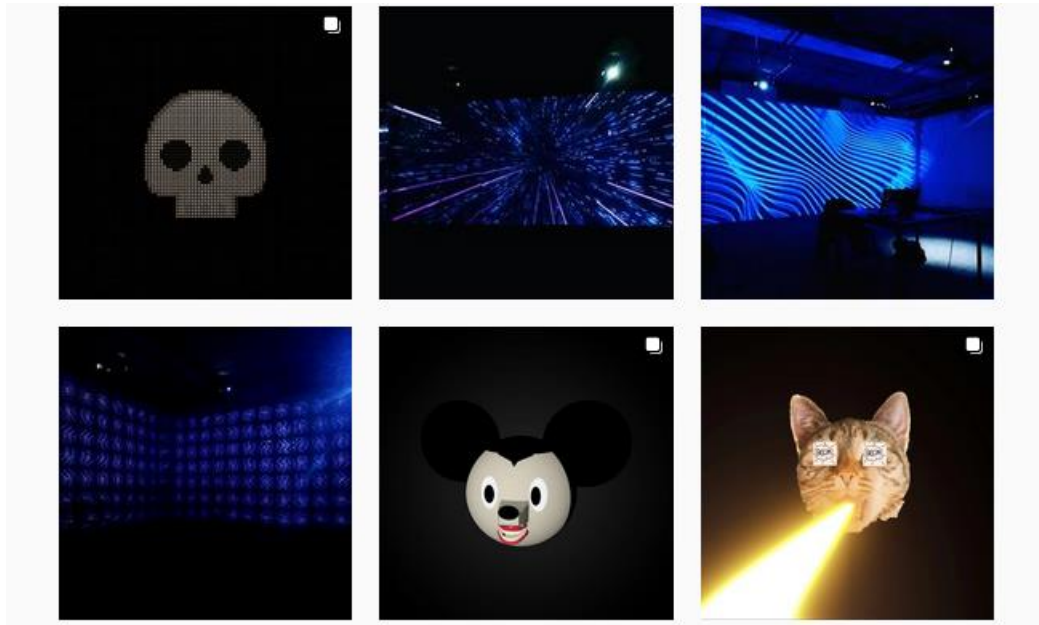


Figure 32 Instagram posts for @block_sys (Instagram, 2022)

Annebel Bunt, head of social media in PLANETART also promoted the event through PLANETART's social media and online communities. Her experience in this field helped tremendously since the accounts she manages have a far bigger reach than the account that was created for this project at this point of time.

The promotional campaign was important for a variety of different reasons. Firstly, it provided a direct outlet to communicate with the target audience which was adults in Enschede that enjoy attending EDM events. By following and engaging with similar accounts (e.g. @spacebar.enshcede, @planetart.enshcede, @crossxtic etc.) the Instagram algorithm made the account more likely to get through to the desired audience. Reaching out to them would ensure that enough people attended the testing event since gathering a small crowd was a key part of the physical testing process. A ticket system also had to be implemented both for ethical and practical reasons. The tickets were free, however they required the participant's email address and their consent on getting recorded and participating in the research. In addition, it warned them about potential health risks such as epilepsy attacks. This also allowed to put a limit on how many people could sign up for the event since the 360LAB could only host a limited amount of people at once. 45 ticket responses were recorded. The email addresses would also be used later for sending out surveys for evaluation purposes during the gathering of data phase. Therefore, the promotion was important in order to ensure attendees would sign up for a ticket prior to the event. In order to set up the system the open-source platform "pretix" was used (pretix, 2022).

4.2 Testing



Figure 33 Digital promo poster for the testing event

4.2.1 Testing Methods

As seen in the figure above the testing event was split into three shows. The first two were similar both lengthwise (~25mins), and content wise, featuring the same graphics and music in the 360LAB. Show #1 offered the full interactive experience to the crowd. As explained in section 3.3, both the 360LAB and studio rooms were open, meaning the crowd could use the equipment in the studio room to participate in the performance. In contrast, the crowd could only access the 360LAB in show #2 meaning no interaction was available. Therefore, the standard procedure for A/B testing could be conducted between the first two shows (VWO, 2022). In the third show (Free4all) an open DJ booth was introduced into the 360LAB in which local DJs could bring their own USB device and play their music of choice. There was no interaction since the studio room was not accessible. The visuals were reused from the first two shows. This was a more informal affair, however it provided an additional perspective to the project since it resembled a more traditional EDM show.

Lastly an experimental method of measuring immersion was adopted. Two members of the crowd (clickers) were chosen and given a time measuring device, in this case the stock stopwatch app on their phones. They were instructed to place a flag every time something interesting or immersive happened during the performance. This method was deployed only for the first two shows. The plan was to visualize their flagging behavior on a timeline and examine it by comparing it with the recording of the shows which would help quantify key moments of the show. The participants can then be confronted about their flagging pattern and be reminded of those moments, in order to hopefully gain some valuable insight about the performance and the element of immersion. This testing method was ideated with the help of the project supervisor Dr. Edwin Dertien.

4.2.2 Testing Process

The testing event that took place on the 4th of June 2022 was split into three shows:

	Show #1	Show #2	Show #3
Name	Show #1	Show #2	Free4all
Type	Interactive	Non-Interactive	Open decks
Performer(s) / DJs	@chris_to_os	@chris_to_os	@chris_to_os/local DJs
Location	360LAB/Studio	360LAB	360LAB
Performer Location	Studio	Studio	360LAB
Remote	Yes	Yes	No
Recorded	Yes + streamed to studio	Yes + streamed to studio	No (attendees took videos though)
Description	Crowd could interact with the Launchpads in the studio	Crowd was in the 360LAB by themselves, no interaction	A DJ booth was installed in the 360LAB, no crowd interaction
Starting Time	22:00	23:00	00:00
Ending Time	22:30	23:30	08:00
Ticket Sales	45	45	45
Attendance	~20	~15	Flexible (~50)
Door	Closed	Closed	Open

Table 1 Testing event information

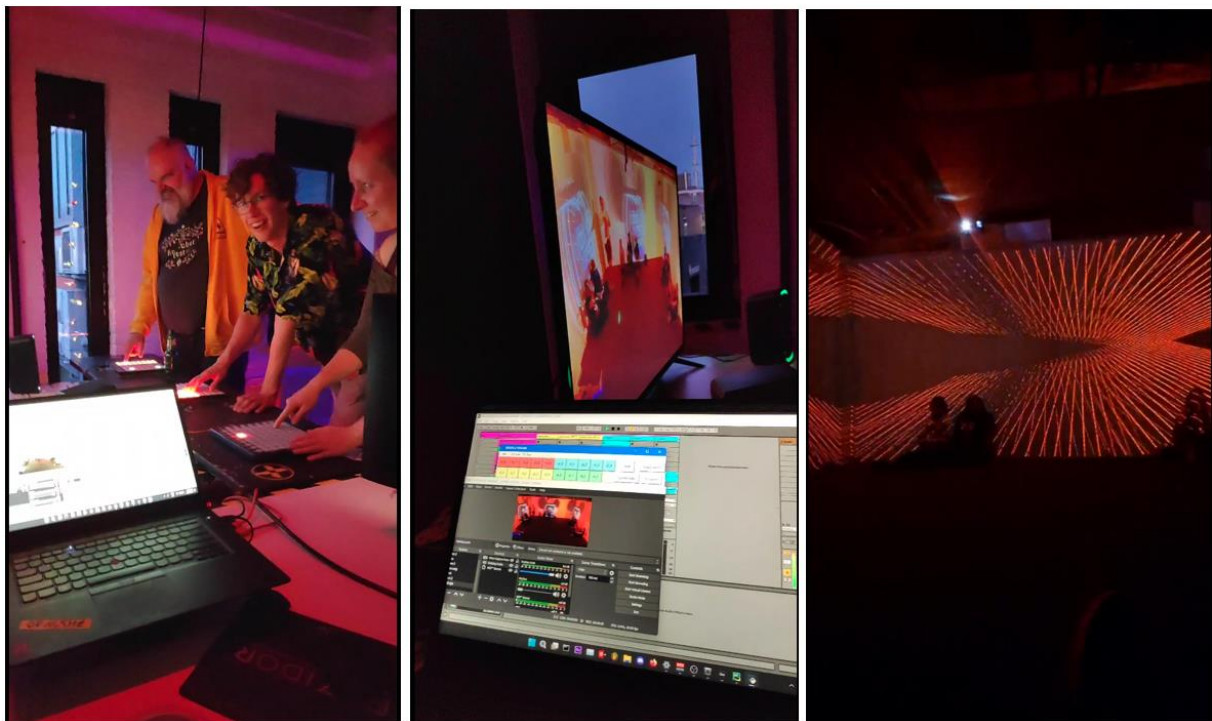


Figure 34 Show #1 (Interactive)



Figure 35 Show #2 (Non-interactive)



Figure 36 Show #3 (Free4all)

4.3 Evaluation

4.3.1 Collecting Data

The data collected was largely qualitative since it mainly was related to subjective topics such as immersion and personal satisfaction. Therefore, the dominant form of evaluation was 1-1 interviews with people who attended the event. The interviews were semi-open and were based on a series of questions that existed in an online evaluation form that was created in order to get specific feedback on each show. The form was sent to the emails of the attendees that got a free ticket. Furthermore, some were called in for a personal interview. Each personal interview was voice recorded and the responses were also submitted as a response to the form. The form/interview process was split into 4 parts, the first 3 asked open ended evaluation questions about show #1 to show #3 while the fourth part was focused on assessing the overall experience.

In total 14 responses were recorded, 8 being interviews with regular attendees, 2 interviews with the “clickers” (as explained in 4.2.1) and 4 online responses.

The second most dominant form of data were observations made during and after the event. Shows A and B were video recorded which made that possible. In the case of the experimental testing method, parts of the video recordings were also shown to the 2 subjects which were then questioned about them.

A form of quantitative data that was collected had to do with the interaction behavior in show A. The custom code that was running on the Launchpads also included a function which allowed for the inputs to be recorded and saved in a .txt file.

P	//	CS	//	2927.354628801346	Pressed
P	//	FX	//	2928.1339857578278	Launchpad Type
P	//	BS	//	2928.570268392563	Time (in seconds) since the start of app

Figure 37 Section of log file of Launchpads

Additional quantitative data was extracted from the Instagram page of the event. This data focused on the overall growth of the account over time. The account managed to reach about ~170 followers during the promotional phase (May 12th – June 4th, 2022).

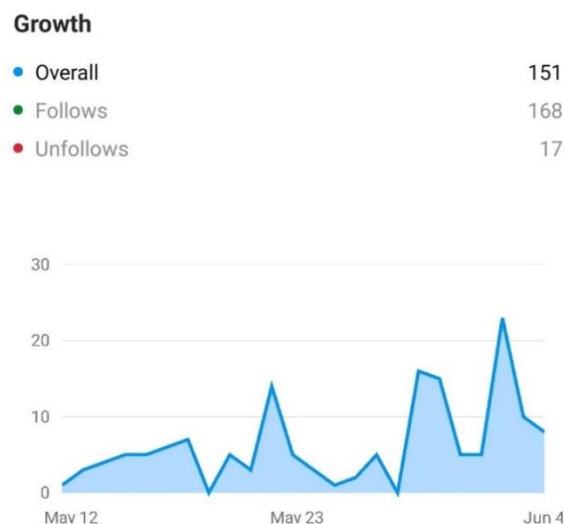


Figure 38 Instagram account growth during the buildup for the event (Instagram Analytics, 2022)

4.3.2 Analysis

4.3.2.1 Observations:

During the show, some observations were made about certain aspects of the performance. The observations will be noted in this section and interpreted in the Conclusion & Discussion chapter as further data collected from the other methods will help put them into perspective and make more accurate conclusions.

A key observation was the behavior of the crowd during the event. Specifically in show #1 and in the first half of show #2, the crowd in the 360LAB was observed to be sitting down around the perimeter of the room. In contrast on the second half of show #2 as well as the entirety of show #3 the crowd in the 360LAB was either standing up or dancing.

The crowd was also changing from show to show. The more drastic change came in between show #2 and show #3, where in the latter a lot of people that were not present during the first two shows were present in the Free4all session. It is worth noting that from 00:00-08:00 another EDM live performance which hosted around ~80 people were taking place in a different room at the same building as BLOCK // SYSTEM. During the event attendees were free to walk in and out of the room. During the first two shows the main entrance remained closed for large parts of the performance and it was occasionally opened by people walking in/out, however in show #3 the door was duct-taped on the wall to stay open. It was noticed that more people were in the 360LAB while the door remained open. More observations that related to the size of the crowd were made. The overall size grew over time. At one point a DJ that was playing in Free4all invited a crowd of ~35 people from the already mentioned event that was happening in parallel. The number of ticket sales did not accurately represent the actual attendees that were present during the performance.

Another distinct observation had to do with show #1. To ensure that the crowd became aware of the interaction possibilities in the studio room an intro sequence was created to hint at just that. Hence it was expected that during the show the crowd would walk in and out of the studio room and interact with the performance as intended. However, it was noticed that a big portion of the crowd was almost exclusively in the 360LAB during the performance, while a small section of about ~6 people were moving between the rooms. A sub portion of the latter also spent a considerable amount of time in the studio area. The user behavior in that area was similar, since a user normally would "take over" a Launchpad and try to work out how the interaction worked. It is worth mentioning the non-explanatory approach towards the interaction was intentional, as a part of the experience was having the user discover the types of interaction by themselves.

4.3.2.2 Surveys / Interviews:

The same set of questions were asked in both online survey and interview, however the semi-open structure of the latter allowed for further clarification and discussion about the participant's answers. Out of the 14 attendees questioned 9 were present in show #1, 7 in show #2 and 4 in show #3 (Free4all/open decks). The 2 clickers are also included in this demographic. Their answers about overall show impressions will be included in this section however questions targeted specifically at the clicker behavior will be covered at the next section. Data related to the first two shows will be directly compared since an A/B testing is conducted between them while the data related to the third show will be compared to both first and second shows as a unit.

Show #1 vs. Show #2

Rate show #1/#2:

Firstly, the participants were asked to rate the shows they attended in a scale from 1 to 10. Even though this may seem a bit counter-intuitive since as mentioned, the goal from the surveys/interviews was to gather qualitative data, the respondents were asked to explain the reasoning behind their rating immediately afterwards. This would not only provide an insight on the first impressions of the user but would also be used as an internal comparison source between the shows the participant was present in.

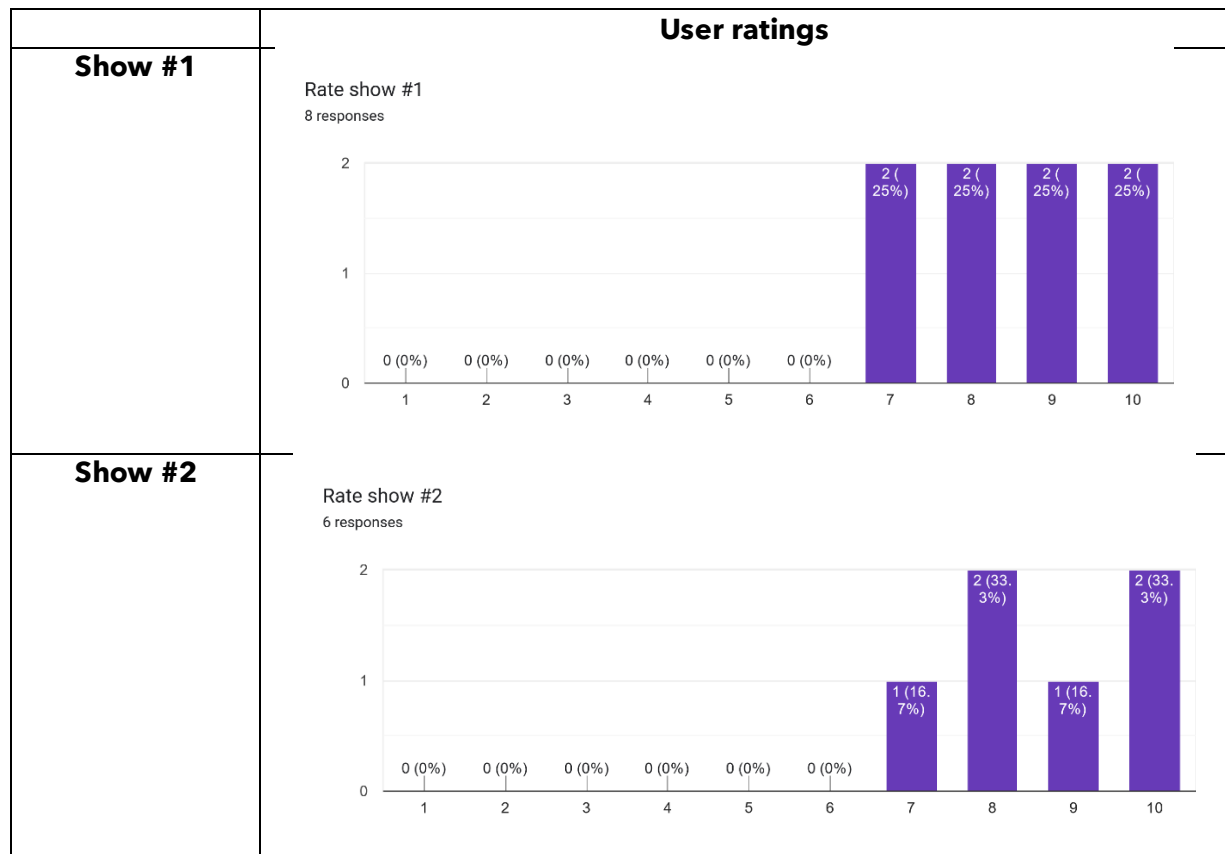


Table 2 User ratings of the first two shows

Explain your rating:

The first two shows received positive feedback. A clear point of interest were the visuals since they were praised universally by the attendees of both shows. The majority also liked the music, mainly due to its uniqueness and the synchronization with the visuals, however few complained that it was too loud and chaotic for their taste. Some participants were quick to point out that during the first show, the crowd in the 360LAB was sitting down and being more passive compared to the latter half of show #2. In a few cases this was a bit disappointing since they expected the audience to be dancing, however in some other cases the participants preferred sitting own during the experience. Some users even expressed they enjoyed both scenarios since while sitting, they claimed that they had the chance to observe the visuals and take in the experience. In contrast when dancing users claimed to be less focused on the visuals and more on the music, the people around them and the actual activity of dancing. A noteworthy observation is that there was not a clear overall preference between the two shows. Furthermore, the summed-up results from the 4 people that happened to be present in both shows are identical.

	Pros	Mixed	Cons
Show #1	+ Everything worked seamlessly + Interaction was a unique addition + The interaction was not ruining the performance	~ Sitting Down	-Unclear interaction/studio hidden -Control launchpad not doing much
Show #2	+Dancing (2 nd half)	~ Sitting Down (1 st half)	
Both	+ Visuals + Music synced to visuals + Music +The 360LAB +Two different shows		-More gradual transition between genres -Too loud

Table 3 Pros/Cons of shows #1 and #2 based on the user's responses

A criticism that was mentioned by a few respondents was that during show #1 the interaction element was unclear. They expressed that the studio room felt hidden with some even not being aware that it existed at all before the interview. The actual interaction was also unclear according to the people that did try it. They expressed that the effect that they were having on the performance was not very noticeable, especially in the case of the Control Launchpad. Not all considered that a negative since some liked the concept of exploring the interaction and trying to deduce how their actions affected the performance. Overall people believed it to be fun. The audience that was in the 360LAB during the first show stated that they found the output of the interaction to be nice and coherent with the performance. A participant liked the fact that there were two separate shows for interaction and no-interaction.

Explain how immersed you were in the experience:

When asked about how immersed the attendee was, show #1 recorded a diverse set of answers. The majority claimed to be very immersed in the experience, however for different reasons. The visuals, 360 room and music were aspects that people linked to immersiveness. Some did not find the interaction in the studio immersive while others did but clarified they were immersed in a different kind of way when compared to being in the 360LAB. Lastly a minority of the respondents was not very immersed in show #1, even though they still claimed to like the experience. The door from the 360LAB to the studio was open during the whole show, a feature which someone claimed broke the immersion since there was a hole in the 360LAB.

In comparison show #2 had more shared answers. The vast majority claimed they were very immersed. Again, the visuals, room and music were the key aspects of immersion however some people also added that dancing in the second half made them feel more part of the experience. A few respondents also pointed out that the synchronization between the music and visuals made them more immersed in the show, with some recalling specific moments where that effect was the most intense for them. Lastly one responded claimed to not be immersed since they were present on the first show which featured the same music & visuals.

What did you do during the show?

During show #1 the main activity of the respondents was sitting down and experiencing the performance. Some combined that with other small tasks such as taking pictures/videos, minimally dancing on the ground, drawing and for the “clickers” operating the stopwatch. A small minority was walking in and out of the studio where they socialized with people and interacted with the launchpads. Some attempted to pick up more people to join them in the studio.

In addition to sitting down, dancing and drinking were also two dominant activities that people recalled doing during show #2. It is important to note that the responders explained that during the first half they were mostly sitting on the ground while only at the second half they engaged in standing up and dancing.

How much time do you think it lasted?

Most people were accurate in estimating that both shows #1 and shows #2 lasted about 30 mins, however a couple of respondents believed the shows lasted for 1 hour. A few also were under the false assumption that show #2 lasted longer than show #1

How does it compare to other raves/EDM events/festivals?

When comparing show #1 to other EDM events, the attendees pointed out that the overall experience was different than any other raves they have attended. A respondent claimed the closest thing they experienced was a projection mapping art installation that took place in the 2021 edition of GogBot. Another claimed that even though the music was comparable to rave music, the atmosphere was not. A common response was that the atmosphere was relaxed and more intimate due to the small size of the room as well as more fitting for sitting down and taking in the experience as opposed to dancing like in a common EDM event. A shared opinion was that even though compared to other events the overall production value was claimed to be lower, the visuals were more impressive.

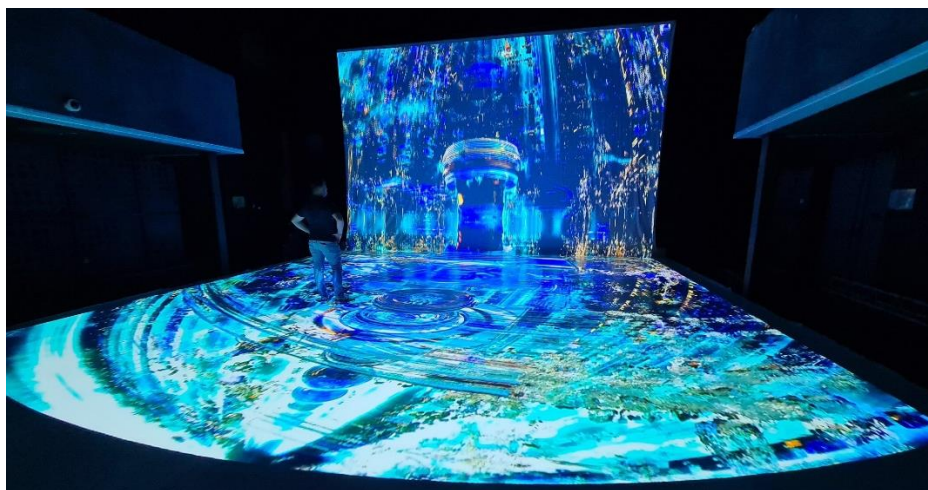


Figure 39 Art installation at GogBot 2021 (Horsthuis, 2021)

Show #2 yielded similar answers. While dancing was a small part of this performance, most of the attendees would still agree that the overall show hardly resembled any other EDM event they have attended. Again, a common response was that the visuals were superior to other raves however the sound quality was comparatively worse. A respondent claimed that this show felt more like an addition to an EDM show rather than a standalone one.

Show #3

Rate show #3 / Explain your rating:

Rate the open decks experience

4 responses

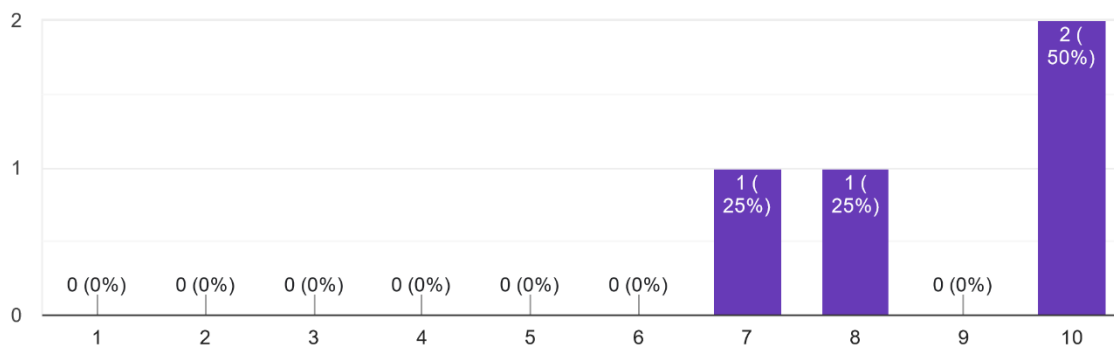


Figure 40 Ratings of show #3

Show #3 received mostly positive comments. The most negative review was left by a crowd member who was only present during the first ~30mins. In this timespan some technical difficulties occasionally stopped the show and not many people were present which were the main criticisms of the interviewee. However, the respondents that were present afterwards had no negative feedback apart from the quality of the sound system. The visuals and 360LAB were highly regarded features. One attendee was very praiseful of the concept of this show since they believed that having an open DJ booth did not only make for an enjoyable show as an audience member but would also give a platform to aspiring local DJs.

Explain how immersed you were in the experience:

The majority of the respondents claimed to be a little immersed in the experience. A participant that got the chance to DJ which was an immersive experience for them while another said the experience as a crowd member was almost too intense, especially when more aggressive music was being played. They went on to suggest that it would be a nice idea for the crowd to have had some control over the visuals.

What did you do during the show?

All the participants reported that they were mostly dancing during the show. A shared response was also substance use during the third show. Two participants also acted as DJs at one point of the performance since it was as mentioned an open deck event. Talking to people was also a common response.

How does it compare to other raves/EDM events/festivals?

One participant liked the close proximity with the performer and the informality of the event. In addition, they also praised the decision to make the show open deck, characteristics which are uncommon among EDM raves. Another attendee compared it to a laser show, a common type of audiovisual experience in high production EDM events where intense laser visuals are shown in combination with the music. Another participant commented the visuals were better than most EDM shows they've been to but the sound quality worse. They added that they'd love to see this room featured in an EDM festival. Lastly a participant added that the venue was smaller than most raves but still nice.

General Questions

What did you think of the overall experience?

The overarching response was very positive. Most respondents mentioned that experiencing the visuals in the 360LAB was the highlight of the event. One participant went into further detail mentioning the storytelling and the synchronization with the music during the first two shows in a positive way. The rave aspect during the third show was also brought up. Some pointed out that the fact two shows were happening simultaneously in the same building enhanced the overall experience as it resembled a small festival. The social aspect was also brought up by a few users, they believed that meeting new people and seeing how others interact with the experience was a core value of the event.

What do you think about the space that the show was performed in?

Both the building and 360LAB received mostly positive reactions. The 360-projection feature was highly praised among some users. The temperature and atmosphere were also mentioned in a positive light. Some features of the 360LAB however were criticized. Mainly objects such as radiators and the AC unit which were installed in the room had a negative impact on the overall immersiveness of the experience. Moreover, a user supported that its not suitable for dancing since it's too small and can get too crowded. The sound received mix reactions since while some people said it was acceptable some claimed that the sound system was not up to standards. A user considered the studio room to be a nice idea in theory but in practice they believed having a single space for the crowd and performer works the best.

Any suggestions for future live events?

Making the interaction element more obvious was a point that was echoed regarding show #1. Various additions in the 360LAB that would enhance the visual aspect of the experience were also mentioned by different users. Those include: add a smoke machine (a participant observed that some people were smoking and that made for an interesting effect when combined with the projector rays), add a laser box, replace the projector beamers with LED screens or find a way to eliminate the crowd shadows, ensure that no light enters the room from outside, "force" the crowd to move to the center for a better viewing experience, add visuals to both top and bottom of the room and make the room rounded for a better projection mapping. Having a performer presence inside the room was very important to a few users, some even suggested to invite more DJs to play in the 360LAB. On the sound aspect, getting a better sound system was recommended. Additionally introducing a storytelling element that links the music with the visuals, not only by having them be in-sync but also build both elements around the same aesthetic, was suggested.



Figure 41 Projection beamer with smoke example

4.3.2.3 Interviews (clickers):

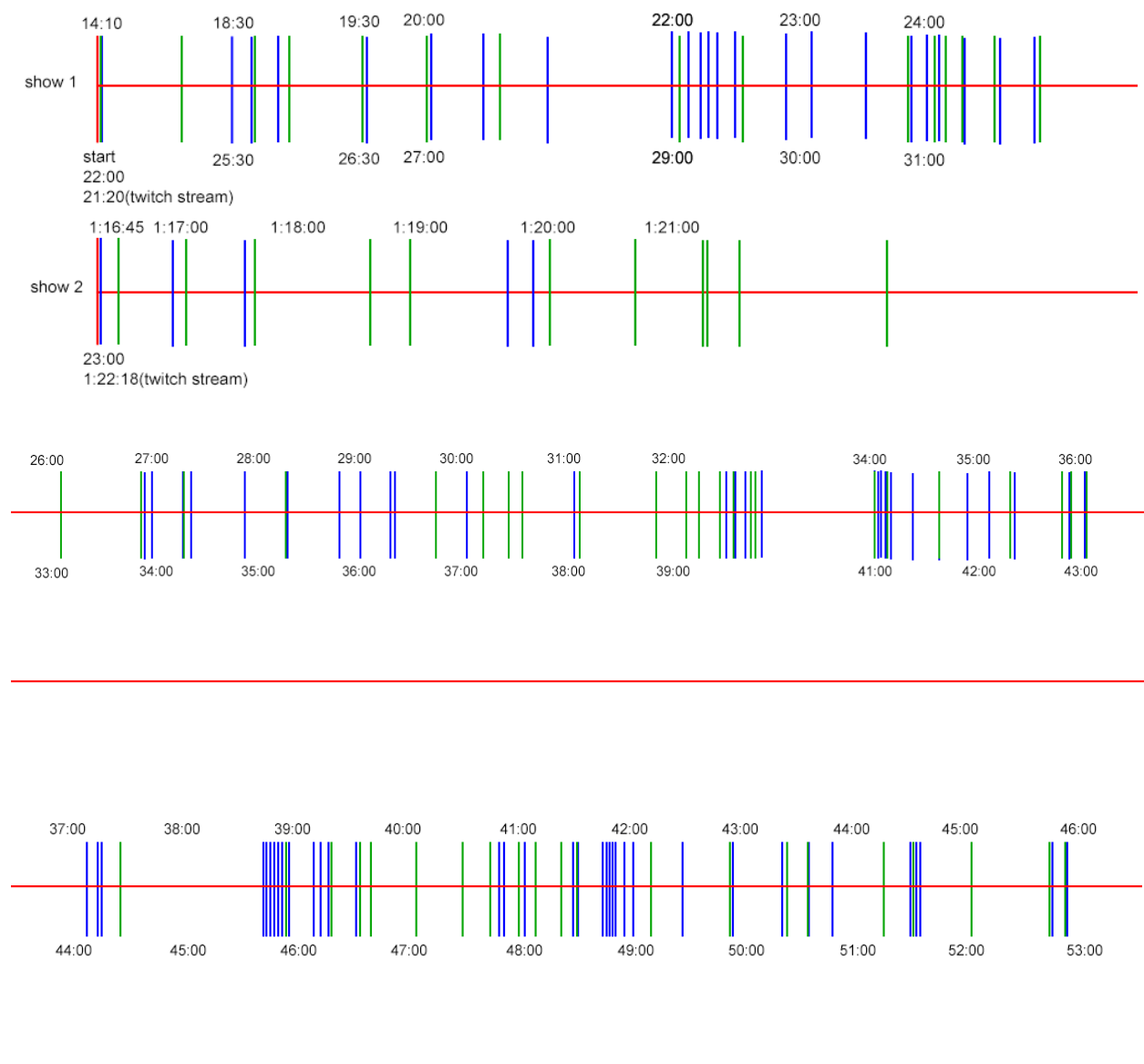


Figure 42 Flagging behavior of clickers on the show's timeline

The "clickers" were two individuals that were given a stopwatch and instructed to place a flag every time something immersive happened during the first two shows. In the figure above you can see the flagging behavior spread over a timeline. The colors blue and green represent each clicker respectively while each red line represents show #1 and show #2, as marked in the graph. The timestamps on the top of each show's timeline represent the time marks on the stopwatch of the user while the timestamps on the bottom represent the corresponding times on the video recording.

The clickers were individually interviewed after the event. The main line of questions about their clicking pattern revolved around moments where their flagging was either observed to be intense or absent for a certain period of time. The video recording was also shown to the users in order to make them recall the events that caused their behavior. The clickers will be referred to as clicker A and clicker B, respectively.

Show #1

It is worth mentioning that although both users were present during the first show none of them was aware of the interaction element or the studio room until after the show, therefore they responded simply as observers of the experience.

A common response between the clickers was that they engaged in intense flagging behavior when they liked the visuals. While in some cases the music also was a factor, it was only when it served as an enhancement to the visuals. By confronting them with the recording of the show the most liked moments were identified.

	Intense flagging behavior
Clicker A	<ul style="list-style-type: none"> - Blue 3D head (visual) - Flashing between black and white (interaction triggered visuals) - Cat (visuals) - LEDs square (visuals)
Clicker B	<ul style="list-style-type: none"> - Red eyes (visual) - On screen lyrics (audio/visual) - Blue 3D head (visual) - Vice (visual) - Cat (visuals) - Spiral visual cool, rainbow flick (visual) - Geometrical lines (visual) - LEDs squares (visual) - Dots (visual)

Table 4 Sections where intense flagging behavior was observed

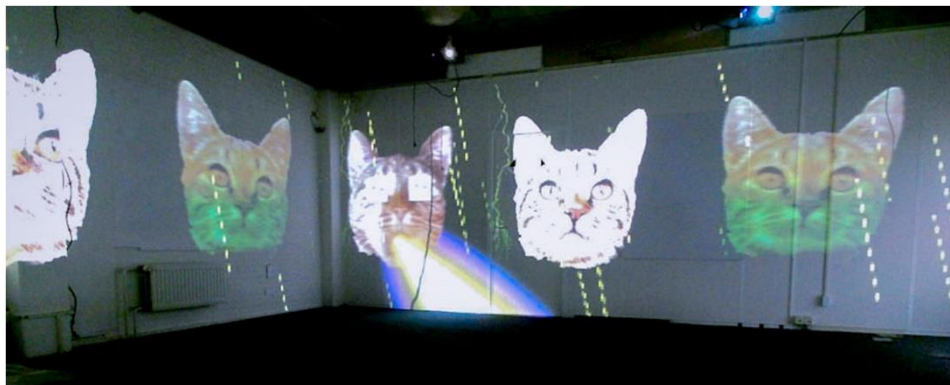


Figure 43 Visuals that triggered intense flagging behavior in both clickers

It is worth mentioning other users who also enjoyed the visuals referenced highlighted different parts of the performance.

In certain sections of the performance noticeable pauses between flagging were observed. When confronted with this observation clicker A responded that this was caused by moments in the show where the music and visuals entered a looping state. The long pause was interrupted when a user in the studio room pressed the corresponding button on the control launchpad to make the performance progress, Clicker B also listed this reason to be behind the long pauses. They also added that when very rapid changes in the music/visuals were taking place they made the conscious choice to not press the button since the immersiveness in their opinion was simply not high enough. An interesting response by clicker B was at a specific moment around the end of the show they claimed to really like a certain visual but there were no flags around the time the visual was shown. When asked about this contradiction, clicker B said they were just immersed in watching the visual and forgot to mark a flag.

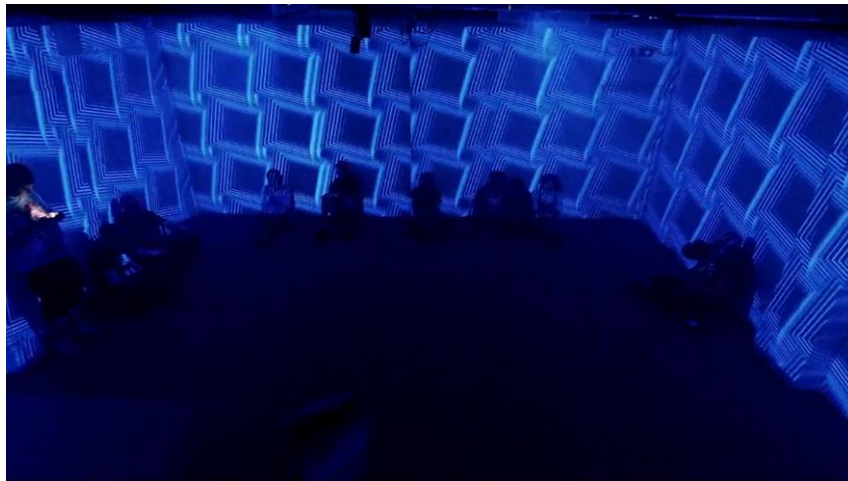


Figure 44 The moment where clicker B forgot to mark a flag

The general reactions from the clickers on show #1 were positive since they claimed to really have enjoyed the show. A criticism that was shared however was the lack of clarity on the existence of the interactive element, as they felt it was not communicated well enough that it was present.

Show #2

At the start of the 2nd show both users continue their flagging behavior as they did on show #1. However, at a certain point it becomes apparent that the users stop using their stopwatches entirely. When asked about the reason behind that both users answered that dancing and socializing made them forget about the flagging instructions.

4.3.2.4 Interaction logs

During show #1 the input that the launchpads received was saved in a .txt log file. Each time a button on the three launchpads was pressed, the code recorded the type of launchpad and exact time of being pressed since the start of the program (in seconds). In case the button was pressed for more than 1s the code also recorded when it was released (mark "P" meaning pressed and "PP" released).

By removing all the instances of the buttons being released from the .txt file and counting the lines using a line counter tool it was discovered that during show #1 all three Launchpads were pressed 2765 times in total. Considering the first show lasted for approximately 32 minutes it can be estimated that on average there were 86 presses per minute.

Furthermore, by using a word finder, it was calculated that the FX (FX) Launchpad was pressed a total of 994 times, the CHAOS (CS) 1054 times and the control (BS) 716 times. Between all three launchpads the buttons were pressed for less than 1 second 2582 times and 183 times more than 1 second. The majority of long presses were done at the CHAOS launchpad with 114 out of the 183 long presses being linked to it. The FX launchpad followed with 64 of the long presses while the control had only 7 out of 183.

4.3.2.5 Instagram analytics:



Figure 45 Instagram insights, May 12th -June 4th, 2022 (Instagram,2022)

An Instagram page under the handle @block_sys was created for both promotional and achieve keeping purposes. The page would feature teasers and announcements of the event in the build up to the first test show on the 4th of June and videos and photos of the event afterwards. In the figure above you can see the growth that took place before the event while in the figure below you can see the growth that happened after the event.

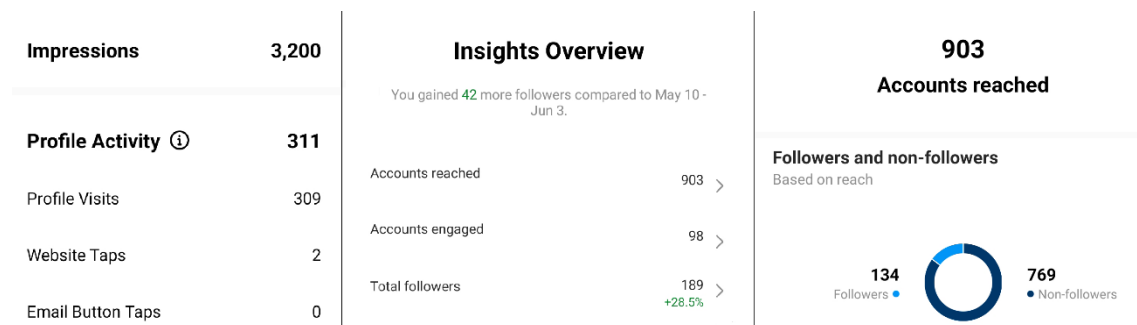


Figure 46 Instagram insights, June 4th -June 28th, 2022 (Instagram,2022)

5. Conclusions & Discussion

5.1 Summary of Findings

	No of respondents	Common feedback	Immersion element	Common actions	Key observations
Show #1	8	Interaction was interesting and worked well, however it was not obvious	Mixed answers, some were immersed while some were not	Sitting down / Interacting	Crowd was mostly sitting; many did not move and never entered the studio room. People in the studio seemed to have fun
Show #2	6	Dancing was nice, a few people left early because they already had seen the music/visuals	Most people were immersed	Sitting down / dancing	First half people were sitting while second half the crowd started to dance
Show #3	4	The DJ booth idea was praised, technical issues were criticized	Little immersion in the experience	Dancing / substance use	Everyone was dancing, a lot of people showed up at certain points. DJs seemed to enjoy playing
Overall	14	The visuals were one of the highlights, especially when they were in sync with music The 360LAB area was nice. The sound quality was bad	Immersion levels and type differs between shows	Socializing	People seemed to dance more at later hours and when the door was open. Even more when a DJ presence was in the room

Table 5 Survey/Interviews, summary of responses

The main points that the respondents brought up during their questioning as well as key observations were categorized in the table above. In the case of the clickers, it was noticed that aesthetically pleasing visuals was the main cause behind an intense clicking behavior while repeating visuals, immersion and doing other activities such as dancing or talking caused them to either not click for a significant period of time or forget about their task completely.

On the side of quantitative data, both the logs of the interaction from show #1 as well as the Instagram analytics for the whole event can be used to draw some conclusions.

5.2 Conclusions

By triangulating the qualitative data of the observations, surveys and interviews a few conclusions can be assumed.

The majority of the crowd during the event was recorded to be either sitting down or dancing. It was noticed that small changes in the time as well the setting of the show can influence this behavior. The former is pretty straight forward since the more late the show was taking place the more likely was for people to be active, since show #3 featured the most dancing out of all shows, however in the case of the latter more details were presumed to have an effect. For starters it was noticed that when more people were in the 360LAB, dancing was more common. This also worked the other way around since when the crowd was dancing, more people were likely to join the room. Therefore, having the main entrance stay open will attract more people in the room hence make the crowd more likely to dance. Another way that got people to join the show was promotion. An online promotional campaign that took place before the event was successful in bringing in some people, mainly in the first two shows, however the majority of people that attended show #3 were attendees of an EDM rave that was happening in the same building and found out about it either by passing by the room or by hearing about it from friends. This can also hint to how a different type of crowd can have a different behavior since almost nobody from show #3 was present earlier.

Another factor that influenced crowd behavior was the type of performance. Mainly in the first two shows the attendees were more passive and treated it more as an art installation (especially in show #1) while in the third show the crowd became more active by dancing and being social, an expected crowd reaction among an EDM setting. One of the key differences between shows #1/#2 and show #3 was that the former was performed remotely while the latter featured a DJ inside the 360LAB, therefore it is assumed that the mere presence of a performer can make a crowd be more active. This however is not definitive since as mentioned dancing was observed in show #2 as well. At the observation stage it was assumed that dancing implied a higher satisfaction level however in both instances the respondents claimed to have enjoyed the experience, so the type of behavior does not necessarily imply the overall satisfaction levels of the crowd.

A noteworthy observation is that respondents did not mention the interaction in any way when asked to evaluate the overall experience. This may hint towards the fact that the interaction was assumed to be a secondary part of the show with the main focus being on the music and visuals that were displayed in the 360LAB. This is backed up by the fact that the visuals, and the music to a lesser extent, were the highlight of the experience according to the people who were asked to evaluate it.

The experimental method of measuring immersion by assigning the role of clicker to certain people in the performance yielded some meaningful results. Not only it pointed out the exact moments in which the clickers were potentially immersed, but it also made clear what specific aspects of the performance they found interesting or lacking. Although the accuracy of their claims on being immersed can be debated, at the very least this method provides an efficient way of evaluating and getting meaningful feedback on such a performance.

Analysis of the quantitative data also provided some interesting findings. Firstly, the high number of clicks on the launchpads in show #1 can suggest that the people that were interacting with the performance found it interesting. This is backed up by the

observations from show #1 and the interviews where it was noted that people in the studio room seemed to find the interaction element enjoyable. The lower number on clicks on the control launchpad compared to the CHAOS and FX, combined with the respondent's comments can suggest that it was not as interesting to the crowd as the other two. However, this is not conclusive since by design the control launchpad is only meant to be used at certain points during the performance. It is also clear that long presses were not as common as short presses therefore implementing features that do not require them would be preferred, unless it's made very clear that a long press is necessary.

The growth observed in the Instagram analytics can also indicate towards a natural demand and overall interest for this project. Not only did the page experience engagement prior to the event, where it was also promoted through PLANETART's socials, but even more engagement was observed afterwards when pictures and videos from the event were released.

5.3 Discussion

The results from the testing leave a few unresolved points. For example, there is not a clear answer if the interaction enhances the experience or not. The most concrete conclusion is that in this case it made for a vastly different type of experience that simply cannot be directly compared with a traditional EDM event, however the question remains in case small interactive elements are introduced in the latter. Further research that tweaks small variables and compares such shows can help pave the way towards a clearer answer.

A point of interest in the testing was the substance use during show #3. Although the sample size was small everyone that was interviewed was under some influence in the time of the show. This can be a point of discussion since on the one hand it can affect the response and feedback of the performer but on the other hand it shows how common is that type of behavior in EDM events. It was noteworthy that in the first two shows this was not observed.

Overall, this research and its results are important for a variety of different reasons. Firstly, the gap that exists between the EDM scene and the academic world due to lack of academic research can be reduced by the contributions of this project. Moreover, it examines alternative ways of conducting EDM shows, a subject which has been static for the past couple of decades. The importance of the project can be backup up by the fact that established local companies already took interest in it. Apart from PLANETART the parent company and one of the main stakeholders, a second organization named Cross-TIC was also interested in being involved during the research. Cross-TIC promotes projects that center around creativity and technology, and it is closely related with well-established organizations in the region as well as the government.

5.4 Limitations

Even though there was an effort to conduct A/B testing for the first two shows, true A/B testing was not possible during the test. In theory the single variable that should have changed between the first two shows is the interaction, however in this case the crowd and time were also different between the two shows. Making an accurate A/B test would be extremely difficult considering that the exact same crowd is impossible to give their first reaction to both shows since experiencing one can alter their opinion on the other.

Although much of the equipment was provided by PLANETART, no budget was provided for this project. Therefore, enhancing the space with a better sound system or better beamers/display walls was not possible.

Even though the test event provided some useful insights, a series of test events would help make more clear and precise conclusions. This was not allowed due to time constraints.

Lastly this project involved working on a lot of different areas and it was largely held together by a single person. Having a team of individuals instead would potentially help diversify the workload and provide more efficient results in a shorter period of time.

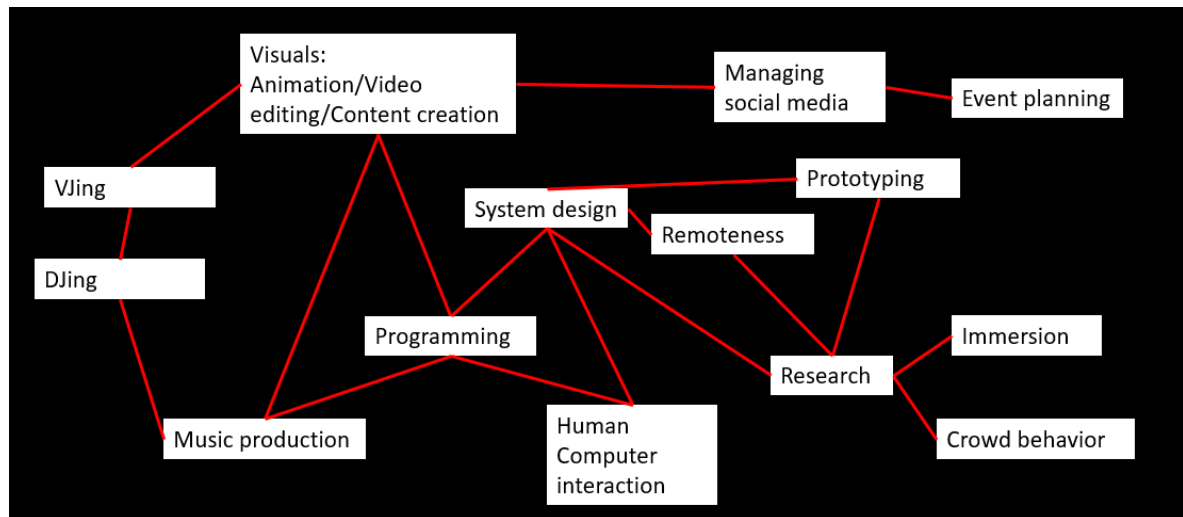


Figure 47 Main subjects that were involved in the project

5.5 Future Work

Some important research points that were examined during this research were crowd behavior and measuring immersion/overall satisfaction in EDM events. The former was somewhat tackled in past research, however none of the papers that were examined did it in the context of an EDM environment therefore it can potentially help get a better understanding on the target audience of such events. The latter can be crucial since the results suggest that the experimental clicker approach was successful, therefore indicating towards an innovative way of evaluating such events. Moreover, the possibility of conducting shows remotely was tested and although it had some drawbacks it worked flawlessly from the technical side. This paves the road for further research on remote controlled shows which is a topic that is still very much undeveloped.

In the short-term future this project can be split up into two smaller subprojects. The first one being an art installation that is reminiscent of shows #1/#2. It heavily focuses on the audiovisual experience and interaction and is meant to be displayed at open local exhibitions such as the Museum Of The Future or GGOBOT (PLANETART,2022). The second one resembles more the concept of show #3, where it mainly focuses on providing a more EDM-like experience to the audience by having a DJ booth and small active crowd in the 360LAB. The latter can also be pitched to local EDM festivals or events as an addition to their experience since as it was noted in the observation section as well as suggested by some respondents something like that could potentially work well in that setting. Lastly experimentation with interaction or remoteness is still an area that is worth exploring more in the context of such an event.

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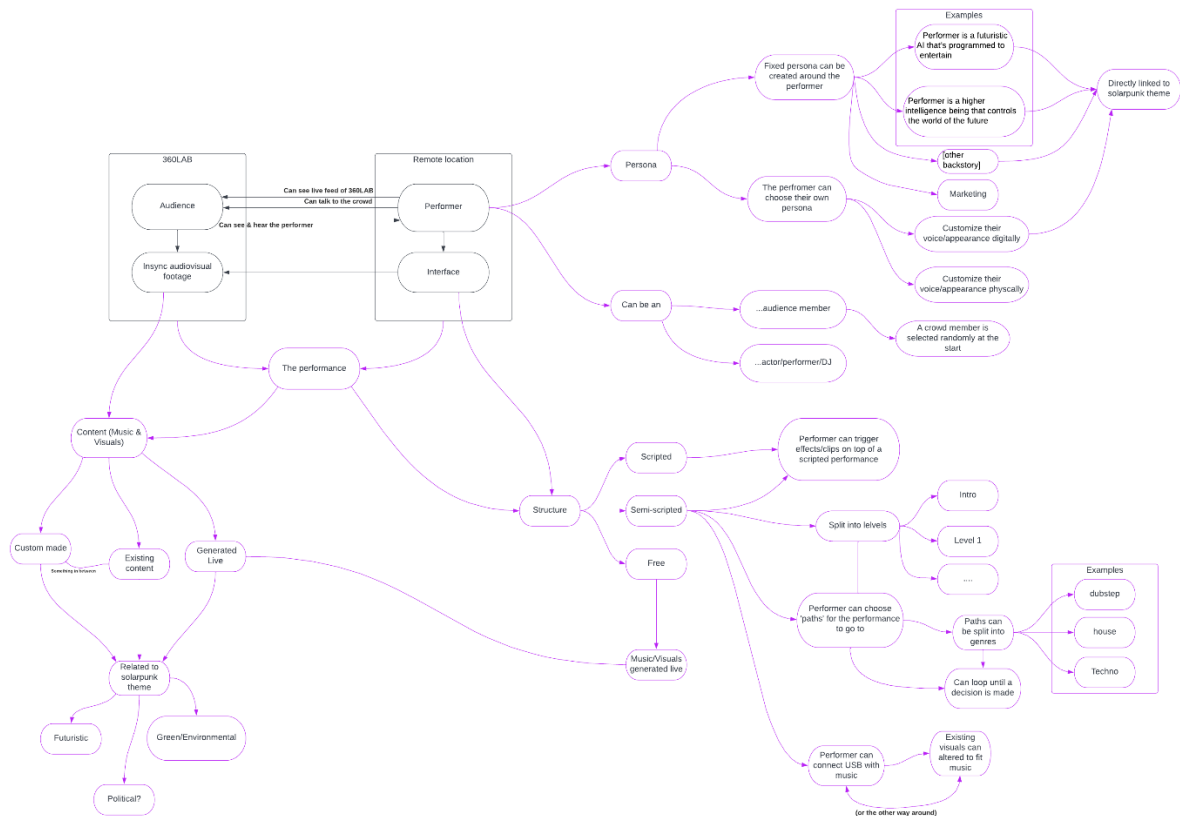
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APPENDIX



Appendix 1 Brainstorm scheme

JUNI 9, 2022 DOOR EDITOR CROSS-TIC

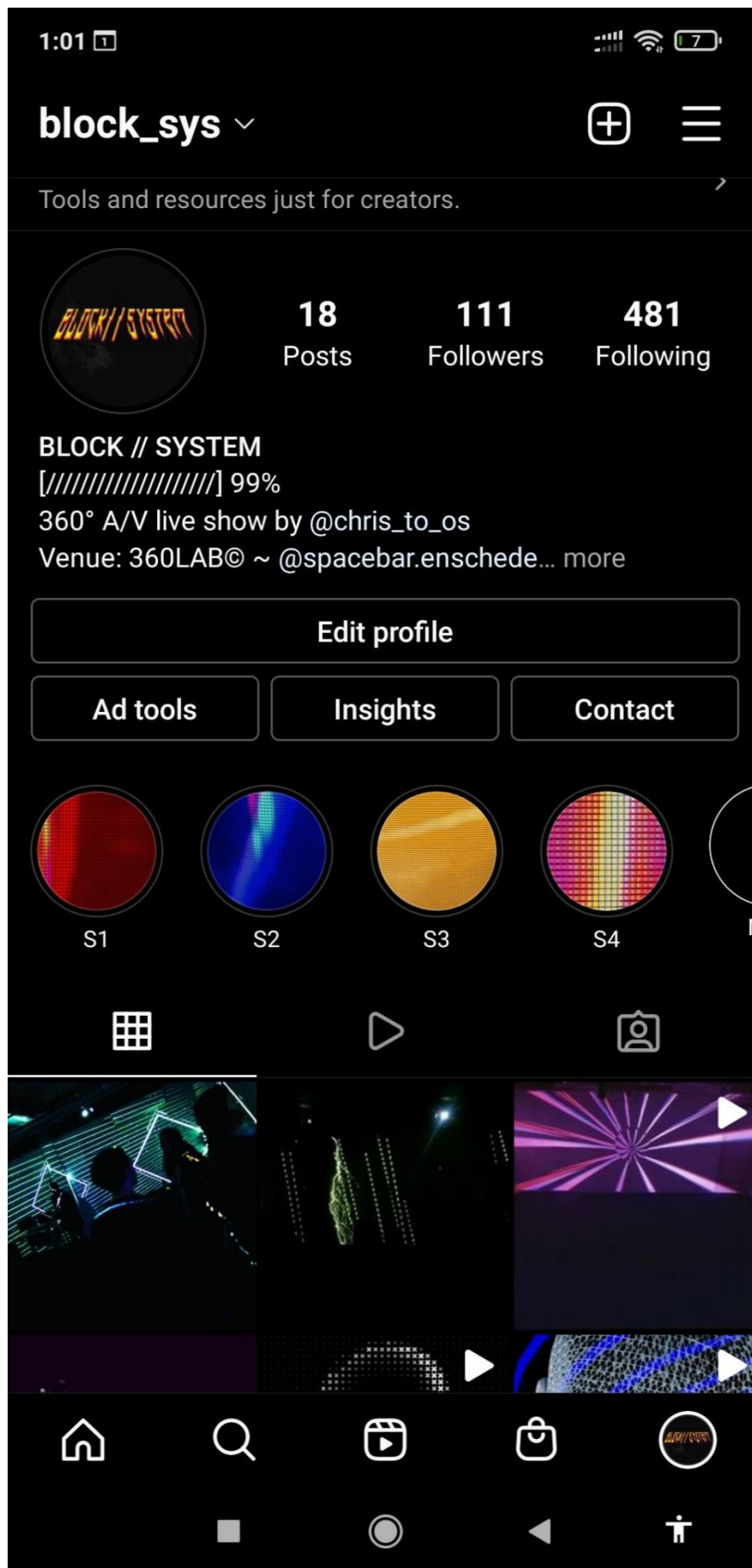
Christos Constantinou

Vorm: Onderzoek X Broedplaatsen

Periode: Voorjaar 2022

Christos Constantinou ontwikkelt zowel de software als hardware voor een dancefeest op afstand, in het 360 Lab in PLANETART. Zijn Cross-TIC onderzoek richt zich op het experimenteren met elementen die een EDM-experience 'immersive' maken – hoe kun je mensen ook op afstand onderdompelen in een totaalervaring van beeld en geluid? Christos voert zijn project uit binnen de Broedplaatsen, in het 360lab van PLANETART, in nauwe samenwerking met UT.

Appendix 2 Cross-TIC endorsement on their site (Cross-TIC, 2022)



Appendix 3 Instagram account , @block_sys (Instagram,2022)

BLOCK // SYSTEM
Your order: KWP9T

Thanks for your order!

Before you attend the event make sure you read and agree to the following:

- I confirm that I don't suffer from ptsd,nausea, epilepsy or any similar conditions that are triggered by intense audio-visual stimulation.
- I agree to be audio/video recorded in the event.

IMPORTANT: This event is part of a research project organized by the University of Twente. Therefore after the event you will receive an invitation to evaluate the experience. The following apply:

- An evaluation session after the event will take place. It can either be through an online survey or interview. You will be contacted after the event.
- You have the option to withdraw at any time.
- You may be asked to provide personal data such as name, occupation etc. The data will not be shared beyond the research team.
- The data recorded will only be used for this research and deleted afterwards.

IF YOU HAVE A "TEST SUBJECT" TICKET YOU MAYBE ASKED TO PERFORM SPECIFIC TASKS AT THE EVENT. PLEASE BRING YOUR PHONE WITH YOU.

////////////////////////////////////

TICKETS ATTACHED BELOW \\\ SEE YOU SATURDAY >:)

BLOCK // SYSTEM evaluation

You have the option to withdraw at any time.

The data will not be shared beyond the research team.

The data recorded will only be used for this research and deleted afterwards.

The survey will be split into 4 parts:

- Show #1 (22:00)
- Show #2 (23:00)
- Open Decks (00:00+)
- General Questions

Please answer for the shows you've attended

Answer all the questions as honestly and as detailed as possible

Clicker questions

Why did you repeatedly press it sometimes?

Your answer

Why did you stop sometimes?

Your answer

Why did you stop in the beginning of 2nd show

Your answer

Clicker notes

Your answer

Show #1 (22:00)

Show with real time interaction

Were you there for show #1 at 22:00? *

☐ Yes

☐ No

Rate show #1

1 2 3 4 5 6 7 8 9 10
Really bad ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ Perfect

Explain your rating

Your answer

What did you think about the interaction in the screen room?

Your answer

Explain how immersed were you in the experience

Your answer

What did you do during the show?

Your answer

How much time do you think it lasted?

Your answer

How does it compare to other raves/EDM events/festivals?

Your answer

Show #2 (23:00)

Show without real time interaction

Were you there for show #2 at 23:00? *

- ☐ Yes
- ☐ No

Rate show #2

Really Bad 1 2 3 4 5 6 7 8 9 10 Perfect

Explain your rating

Your answer

Explain how immersed were you in the experience

Your answer

What did you do during the show?

Your answer

How much time do you think it lasted?

Your answer

How does it compare to other raves/EDM events/festivals?

Your answer

Open Decks 00:00+

With DJs playing in the 360LAB

Were you there for open decks at 00:00 until late? *

☐ Yes

☐ No

Rate the open decks experience

1 2 3 4 5 6 7 8 9 10
Really bad ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ Perfect

Explain your rating

Your answer

Explain how immersed were you in the experience

Your answer

What did you do during the show?

Your answer

How does it compare to other raves/EDM events/festivals?

Your answer

General Questions

What did you think of the overall experience? *

Your answer

What do you think about the space that the show was performed in? *

Your answer

Any suggestions for future live events? *

Your answer
