

Festival at home

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Preface

In front of you is my thesis, Festival at home. This thesis was written in the context of my graduation from the TU Delft at the faculty of Industrial Design Engineering for the master Integrated Product Design. The research and development have taken place at Philips Lighting in Eindhoven, currently known as Signify. I have executed this project individually with support from both institutions, bringing the Delft way of designing together with the internal knowledge of light at Philips.

Years of events, festivals and concerts attest to my passion for music and show. Combining lighting design and music in a festive way was a dream come true.

I want to thank Simon Rycroft, Paul Thursfield, my fellow interns and the rest of the design team at Philips Lighting in Eindhoven for their support and co-operation. Their knowledge lifted my project to a higher level. I especially enjoyed the quick communication and fast iterations during the process. The easy accessibility to experts was something I have not experienced before.

A big thanks goes out to all participants during research and validation studies. Without their insights I would never have achieved the outcome I came to.

Lastly, I want to thank my chair Sylvia Pont and mentor Erik Jepma for their guidance and feedback during the process.

I hope you enjoy your reading.

Jasper van Schaik

Maarsse, August 15, 2018



Executive summary

This reports describes the process, results and validation of the graduation project: Festival at home. The project was carried out for Philips Lighting BV in Eindhoven, currently known as Signify. During a time span of 7 months the research and design were carried out.

Philips Lighting is a company producing lighting solutions for business and consumer needs. In the domain of home lighting the most innovative product is the hue system. This system provides smart lighting that the user can control with the help of the hue app. Venturing into entertainment lighting, Philips is looking for ways to expand the hue system to be used in combination with movies, gaming and music.

The first phase consisted of research to get an understanding of people's motives to attend a festival. Visiting a music event was described as an immersive music experience. Through interviews and questionnaires it was determined that stage lighting immerses people into the music and gives a feeling of amazement.

Stage lighting was analyzed and compared to domestic lighting. Where ambient luminescence and focal glow can be found in a living room, lighting at a music event consists mainly of play of brilliance. An ideation phase was conducted on ways of bringing play of brilliance to the home domain and simulating stage lighting. The end result was a system consisting of multiple lights, controlled by an algorithm, that are spread to a room.

Lights

The lights are wireless, battery-powered units. Users will have a number of these units and place these through their own living room. It is encouraged to experiment with the position of the lights to emulate a music event stage. Customizing the light by using furniture and available accessories is advised. The position of the lights is mapped so the algorithm knows where they all are in space. They are remotely controlled by the hue entertainment app.

Algorithm

The algorithm takes video as an input, analyses the color in the correct places and sends the information to the lights in real-time. The video is synced to a piece of music and is made by an artist. Patterns of colors move in accordance with sound in this video. These colors and patterns are then transferred to the lights. Every light corresponds to 1 pixel in the video. The light continuously adjusts to the color of this single point. This way a light show is created throughout the room in sync with the music. An artist makes the lightclips instead of a computer in order to capture all nuances in the music that a computer can't recognize.

User experience

The user experience is enriched because of the addition of lights synced with music. A validation was carried out with a prototype of 20 light points. Users felt more immersed into the music with a lightshow. The synchronization between light and sound made the music more intense according to the participants in the validation study.

Philips hue

This system expands on the current possibilities of Philips hue. The current advances in hue entertainment let the user synchronize their lamps with music through the Hue Sync application. Festival at home adds dynamic light patterns, play of brilliance, real-time control and light shows that are produced by artists instead of an algorithm. Dynamics and meaning of a song can be better translated in this way, which creates a more immersive music experience.



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Introduction

Imagine standing in the crowd just before a Coldplay show. All the lights dim, the energy around you rises, suspense builds, and you feel hyped up. Then, the music starts, the lights turn on and the show has begun. The next hours, the world outside does not matter anymore. The show, the people and the music are what counts!

People get in a state of ecstasy where they forget the world around them. All that matters is the music and their place right then and there. This project strives to quantify the elements that make this possible and bring this experience to the living room.

Assignment

The original assignment is specified as follows:

Design a product where the user can input data such as video or pictures from a festival or music event. The input will be mapped to the light installation to recreate the atmosphere in the room captured in the video. When this is synched with music, memories can be re-experienced by the user.

The lighting in the room will intensify watching a music performance. Recreating a lightshow tailored to the user in private is the final goal. The Philips hue system should function as the base of the to be design product.

All pictures used in this report were downloaded from unsplash.com and are royalty free. If not, the source is explicitly stated.



Motivation

On March 25 of 2001, Eric Clapton performed live in Rotterdam Ahoy. It was the first music performance I attended. I was only 9 years old, but that is where the love for music events started. My dad liked classic rock and pulled me with him. Before my 18th birthday I had seen the Dire Straits, Status Quo, Supertramp, Paul McCartney, Golden Earring and more.

Then, by the time I was 18, I had already discovered electronic music. So when the age limit was no issue anymore I started attending those parties as well. The music paired with lights and lasers and like minded people opened a new world. I knew I wanted to do something in the music entertainment. The emotions it provoked in the people around me gave so much energy; I want to be a part of that.

Now I get the chance to use my experience and bring that to my graduation project. Combining light with music and giving people a good time is the main goal. This project for me is the ultimate voyage on a discovery of the essence of music events. Finding out what has been so special all these years.

So when the opportunity rose to discover ways to bring the festival experience to the living room it was a no-brainer. In this project I can bring my passion to the table and make others feel the same in the comfort of their own homes.



Photo: Jasper van Schaik

Process

This report is separated into five parts, titled: Discover, Define, Develop, Design and Evaluation. In each part a phase of the process is described.

In 'Discover' all the conducted research is explained. It starts with a literature study to find out what motivates people to attend music events. The study was expanded with interviews and a questionnaire to gain insight into people's drivers to visit. From these studies a map was constructed with experience value drivers. This shows the personal needs and benefits visitors experience when attending an event. These results were used in determining the design directions and from the basis for the chapter 'Define'.

Context analysis, stage analysis and light experiments were conducted to gain insight in lights. The results from these studies are used during the ideation and concept phases in the part 'Develop'.

'Define' describes the process which led to the design vision. This part takes the conclusions from the Discover phase as input. The conclusions are combined and condensed into design directions. These design directions are ideated on and from there a final directions is chosen. A design vision is given to conclude this part.

The design vision is used as a start for the ideation phase. The ideation, and conceptualization are described in the part 'Develop'. Using the design vision as a guideline light sketches were made. Input from the stage analysis and the light experiments were used to create the sketches.

These resulting sketches were ordered and clustered. With the help of criteria and company experts, concept directions were synthesized. A final concept direction was extracted from these directions.

The final concept direction was further developed into the final design. The different sub-parts of the total design are explained in 'Design'. A roadmap was made to guide the reader through the components of the system. It starts at the point of buying the product. Then guides through installation and then to the functionality. The journey ends at future uses. Each step is explained in detail to get a full picture of the system.

To conclude this report, the last part is 'Evaluation'. In this last part the final design is tested. A prototype was made to validate the design. How this prototype works is explained in the Evaluation. To conclude this part a validation study is carried out. In this study the prototype is tested against the design direction. Participants from within the company and outside the company were asked how they experienced the demonstration given with the prototype. This was compared to the design direction to validate the final design.

This report concludes with recommendations on the light experience. The end result of this project is not a product. The end result is an experience. All products that have been designed in this project serve to support the final experience. The goal was to create an immersive music experience, therefore this is validated. Products such as the lamp and the prototype were means to make the design into viable system. They do reflect a possible way of implementing the design into the market but the main result is people's reaction to the lightshow.







A photograph of a DJ performing at a night event. The scene is bathed in blue light, with a background of numerous small, glowing blue dots resembling stars or a starry sky. In the foreground, the silhouettes of several audience members are visible, looking towards the DJ. The DJ is positioned behind a desk with a laptop and a microphone. The overall atmosphere is vibrant and energetic.

Discover

Internal analysis

Philips Lighting has a broad assortment of products. The total range varies from garden lamps to large factory systems for the automotive industry. Getting a grip on the departments and individual lighting systems helps research and future implementation of new products. This chapter shines a light on the different light experience domains defined within Philips and explains the hue system to get an initial impression of the system.



Experience domains

All activities and products are divided up into four categories. These domains, as they are called, cover all projects and departments. In figure 1 a representation is given.

This project is about creating an immersive music experience at home. This will therefore be the area of focus. The Home domain encapsulates all consumer light products: luminaires, light bulbs, car lights and the hue system. Most products are conventional lighting; bulbs and luminaires. Philips hue can however be used as interactive lighting and create light scenes tailored to the user.



Figure 1: The experience domains within Philips Lighting BV.

Hue system

This project focuses on light experiences at home. Building on the hue system gives a foundation. The system gives the possibility to adjust light and intensity through time at home. The interactive nature makes this an ideal starting point to bring user centered and music tailored light to the living room.

What is smart lighting?

The hue system consists of three main parts: the lamps, the bridge and the controllers. These parts connect together wirelessly.

Lamps

The lamps of the hue system are LED lights. They are available with different fittings, as armatures and as light strips. All produce white light and some produce colored light too. The lamps are dimmable they can blink and pulse. These lamps produce the light that illuminates the users house.

Bridge

The bridge is the central hub in the hue system. It connects smartphones and controllers to the lamps. In the case of hue, 50 lamps can be connected. The bridge is connected to the Internet via Wifi allowing the user to control the lamps when not at home. The lamps are connected to the bridge via the Zigbee LightLink protocol.

Controllers

The lamps can be controlled in several ways. The main control is through a smartphone with the hue-app. Users can set the colors and intensity of the lights. In the hue-app it is also possible to set timers and create light schedules for when the lights should turn on and off. The app communicates with the lights through the bridge. There are also switches that control the lights. These connect to the bridge and can be used without the interference of a smart device. They can also dim the lights, control color and act as an on/off switch.

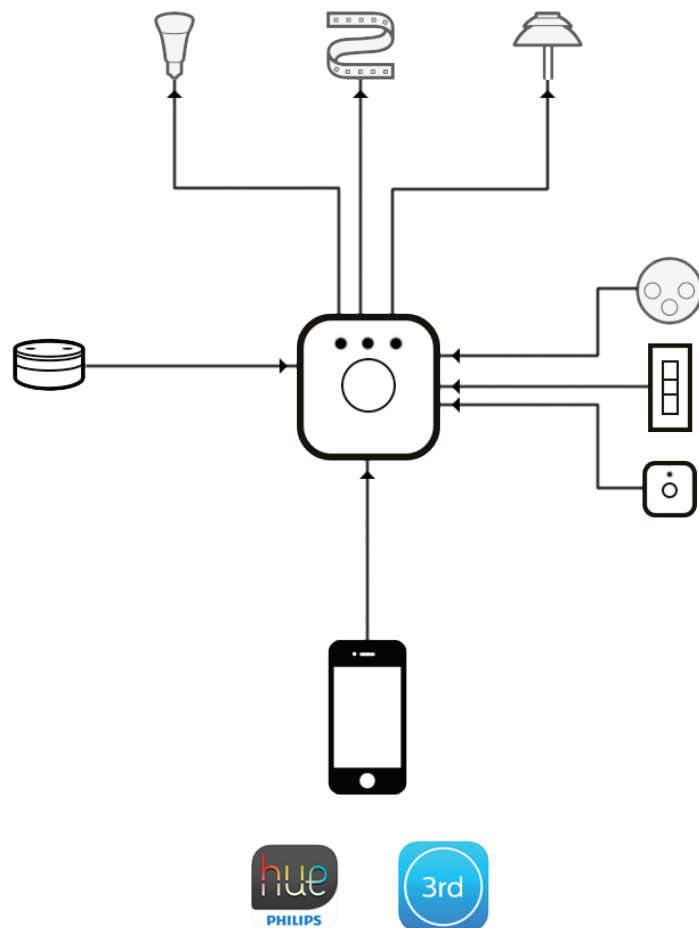


Smart lighting gives the user control over the lights. By having a smart system that is connected to all parts the user can control all lights at once. The user is free to set colors and intensity of light to their own liking. Automating the lights is a possibility as well. Having the system reacting to the users input directly makes the system perceived as being a smart lighting system. Philips hue can communicate with other smart home appliances such as amazon Alexa and Toon by Eneco.

A schematic overview of the workings of hue can be seen in Figure 2.

There is a central bridge that is connected to all the lights in the house. This bridge sends out color and intensity information out to each individual light source. These form light scenes that are tailored to the user. The bridge is controlled by a smartphone and a variety of hardware switches.

For more information, scan the QR code and read about the system on the website.



www2.meethue.com



External analysis

A festival at home, how can that be done? What defines a festival so it can be translated to a living room? This is what this external analysis is about. By combining qualitative and quantitative research with expert opinion a total picture is established. The defining factors are clustered, deeper emotion needs and benefits are set leading eventually to design directions.

The external research focuses on the experience of users. Their needs and desires are the central points of interest. The Discover part therefor focusses mainly on the role of the user. It tries to uncover the feelings a festival evokes. Once the emotional, personal drivers are established, it is clear what characteristics the future product should possess. From than onward, the lighting side of the project will find its way back in.

The first step is initial sensitizing. Past experiences and personal views create a starting point. After that a literature study into the motivation to visit a festival is conducted. With this knowledge, explorative interviews are held to figure out what the drivers of an immersive music experience are. Once these drivers have been established they are validated through quantitative research. Using a larger number of people through a survey gives more reliable data. The last step is to discuss with experts what the emotional drivers are. These are the personal needs and benefits a user gets from visiting a music event. Then the drivers to attend a music festival are clear. These can than be translated into design directions.

The term festival contains much more than just a music performance. Festivals can be whole cities with extra peripheral activities going on. This research focuses on the music performance part of a festival. For the rest of the report the term used is: immersive music experience.



Literature research

Bringing the festival experience to a living room can seem like a straightforward process. It does however involve many factors which make good translation of the experience difficult. Capturing human emotions and evoking the same emotions in a different setting poses challenges. What do people experience at a festival on a personal level?

To rephrase that question: What do people seek and find at a festival? The decision to attend follows from a motive. This is the starting point to start the research. The first step is to find out what motivates people to attend a music festival. It makes little sense to study satisfaction in isolation from motivation (Crompton, 1997)

The literature about people's motives to visit music festivals is sparse. Papers that are available have their foundation in tourism and event management mainly focusing on results to give event organizers an insight to get more people to their events. The results however can also be used to find the motives for attending.

In a study from 2009 two festivals were compared to find what motivates each festival's attendee. A comparison between Glastonbury and V Festival was carried out concerning the drivers of attendees for visiting. What is relevant is that both share two motivational statements. (Gelder, 2009)

Namely:

- Socializing with Friends/Family
- Music or Artist Playing

Music/Artist playing was the main motivation for 49 % of the attendees for V festival. Glastonbury attendees gave socializing and atmosphere as the most important factors to visit. Music came after that as main motivator. Pegg and Patterson studied the motivation to attend the Tamworth Music Festival in 2010. 52% of the respondents identified their love of country music as principal reason for attending the festival. The same result was found at the Kongsberg Jazz Festival in 2002. The main motivation to visit was the love of jazz music. (Thrane, 2002)

Not all festivals share the same motivational principles. 'The most important reasons for attendance given by the participants were the theme of the specific attractions or activities related to the event'. (Pegg, 2010) This means that the main motivation for visiting a music festival is the music itself.

So, does the music matter? Yes, to an extent. (Bowen, 2005) The conclusion is that the artist and the music is the main attracter to music festivals. However, a key component to the whole festival is the social aspect. 'It is equally important to attendees to experience a fun and festive atmosphere that offers ample opportunity to socialize.' (Bowen, 2005)

In conclusion: The main motivation for people is the enjoyment of the music. This does have to be together with friends or family.

It is now established that the music itself is main driver, but what do people experience? How do they immerse themselves in the music? What do they find at a festival what they can't find at home? In the answer to these questions lies the key to the festival experience. This forms the question:
What defines an immersive music experience?



Explorative interviews

As the literature states, the most important factor for attending a music themed event is the music itself. People are searching for a way to better experience the music than they can in their own homes. What factors contribute to the enhanced experience are to be found out. How do people experience these events? Why do people actively search for these events and actively attend them? What defines an immersive music experience?

Explorative interviews are held to get an initial grasp on what drivers for music events or festivals are. 6 interviews were conducted. These interviews were quite extensive and took between 30 minutes and 2 hours. The subjects told about a music experience they had and what it meant to them. Every interview had a different theme and genre as to maximize the spread of data.

The results ranged from a classical evening with Mahler's 8th symphony to a high-energy weekend at Defqon.1 Festival. These events seem to be far apart in terms of experience but there are clear similarities to be found. What are these similarities and therefore what defines the immersive music experience is the key question.



Interview guidelines

The interviews were deliberately as open as possible. The interviewees should have room to speak about whatever they find important in regard to the subject. However, there were a few guidelines used to steer the conversation when necessary.

The interview consisted of three layers. The first part is the all-embracing question, when are you touched by the music? What happens when the music consumes you entirely and it is all you can think about?

The second set of questions revolves around passive personal experience. What do you feel specifically? What does the music evoke? What does the music mean to you? In other words, what is the effect on you without you actively doing something?

The third set of questions is about active experience. What do you need for the experience? What products do you use? Do you have a ritual to fully immerse yourself? So, what active actions are undertaken to get yourself into an immersive music experience?

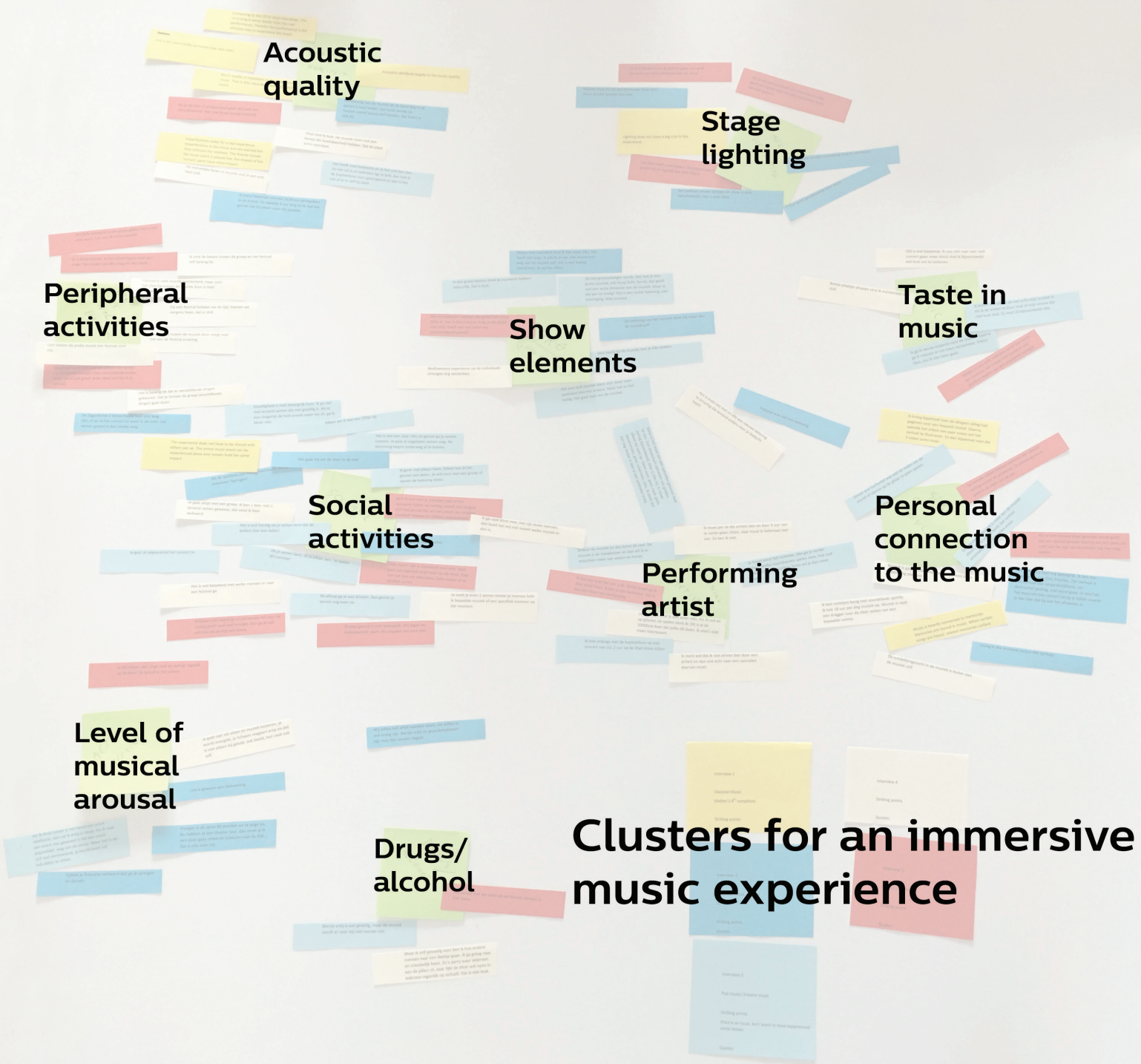
Clusters

After all the interviews were done and recorded the data from the interviews was collected. During playback, quotes from all the interviews were written down. This provided around 15 quotes from each interview. The quotes together define the pillars on what the immersive music experience rests on.

The quotes were printed on individual pieces of paper and laid out. These quotes were then clustered to form the main clusters that define the experiences the interviewees had. A map of these clusters of an immersive music experience can be seen in figure 3. The 10 clusters are the subjects that came up during the explorative interviews on which the participants had an opinion. These subjects define an immersive music experience. All quotes per cluster can be found in appendix A.

These clusters came from a small number of interviews. The significance and validity of this can therefore be questioned. However, this result is a great indicator of the direction further research should be heading. It gave results that yield good insights but need to be verified.

Figure 3: Clusters for an immersive music experience. The clusters define the reasons for attending a music event according to the interviewees.



Conclusion

During the interviews the results of the literature research was confirmed as well as new ideas surfaced. Social activities are important motivators to attend a music event. The same count for the music that is being performed. However, these are not solely important according to the interviewees. The audio quality for example was also a driver to attend an event. People want the music to sound at its best. Also the show itself was seen as a driver for attendance. Fireworks, lighting and decor were named to contribute to the experience. All aspects of an immersive music experience were mapped with the help of the clusters. The 10 different clusters all play a role.

The data gathered from the interviews is valuable but the small amount of interviews makes the result not reliable. In order to validate the clusters, quantitative research was conducted. The study was done with the help of questionnaires. The results would verify the clusters and rate their importance. In other words: What aspect has the most influence during an immersive music experience. The result of that form the base for the design brief. The quantitative research will be elaborated on in the next chapter.





Quantitative research

Questionnaire

Desk research and the explorative interviews have provided a number of leads to the most important principles of an immersive music experience. The main drivers and principles are captured in the clusters from the previous chapter. The weak point however is the limited number of people that have given their view on the matter. In order to rely on the drivers to be used as a basis for ideation they have to be validated. This validation is done through a survey for quantitative data.

So, what questions does the questionnaire answer? The hypotheses that came from the interviews need validation.

The questions where data was needed were:

- Are socializing and the sound quality essentials to the music experience?
- What is expected from the lights?
- How important are extra show elements? Think about pyro, dancers, props, etc.
- How important is the artist and your personal connection to the music?

Method

To get the data the Google survey application was used. This made it possible to send out the survey over the Internet to reach more people with greater ease. It was completely anonymous. No personal information was asked in order to let the participants answer as honest as possible.

People were asked to think of a music performance they had visited. All the questions were about that specific event. This way the participants could easily recall the event and answer the questions with relative ease.

Most questions were rated on a Likert scale from 1 to 7. This gave enough variation for each element to make a distinction between being essential and not necessary at all. Open questions were also included to get a first hand impression of how the participants feel about the event.

A number of questions were asked to verify the literature. The literature states that together with the music, 'social activities', being with friends or family, is the main driver for festival attendance. This was one question in the survey. The quality of sound is also an essential part of the music experience. If the sound quality is not up to standard, the event is not enjoyed to the fullest.

Other questions focused on the stage lighting and the personal connection to the music. These questions answered the importance of music supporting elements and the importance of the story behind the music or artist.

14 pictures of different light scenes at music events were included. Participants had the possibility to select which pictures reflected their experience the best. This gave an insight in the way people want their music events to be lighted.

Scan the QR-code and take a first hand look at the survey.



QR code links to the survey





Results

The answers to the survey were exported and are shown in bar charts. A total of 68 respondents filled in the survey. This sample size gives a good foundation to validate the explorative interviews and base the design directions on.

The respondents asked to participate were interested in different genres. This was done to get more variety in the results. It was not desire to let the survey be biased to one particular genre. Figure 4 shows the distribution of genres. The three most mentioned genres are pop, electronic and rock. The 24 colors in the pie chart represent a genre each.

The x-axis on the bar charts show the number points on a Likert scale the participants gave. The y-axis shows the amount of people.

Social activities

Being with friends or family is ranked high in the survey. An average of 5.5 points shows the importance. Figure 5 shows the distribution of answers given. Almost 65% of the participants rate being with friends or family with 6 or 7 points.

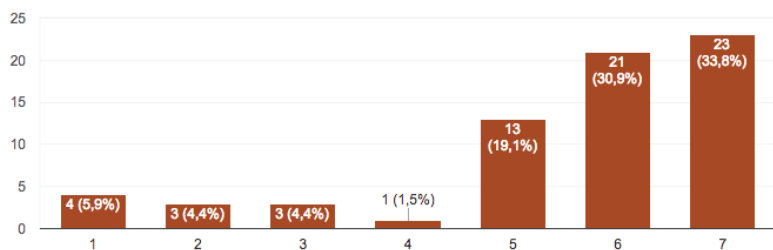


Figure 5: Being with friends or family

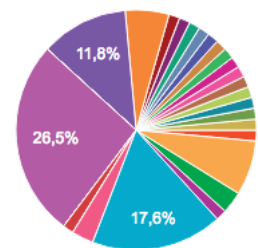


Figure 4: Genres
The colors represent different genres.
Pop = 26.5 Electronic = 17,6 Rock = 11,8

Acoustic quality

As can be seen from figure 6, the sound quality is a very important part of the experience. The average value is 6.25 on the 7-point Likert scale. This implies that if the sound quality is bad, the music experience is bad. No respondent gave a score below 4.

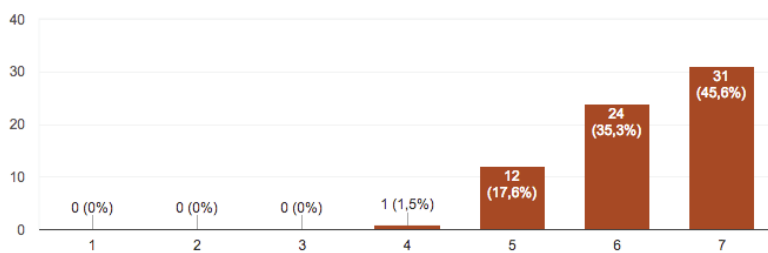


Figure 6: Acoustic quality



Stage lighting and show elements

Figure 7 shows a majority of 38% gave 6 points to the importance of stage lighting. The average of the scores came to 5.4 points. Most people see this as an important part of the experience. Show elements were rated with an average of 4.3. This is not as high as the lighting. The responses are distributed over the whole range as can be seen in figure 8. Noteworthy is that high scoring points correspond mainly with events like Defqon1. Festival, Armin van Buuren, Ultra Miami and the Rolling Stones.

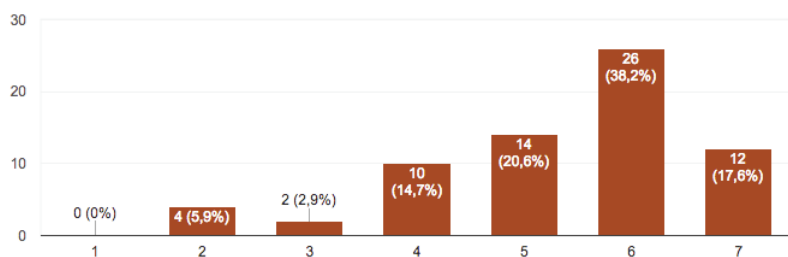


Figure 7: Stage lighting

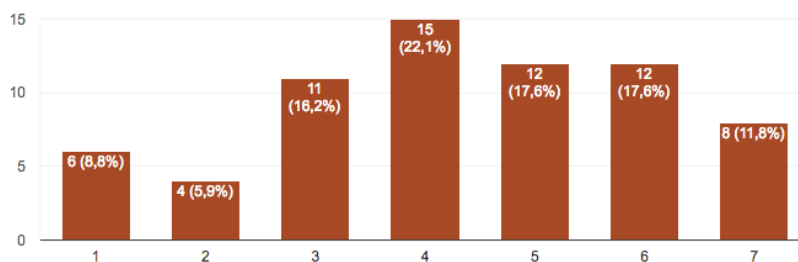


Figure 8: Show elements

Personal connection to the music

Most respondents, almost half, rated 7 points on the fact that they want to know which artist is performing. (figure 9) People find it good to know who they watching. However, when asked whether they search for background information (figure 10) on the artist or know the meaning of their songs, (figure 11) the interest is not as much as expected. With an average score of 4.2 and 3.1 respectively and large deviation in the answers the scores are high.

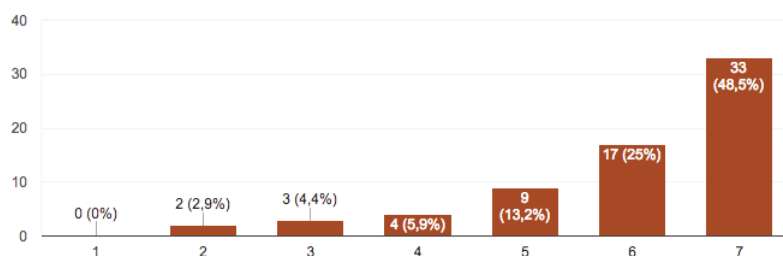


Figure 9: Know the artist



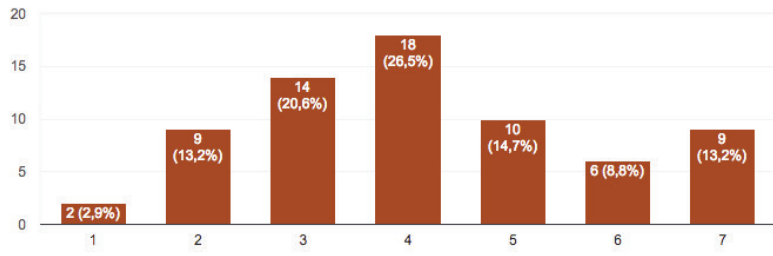


Figure 10: Background information

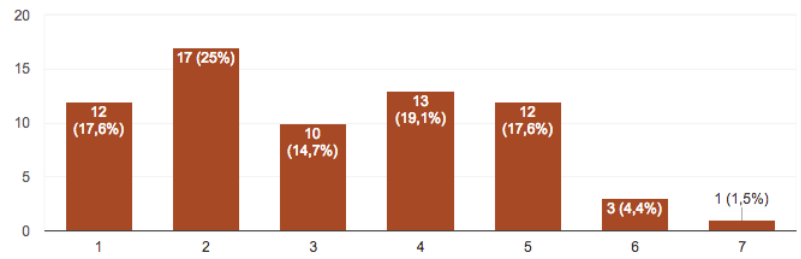


Figure 11: Meaning of the songs

Conclusion

When looking at the results a few findings are notable. Socializing (being with friends or family) and acoustic quality are indispensable elements every event should support. The scores from the survey are high which shows that they are essential parts of the immersive music experience.

Stage lighting is also seen as a very important aspect. With a high score it also shows to be an important part of the show. During the interviews people mentioned that stage lighting is essential at a music event. It can be concluded that stage lighting is indispensable too.

Show elements are considered to be less important than the music and the lighting. This does not mean it should be totally neglected. It can be used as a complementary effect with stage lighting. It is also seen that the subjects are in close proximity on the map of clusters.

When it comes to the personal connection to the music, unexpected results came out of the survey. The large majority of the people want to know who is performing. This was in line with the expectations. However, when it comes to the meaning of songs or background information about the artist, people do not seem to care as much.

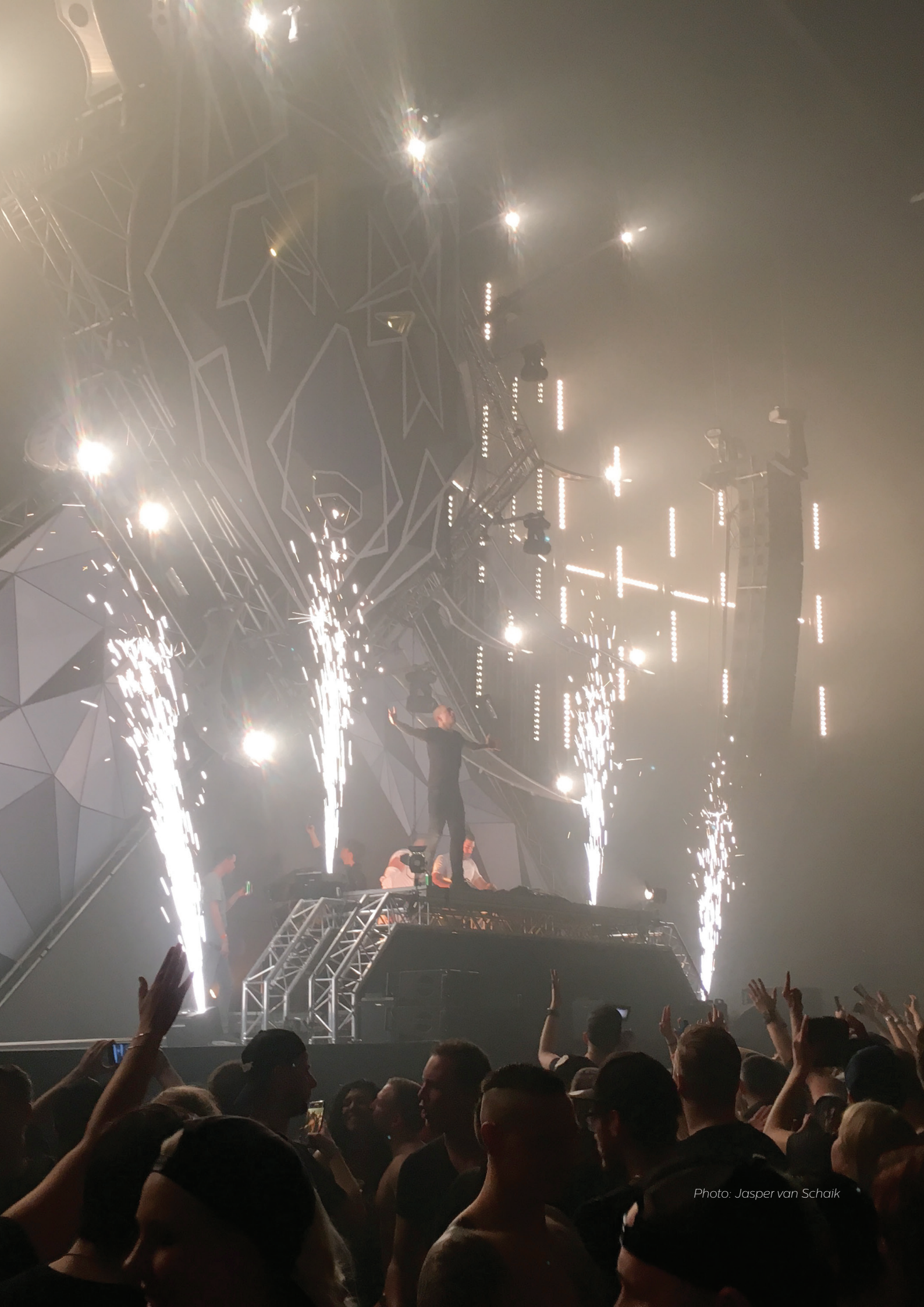


Photo: Jasper van Schaik

Experience value drivers

When the clusters were established, they were concrete and descriptive. The motivation or personal impression of the event was lacking. The reasons to visit a music event are more than just your personal taste in music or the usage of drugs and/or alcohol. There is a much deeper personal motivational layer.

What does an attendee search for and find at an event? This question was answered by the making of a map of what is called: 'experience value drivers'.

Once the clusters were ordered and placed in proximity to each other a map was made on top, that show the experience value drivers. In other words, what feelings does an attendee chase after and try to find at a music event.

In a small team with UX designers these emotional drivers were shaped. During a brainstorm the clusters were explained by the feelings they provoke. This brainstorm was refined to form 10 drivers of personal value. The result is a map on a map with the principles that define an immersive music experience. The map of principles can be seen in figure 12. These principles were used to define the design directions.

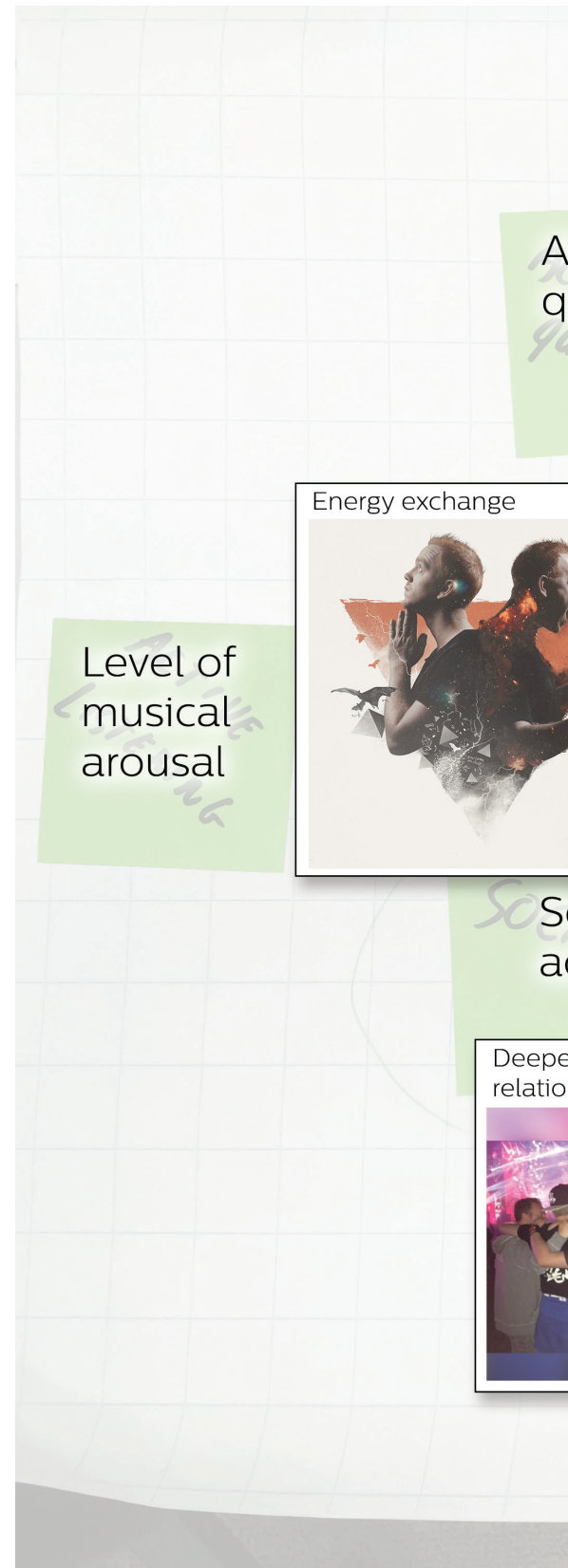
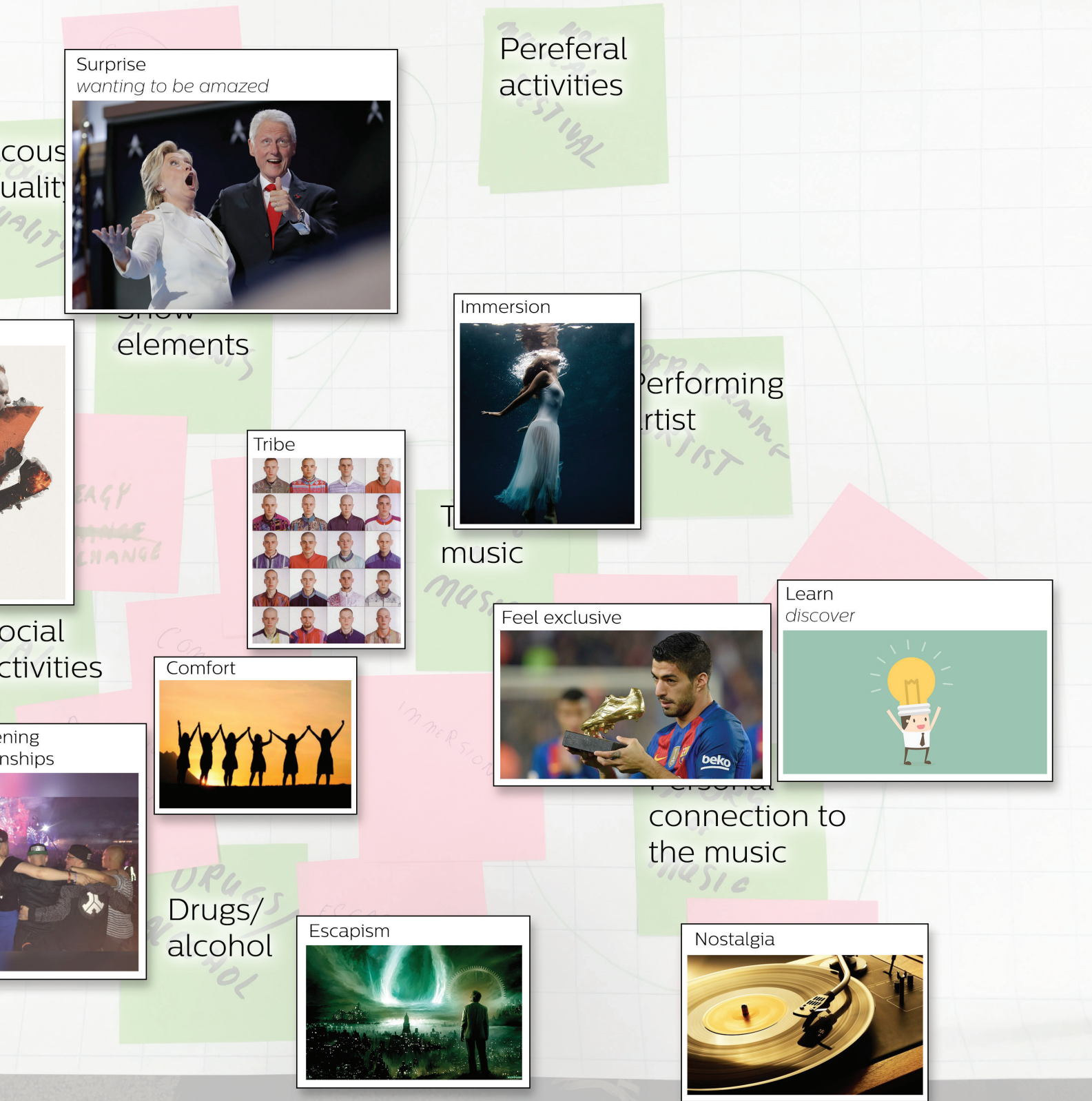


Figure 12: Experience value drivers.
The drivers describe the attendees personal needs and benefits.



Principles of light

Translating the immersive music feeling from an event to a living room seems like a far stretch. Emulating a light show is possible in many ways. However, the product should be non-intrusive in the context of a living room. How can this be done? In this chapter the foundation is laid to make this translation.

Richard Kelly was a lighting designer who lived from 1910 till 1977. In the 50's he described what he found were the principles on which light design can be based. He made a distinction between three basic functions of light. Examples of the functions are shown in figure 13.

Ambient luminescence

The first function is 'ambient luminescence'. This is diffuse light that fills the space, which makes it possible to see people, objects and the space itself. It provides the general illumination. For example: A pendant to light up a living room. (Light to see)

Focal glow

'Focal glow' is the second function of light. It is light to illuminate a specific object directly. With focussed light, more important information can be shown and less important objects can be send to the visual background. For example: a spotlight illuminating a painting. (Light to see something)

Play of brilliance

The third function 'Play of brilliance' describes the fact that light cannot only illuminate objects but also can be a visual stimulant itself. Glimmering and sparkling light effects are large contributors of atmosphere and vividness of a space. For example: candles in a house or the glimmering of the sun on water. (Light to watch)

These terms will be used as basic design principles for the ideation and conceptualization phases. They will form a guideline in the design process and thereby create a better understanding of solutions for the design problem.



Figure 13: The principles of light. From left to right Ambient luminescence, Focal glow and Play of brilliance.



Context analysis

Now the motivation for festival attendance is set, the light analysis can continue. By analyzing living rooms, analyzing music events and comparing the elements and principles of light, differences will arise. These differences in context point to opportunities for products. As an example, most living rooms have lamps that provide mainly ambient light. At a venue spotlights contribute to more focused light. These principles will be examined.

Where chances are discovered, opportunities for new lighting products will be ideated on. This will get us closer to the festival experience in the living room.



Festival lighting

When analyzing stage lighting the first thing that is seen is that the visual impact is striking. The collage in figure 14 shows use of color, contrast and shapes with light. Beams create lines and direction. Lit objects set the tone of the stage. Large illuminated panels and 3D objects give shape to the podia. They define the stage.

The contrast between dark and light is also apparent. Attention is drawn away from areas in the shadow. The light encapsulates the show. Everything outside the light is perceived as unimportant. Shadows create contrast with the lights. This light has more impact with a dark surrounding.

Within festival lighting it is observed that most of the lighting is in the realm of play of brilliance. There is some focal glow from spot lights, but the majority is play of brilliance. The light is used as an aesthetic feature so this observation is in line with expectation.

Figure 14: Collage showing festival lighting. Play of brilliance can be distinguished.



Living room lighting

Living rooms are mostly reflections of people's personal taste. Feeling of cosiness, warmth or simplistic and modern are terms that come to mind when describing an interior. This is also expressed in the collage in figure 15. The same is true when judging the lighting. The luminaires are used to illuminate a specific area of the space. This creates diffuse patterns on the walls and furniture in the form of focal glow. However, most lamps contribute to ambient luminescence.

In comparison with the festival context, play of brilliance is almost non-existing. All light is used to illuminate the room and people. Light itself is not used as an aesthetic aspect.

Figure 15: Collage showing domestic lighting. Ambient luminescence and focal glow are present in the light images.



Hue system lighting

Figure 16 shows a collage of hue products. This is a representation of the available products on the market. When analysing these products and the produced light effects, it is clear that I consist mainly of ambient light. Focal glow is also possible but dependent on the armature.

What is striking is that there is hardly any possibility to create brilliance lighting with the hue system. The lack of this makes the current system suited for light scenes within a space but incapable in creating the right brilliance layer.

Figure 16: Collage showing hue products.



Stage lighting case study

Large music events form the inspiration for this project. In order to get a proper emulation in a living room the structure of the original should form the base of the design. The way these stages are structured needs to be the foundation.

To get a better understanding of the build up of stage lighting four shows were analyzed with the help of concert registration videos. The fundamental principles were described to later be applied to a home setting. Stills were taken from the videos for a closer analysis.

As every show is different, multiple music events were used as cases. The events varied in size from 35.000 to 5.500 people. This gives a representation of more shows than just one singled out case. Screen captures can be seen in Figure 17 on the next page.

The different venues in descending order of crowd size:

- The Gelredome (35k)
- Blue stage at Defqon1. Festival (25k)
- Ziggo Dome (12.5k)
- Heineken Music Hall (currently Afas Live) (5.5k)

All these shows were analyzed on five points. The goal was to find similarities between all cases. The similarities point to principles that always apply and should therefore be used as a foundation for the final concept.

The five points are: objects, spacing, placement in the space, color and rhythm.



HardBass 2018
Gelredome



Kensington
Ziggo Dome



Blue stage
Defqon1. Festival



Tino Martin
HMH (Afes Live)



Defqon1. Festival Blue stage



Kensington Ziggo Dome

Figure 17a: Different music stages were analyzed on the placement of lights.

Figure 17b: Different music stages were analyzed on the placement of lights.



Hard Bass GelreDome



Tino Martin Heineken Music Hall

In figure 18 on the next page one of the cases is shown. It is a concert by Kensington in the Ziggo Dome. On the right side of the figure are three pictures of the stage. The left side shows how the lighting is positioned. The lines drawn over top show the basic shapes that are created. Single lights positioned in a square formation are perceived as a square. Single units form larger elements such as lines and squares. The five points of attention are objects, spacing, placement in the space, color and rhythm. The findings in this analysis serve as input for the final design. Getting inspiration from actual stages will benefit the lightshow at home.

Objects

Single units form larger elements.

1D lines

2D figures

Gestalt principles

Spacing

All the single objects within an element are mostly placed equal distance from one another. The close proximity makes them one element. The elements themselves account for a specific part of the stage.

Placement in the space

Stage lighting consists of single light grouped together to create the total stage. The stage in turn has a place within the venue. A music venue can be seen as the inside of a rectangular block. When considering a block, one side is mostly used for stage lighting. Light shines out to the ceiling and crowd. In some cases light is positioned above the public for a more immersive show.

Distinction in use of color

Every scene has one color and a supporting color if needed for variation. Extensive palettes of colors are uncommon. Every element has one task at the time. It for example shows one color as an element or changes gradually. In every picture from figure 17 this can be seen.

Rhythm

There are multiple rhythms to be found within a show.

Beat

Build-up climax within a song

Build- up over the whole show

These elements in rhythm can be seen when analyzing the concerts on video. The rhythm of the lightshows serves as inspiration for final product.

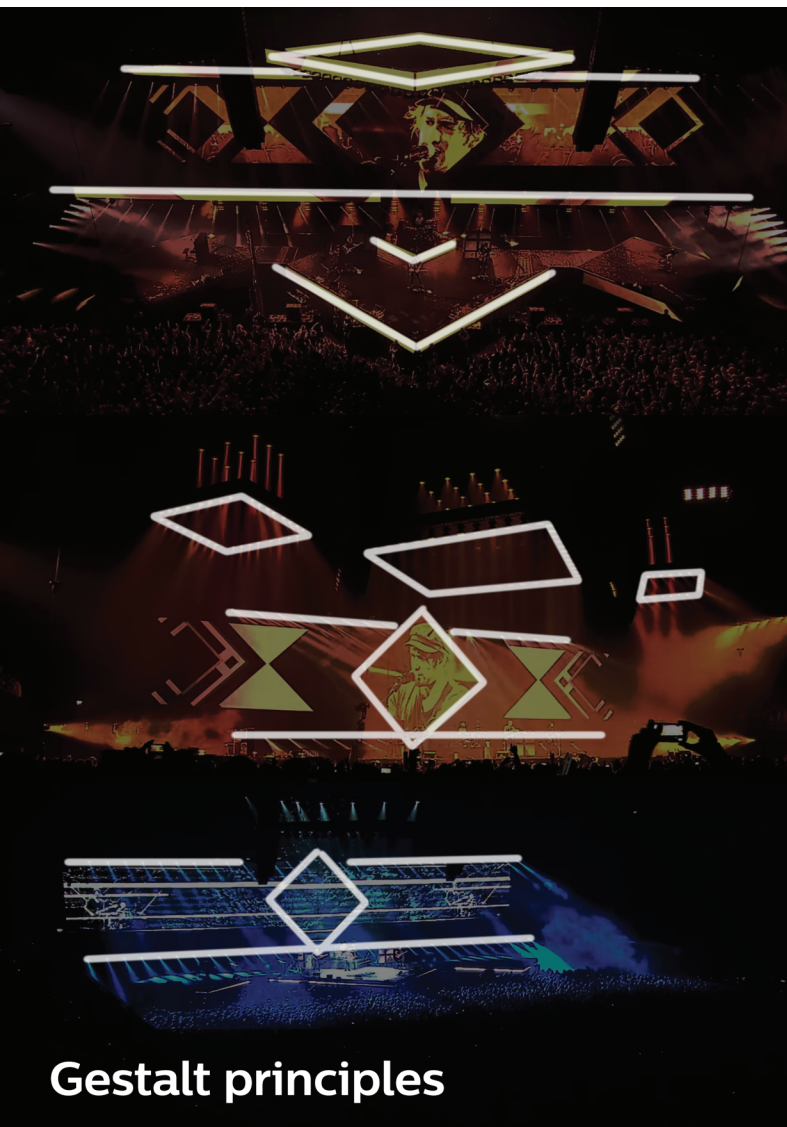


Figure 18: Within stage lighting gestalt principles can be seen.

Stage light emulation

Characteristic to professional festival lighting is the beam of light. Multiple beams synced together can create the effects associated with music shows. A number of these light beams move through the space to create patterns and enhance elements in music.

Set-up

A single RGB LED-pixel was placed on a prototype puck and used as a light source. This LED-pixel closely resembles the type of light source used by the to be designed product and current Philips products. On top of this light, a variety of materials is placed to see the effect it has on the light. The results can be seen on the walls and ceiling. Photos and, if useful, videos were taken of all effects.

Light tests

In figure 19 a representation is given of the light effects that were achieved. By using a variety of objects, different results were seen. Some objects such as candle holders were made from transparent materials and refracted the light in interesting ways. Other effects were achieved by blocking the light and thus creating shadows on the walls.

Conclusion

Multiple effects were found to be aesthetically pleasing. However, no particular effect stood out in successfully imitating professional show lighting. The choice was therefore made to not simulate festival lights in the tried manner.

Some effects were still very successful in creating different atmospheres. The choice was made to make the concept 'customizable'. This means that the user can experiment with these different effects with materials in their own homes. That way the user can use for example existing furniture, home accessories or custom made attachments to incorporate those in the final festival experience. The concept thereby invites the user to use their living space to enhance the experience.

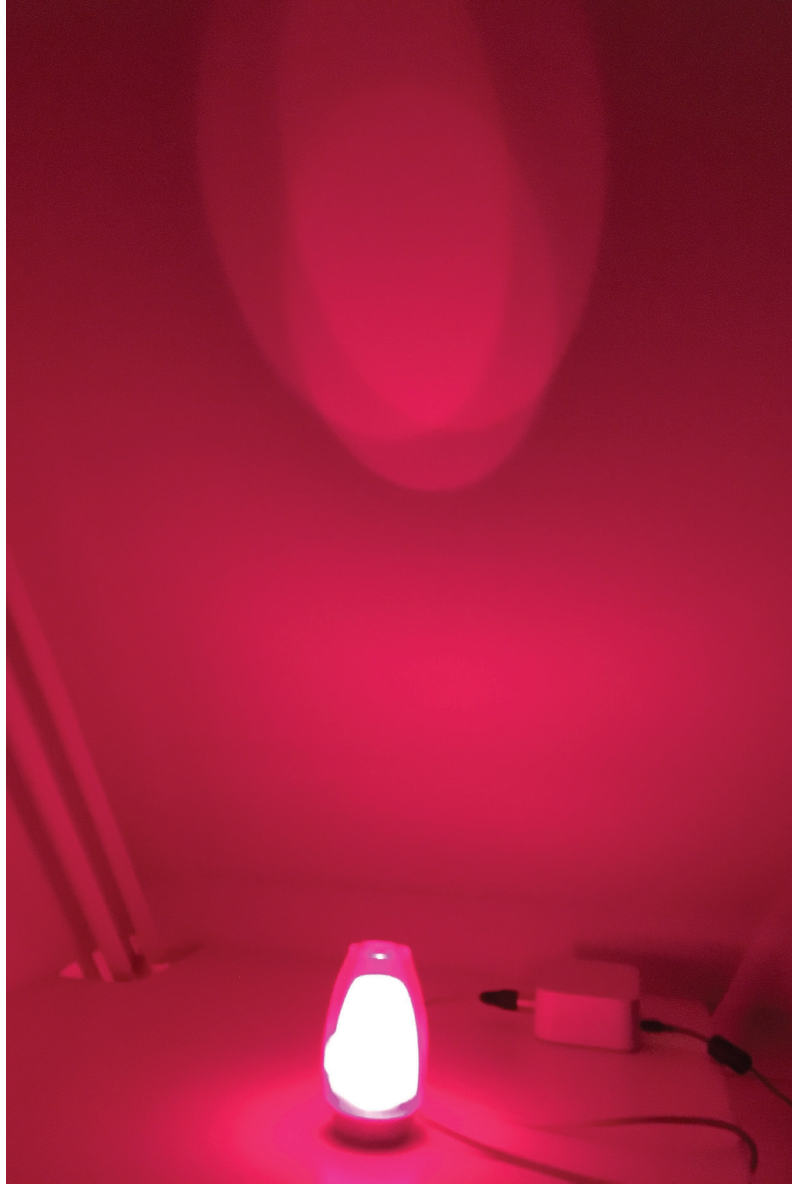


Figure 19:
An impression of light
effects to emulate
stage lighting.





Define



Design direction

Combining the results of the literature, interviews and survey formed a reasoned base for possible design directions. A total of four directions turned out to be a viable base for continuation into the ideation phase.

To give a visual representation figure 20 shows where the design directions fall in comparison with the experience value drivers. The four colored areas are numbered to correspond with the directions.

The main objective is to improve the festival experience at home. This can be done by focusing of the emotional values from an immersive music experience to the context of home. Using value drivers in the design directions the emotional needs and benefits can be translated to the living room. All possible directions are build-up from the emotional values the user wants and the underlying cluster it came from.





ACTIVE LISTENING

PERFORMING ARTIST

TASTE IN MUSIC

TRIBE

COMFORT

↑
DEEPENING
RELATIONSHIPS

IMMERSION

FEEL EXCITED

STORY OF MUSIC

ENERGY

SOCIAL

DRUGS / ALCOHOL

Directions

Direction 1

Deepen the users' relationships and bring them comfort by stimulating the social activities found at music events

From literature, interviews and the survey it came clear that the most important motivator to attend a festival or music event is being with friends or family. This social aspect is an important driver.

By introducing the facility to socialize in the product, the experience from the festival grounds can be brought to the living room.

Direction 2

Enhance the users' music experience by improving on the perceived acoustic quality of the sound

From the survey it became clear that sound quality is vital for an immersive music experience. Without the correct acoustic quality, enjoyment of the music is not fully possible. Enhancing the perception of the sound quality at home can therefore lead to a more immersive music experience.

Direction 3

Give the user a feeling of amazement by surprising them with simulated stage lighting and show elements tailored to the music

From the interviews and the survey it seems that lighting and show elements are indispensable at a music event. The expectation is to be amazed by the lighting in support of the music. 'Without lighting, the show is boring'. It is essential that lighting be present in order to have an immersive music experience. Therefore the correct simulation of stage lighting should be used to create a festival at home.

Direction 4

Evoke nostalgia and the feeling of exclusivity by deepening the users' personal connection to the music.

During the interviews it came forth that music holds meaning through the stories it yields. Music comes with memories attached that can make songs especially for you. Only you have these memories and this connection. These feelings surface strongly during a music performance. Focusing on the story of the music can create a stronger personal connection to the music. Evoking these personal stories can create a more immersive experience in a living room.

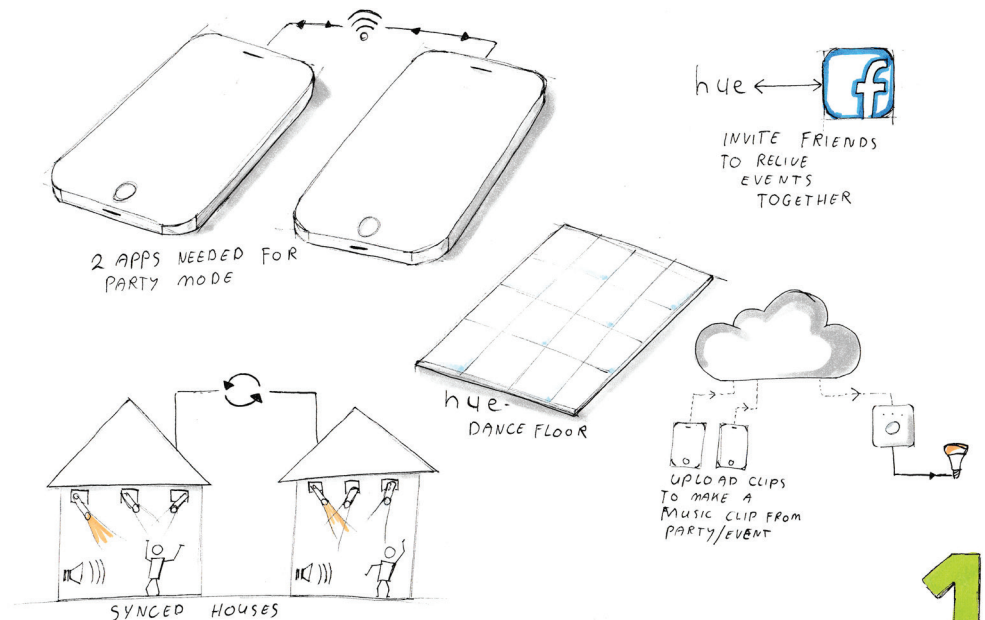




Figure 20: Design directions

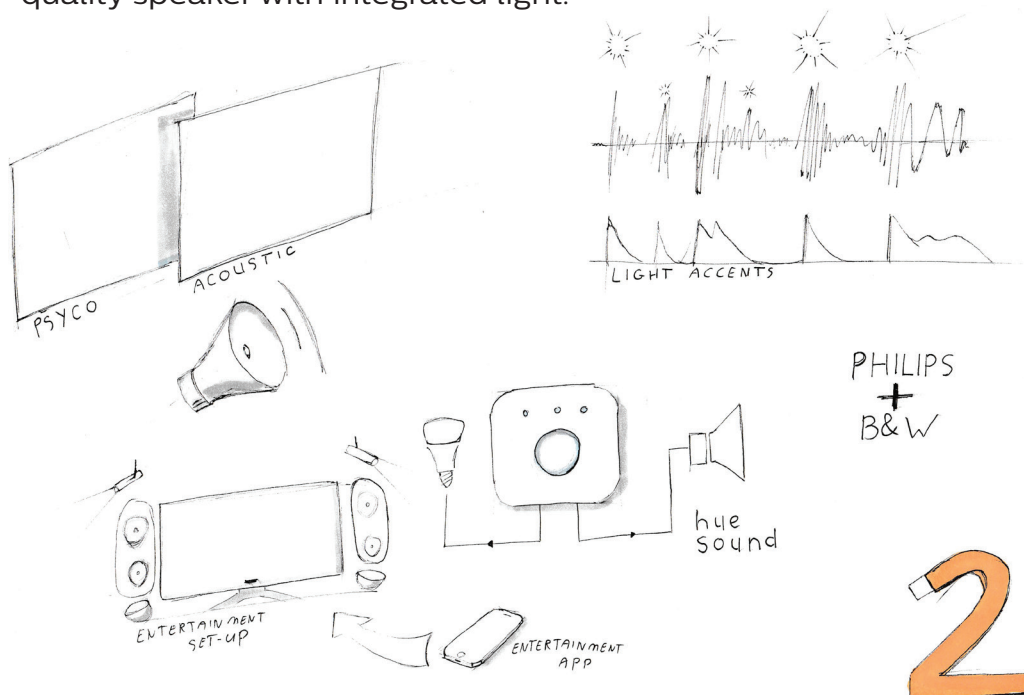
Design direction ideation

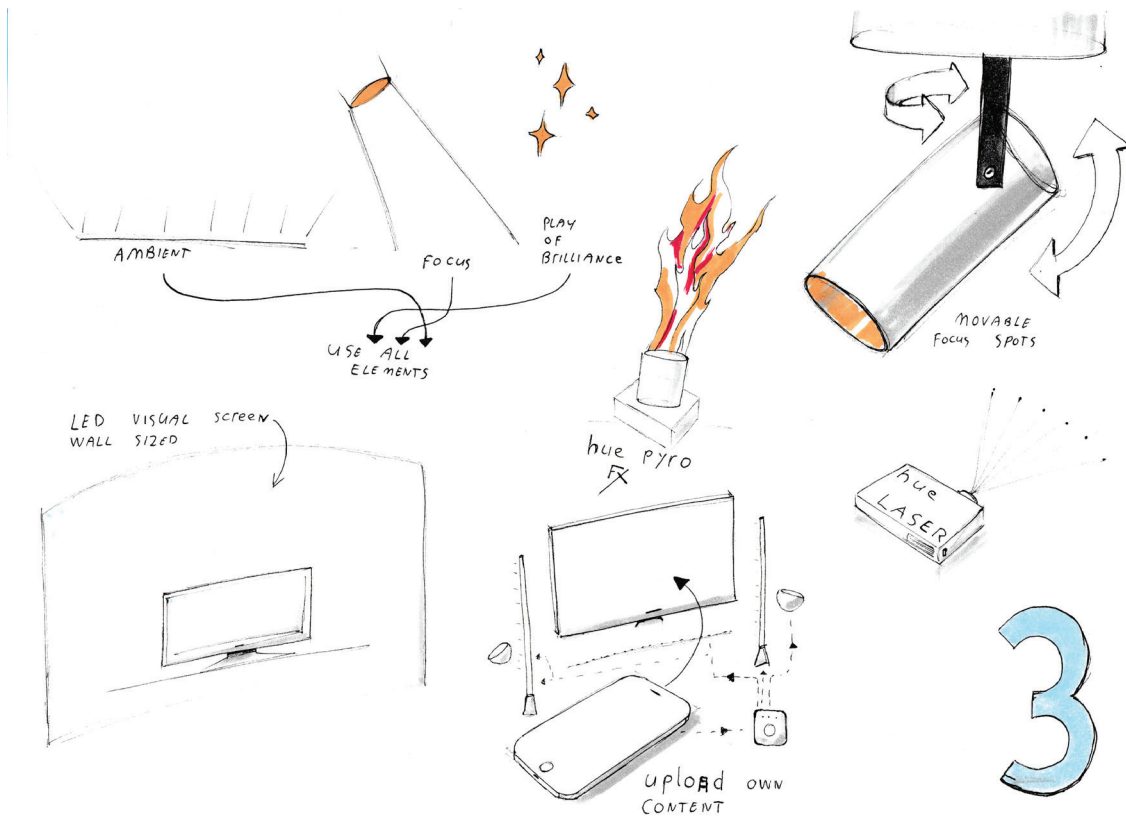
In order to make a decision on what direction to continue with, all directions were ideated on. This ideation consisted of a set of sketches for every direction. In this manner a total light is shed on the possibilities that lay within each direction. The sheets are shown on this page with explanation of the ideas.



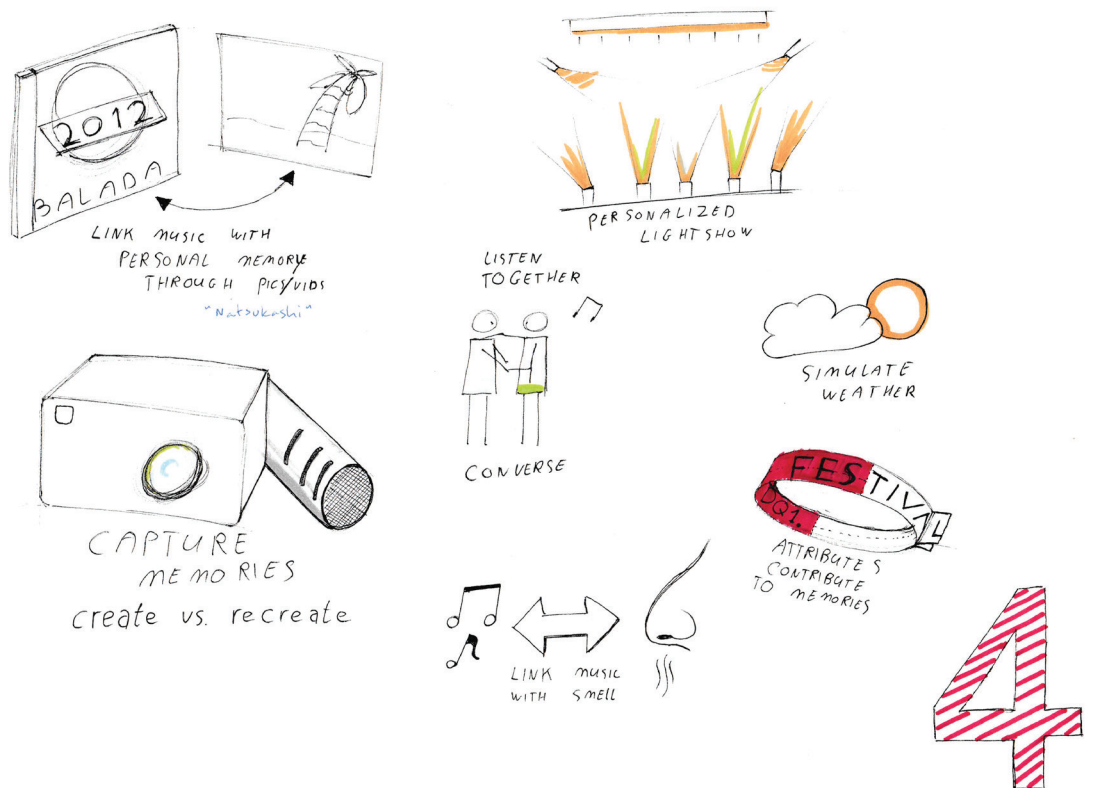
Using wireless connectivity, social media and the IoT, can connect people together. These possibilities can be used to create an activity to be experienced together. This can be physically apart or in the same room. Also products like a dance floor are inviting to conduct social activities.

Using psycho-acoustic effects, increase the perceived quality of the sound. By thinking a step further there can even be a hue sound department; for example a high quality speaker with integrated light.





Surprise users by bringing elements from the music show to the living room. Moving heads, lasers, fire, big screens! Use the power of entertainment lighting to liven up the music in a living room.



What way can the user's memories be made stronger? Instead of re-creating experiences, give the user the possibility to capture memories. Move from sound to imagery or other senses such as smell. By adding other aspects to music, a more complete picture of the users' memory can be compiled.

Chosen direction

In collaboration with the company a preferred direction was established.

The criteria used to judge the directions are:

- Integration with Philips projects
- Fit within the portfolio of Philips Lighting
- Personal affinity
- Made possible by the use of light

During the discussion that followed the conclusion rose that design direction number 3 will be the correct direction for the project.

Design direction 3:

Give the user a feeling of amazement by surprising them with simulated stage lighting and show elements tailored to the music, is the preferred direction for continuation of the project.

Looking at the other possible design directions there is a number of useful aspects that have to be included in the design direction.

The social side of a music experience can't be ignored. This is an essential part of the whole experience. The choice was made to not specifically focus on enhancing the social experience in this project. It will be included in the final product system.

In this project Philips Lighting is not the content creator. The product should function as the content enabler. That means that artists and lightshow developers should have the ability to put their creative input into the system. This aspect of content enabling should be a part of the final product.





Design brief

Smart lighting systems such as Philips hue are gaining popularity in homes. Sales of these LED based products have been rising over the last three years. (Philips Lighting, 2018) The control of the lights in color and intensity is interactive. It can be adjusted by the user at any moment. However, for entertainment purposes the system holds potential still. The possibilities the system offers are not used to the full extend yet.

Within home entertainment media such as gaming, movies and music, light can add to the total experience. Exploring the possibilities with music is the essence of the design. The challenge is to bring the festival experience to the living room. This means that besides the music, light should be part of the experience.

The goal is to let the user experience music to its full potential with the help of light. Inspiration can be taken from concerts and festivals. Users should feel immersed in the music and be amazed by the lightshow.

The design vision captured in one sentence:

Let the user have an immersive music experience in their living room with the help of lights and show elements tailored to music.

The product should fit within the Philips Lighting portfolio. Currently available products such as disco lights and professional event lighting do not meet this. These products do not fit in the Philips Home domain and are therefor unsuited for usage in a living room.



The product should comply with some requirements. These should be kept in mind when designing.

Every living room is different. This means that the product should be adjustable to all living rooms. Festival lighting consists of multiple units forming larger elements. Simulating this for all houses means that the lights should preferably be wireless. The system should be moveable and reconfigurable. Users should be able to create their own placing.

The product should be easy to use. As this is immeasurable the goal should be a product that works intuitively and is quick to setup. The user should perceive the system to be intuitive and smart.

As the product should enhance the experience of listening to music, the link between music and light should be obvious. The synchronization should be in time. The rhythm of a song is not only expressed in beats but also in build-ups. Musicians create tension and release within music. The product should reflect this.

The new product should bring play of brilliance to the living room. This principle of light is missing from most living rooms but is an essential part of festival lighting. By introducing play of brilliance into the Hue family, the system can produce other light plans and event lighting can be mimicked.

The system should preferably be used for other applications in the future. These applications would be in the home entertainment domain, building on the modularity of the system.

Measuring success

Light should be experienced. This means that a light simulation or a movie with the light effects will not have the same impact. The effect the light has on users should be tested in a full-scale test. Synchronization is a part of this. People should feel that the timing of lights suits the music. The rhythm of the lightshow should be equal to the rhythm in the music.



Develop



Introduction

In the last chapter a vision of what the end users need to experience to get closer to the immersive music experience was determined. How is this translated from a vision to a lighting design? This third part of the report is about the ideation process. The progress from the design vision to the final concept is elaborated on.

During the context analysis it was discovered that lighting at an immersive music experience consists almost entirely of play of brilliance. This principle of light is however missing largely from a living room setting. Bringing this type of light from one context to the other will be the base for ideation. Without this, a proper festival feeling is not possible within a living room.

Within the hue system there is no dedicated way to introduce brilliance lighting into the new context. Simulating the festival experience is not possible by only using the current hue system. In order to create a concert experience in the living room an addition to the hue system has to be made. There should be a possibility to introduce play of brilliance. The correct way to introduce this is, is ideated on.

Light sketches were made, ideating on ways to accomplish the design brief. The resulting images were ordered and three concept directions were established. In the Stage lighting case study, order and structure within event lighting was analysed. The results were taken into account when further developing the concept. This refinement led to the final concept, the light image that formed the basis of the product.



Ideation

From the previous analysis we can draw the conclusion that play of brilliance is missing from the current hue portfolio. It is also a necessary aspect to properly simulate a festival environment. The way to achieve this is ideated on during the ideation process.

Sketch templates

Four basic room templates were used as a starting point. Figure 21 shows these basic templates.

On these basic empty backgrounds light sketches were made. This means that the starting template is dark. So instead of normal sketching where you work from light to dark, it is reversed to work from darkness and add light. Photoshop was used to paint with light effects.

By brain dumping as many ideas as possible a large collection of light sketches was produced. Together spanning the spectrum from a small amount of added light to total sensory overload of lights.

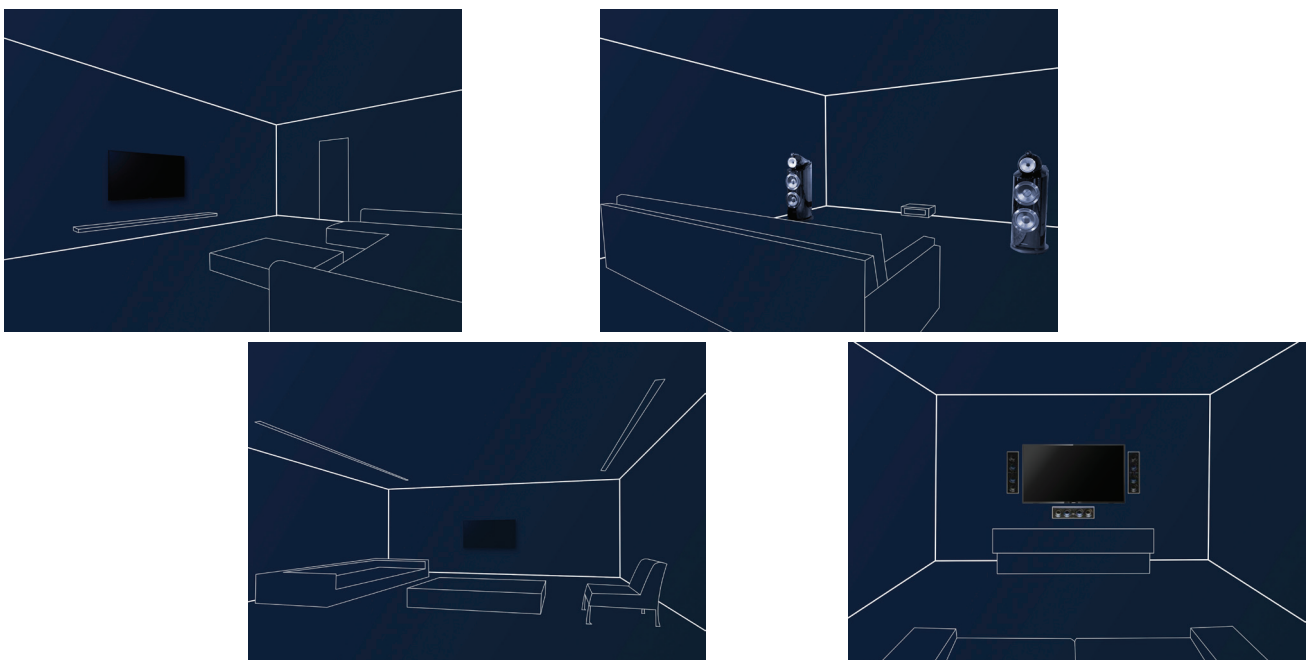


Figure 21: The dark background templates used during the ideation phase

Light sketches

Figure 22 shows a selection of the sketches. These give an impression of the ideas that were generated. Light effects were projected onto the basic templates. These pictures give an insight on what the final light image could look like. The goal was to make a large number of sketches to find a large variety of possible light images. 70 sketches were made in total. The four different template rooms were used to stimulate creativity. One template would limit the view angle. By changing up the background there could be a larger variation of ideas.

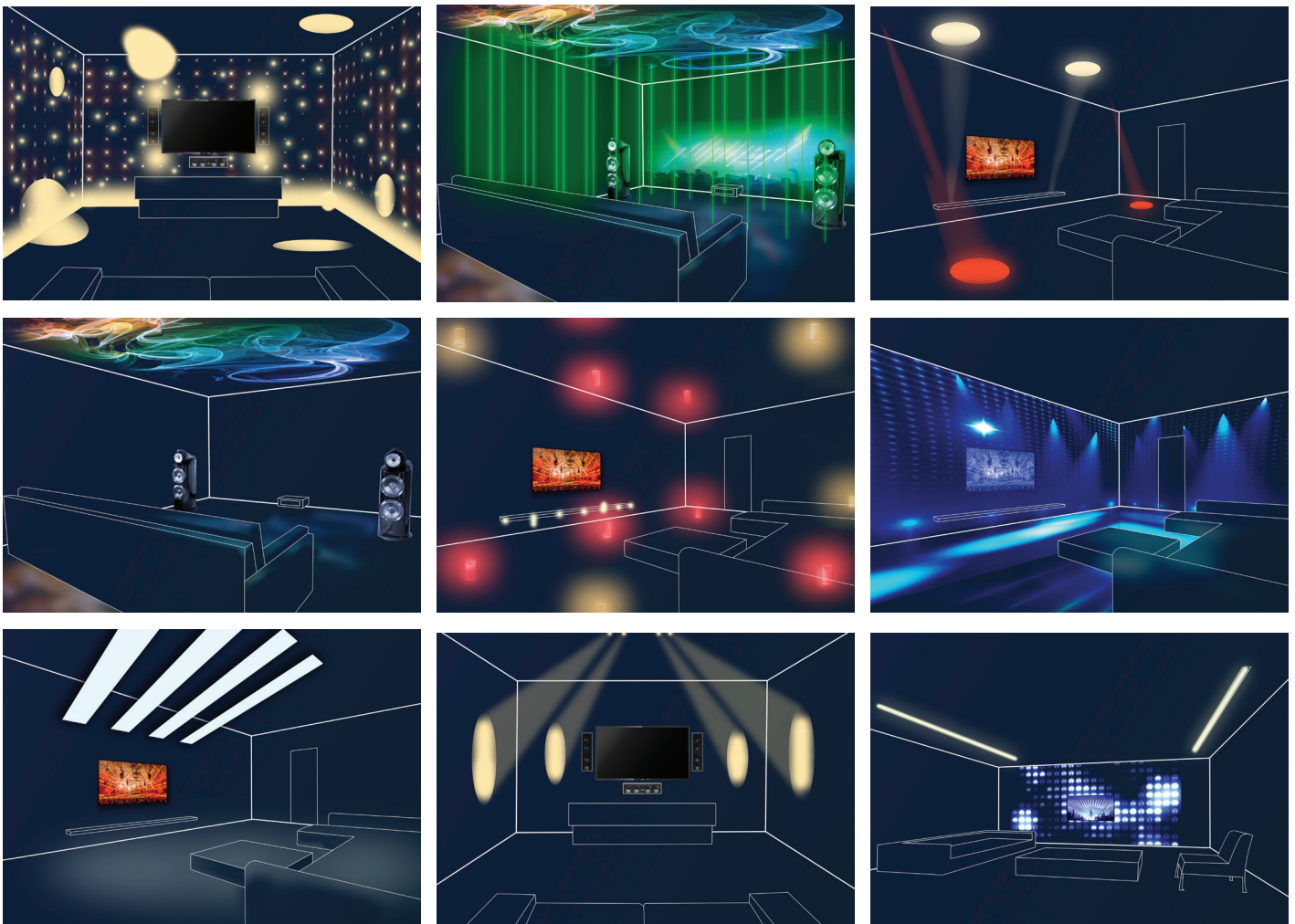


Figure 22: Light sketches. This is a selection of the sketches used to ideate to reach a final concept.

Clustering

After all the sketches were completed, they were all ordered. The ordering can be seen in Figure 23. From left to right the individual sketches were placed from quite subtle to highly intrusive. Many ideas were similar or had a similar level of intrusiveness. These were placed in line vertically. The overview should therefore purely be read from left to right as a line. The y-axis has no meaning. In the background a yellow vertical line is visible. All sketches on the left side of the line are already realizable with current hue products. This line was determined together with input from Philips employees.



Figure 23: Clustering of all light sketches. The images are placed from subtle to intrusive on a line from left to right.

Selection

Once the clustering was completed a selection of the viable ideas was made. During the clustering a line was made which indicates what ideas were already possible with products currently in Philips' portfolio. The rest of the sketches were subdivided into three parts. Figure 24 shows this division. The middle section was found right for the level of intrusiveness. The selection was made during a discussion with the company.



Figure 24: Concept direction selection. From the ordered sketches a selection was made that form concept directions.

Concept directions

From the 'sweet spot' three concept directions emerged. These were not too intrusive nor too plain.

Direction 1

Moving gobo's

By moving light spots through the room, dynamic light is introduced which can sync movement to music.

Direction 2

Points through the room

Having multiple bright light sources, the room can be outfitted to look like a festival stage. The units can be linked wirelessly together to create movement and lightshows.

Direction 3

Light objects

Creating large illuminated objects simulate LED screens.

Those can create movement and large amounts of light.

By adding projections visuals can be displayed that match the music.

Selection criteria

The first direction was discarded first. Creating a moving spot through the space resembles a classic moving head but without the visible light beam. Together with the team it was decided that the execution of this concept would not lead to a product fitted to the Philips portfolio. The fear was that the result would be more like a children's toy.

Concept

Concept 2 was the chosen concept. The choice to pursue this direction was made in collaboration with the company. Strong points were the possibility for dynamic patterns throughout a room and the adjustability of the light image to suit more spaces. Every living room is different. Because of the modular nature of the concept it can fit in every room.

With the help of Photoshop, two final light sketches were made to determine the final concept direction. These images were used as guidance to develop the final design. With these images as a base, a final design was made and realized with the help of a prototype. The goal was to create the light image as close as possible.

The concept consists of multiple light points that are spaced throughout a room. All lights are identical units. By organizing them in patterns like lines, larger light elements are created. The individual lights together are perceived as lines and figures. These phenomena are known as gestalt principles. Using proximity and similarity, the human brain 'connects the dots' and makes a complete picture.

These figures and lines can be found in existing furniture. The users should use their interior to place the lights and accentuate these shapes. This has two advantages, the first one being that the user does not have to create their own gestalt principles. They can use what is already present in their homes. The second advantage is that the interior itself becomes part of the setup, making the room itself part of the light show.

Finally, what can't be shown on paper is that all lights are individually addressable and can receive color data over time. This can create dynamic patterns of color through the room. The layout of a music stage is simulated as well as the dynamics of lightshows.

The final light image sketches can be found on the next page in figure 25 and figure 26.



Figure 25: Final concept
The light sketch describing the final concept.



Figure 26: Final concept
A second light sketch describing the final concept.







Design

Final design

After the final concept was established, the final design was completed. This chapter will describe the product. The product, computer programming and lightshow input together form the final design. The final deliverable is the light experience and not the product itself.

The final design is a system. It cannot be explained as only one product. The system consists of multiple light sources that can be placed throughout the space by the user. When placed, these lights are mapped to the room by the hue app. Then the algorithm knows where every individual light source is in the room. A lightscript (which is the base of a lightshow) can be played back by the lights. These lightscripts are in sync with the music. So, when playing a piece of music the lights that are placed throughout the room create a lightshow. This show is based on the lightscript and synchronized with the music.

The final design consists of three parts: the lights, the algorithm and the lightshow content. Figure 27 shows the final appearance of the immersive music experience at home.



Figure 27: Final design
The final design has individual lights that can be placed through a living room and sync with music.

Puck shape

This light fixture is not meant to have a striking appearance. The light itself is the important aspect. Therefore the product should be as invisible as possible during use. With the help of shape, the product maximizes the effect the light has. The overhang creates an area of shadow at the base. This makes the product disappear more during use compared to a regular cylinder.

Diffuser shape is based on current hue bulb to fit in the hue form family. Figure 28 shows a render of the final shape.

During the design of the shape of the electronics had to be taken into account. The internals are based on a hue Go. This is a wireless luminaire from Philips. Because this is a functioning product with similar properties the assumption was made that the internal parts would function correctly for this project.

The parts are:

- 2 AA battery-pack
- PCB
 - o LED driver
 - o Wireless receiver
 - o Charge circuit
- LED pixel

The height is 20 mm from bottom to top of puck. The diameter of the puck is 85 mm. The chosen material is aluminum for better heat transfer.

Shape is based on a revolved parabolic-like curve with two horizontal planes as boundaries. The diffuser on top is removable in order for the user to customize the light effect.



Figure 28: The design of the puck
It is a wireless lamp with a removable diffuser on top.

Integration with hue

The network of multiple light sources will be a part of the hue system. From the chapter about the hue system follows that the hue system consists of the necessary parts to support the pucks. An extension in the hue app can analyze the lightscripts. The bridge can control the lights and the other lamps can support the lightshow.

Addition of play of brilliance

As became clear during the discover phase, living room lighting consists mainly of ambient luminescence and focal glow. In order to recreate a festival at home, play of brilliance had to be introduced. This is achieved by having dynamic patterns of light through the room. The light itself becomes the main visual attraction. It is 'light to watch' as stated in the chapter Principles of light.

Customizability

The pucks are designed so the light effect is customizable. Users are encouraged to place the lights through their living rooms and involve their own furniture in the resulting lightshow. The interior will become an integral part of the light plan.

Light beams visible at stage lighting can be seen as objects in space. Instead of recreating these beams, the user's interior will be the objects that light up. This way, the features of the room are entangled with the show, creating a more immersive experience.

The pucks can be used in three distinct ways:

- Uncovered
- Diffused
- Collective

Uncovered light. Hard shadows and contrast are created when the LEDs are not diffused. This can illuminate objects and create shapes on walls caused by shadows.

Diffuse light. This creates softer shadows and can be used as a wall wash. Also if the puck is placed in sight, diffusion makes it possible to look directly into the light source without damaging eyesight.

Collective. It is encouraged to customize the pucks. However, not every user will do that. By using a collective holder and placing the lights inside of it, the user does not need to add anything. Figure 29 shows three pucks together in a diffuser. Collectively the lights will form light emitting objects that can form a part of the setup.



Figure 29: Collective diffusion. Three pucks together in a diffuser create a pixelated light object.

Content enabling

Lightscripts come in the form of 2D video files. These videos show moving patterns and colors in sync with music. The videos will be called: lightclips. An algorithm analyzes the content of the video and the color and intensity information is sent to the lights in the room. The lightclip contains all data for the system to produce a lightshow. If the coherence between the music and the lightclip is good, the lightshow will be coherent with the music.

Artists make the lightclips. Variations within the music can be played upon by having a human making the clips. A computer can find the beat of a song and recognize the difference between verse and chorus. However, subtle variations and emotional meaning are hard to pinpoint. People can recognize these elements. The choice was made to let a human make the lightshow. The translation of the meaning of a song into light is done by an artist instead of a computer to capture the variations made the musician.

Video was chosen to control the lights because it is a medium with a shallow learning curve. Video editing software is readily available to many people and learning resources are plenty. People can therefore create content for the system themselves. This is called content enabling. It gives the possibility for professionals and enthusiasts to create lightclips without knowledge of light programming. Different kinds of people can create content, as shown in figure 30.

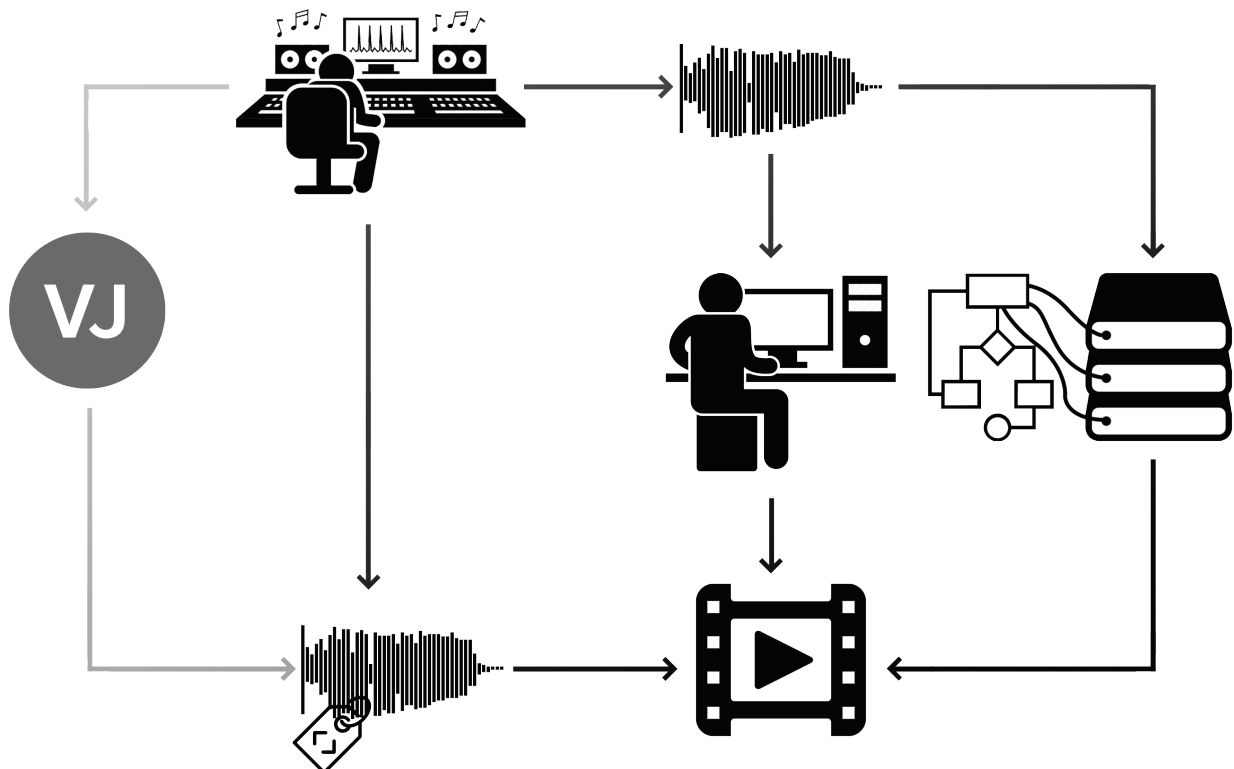


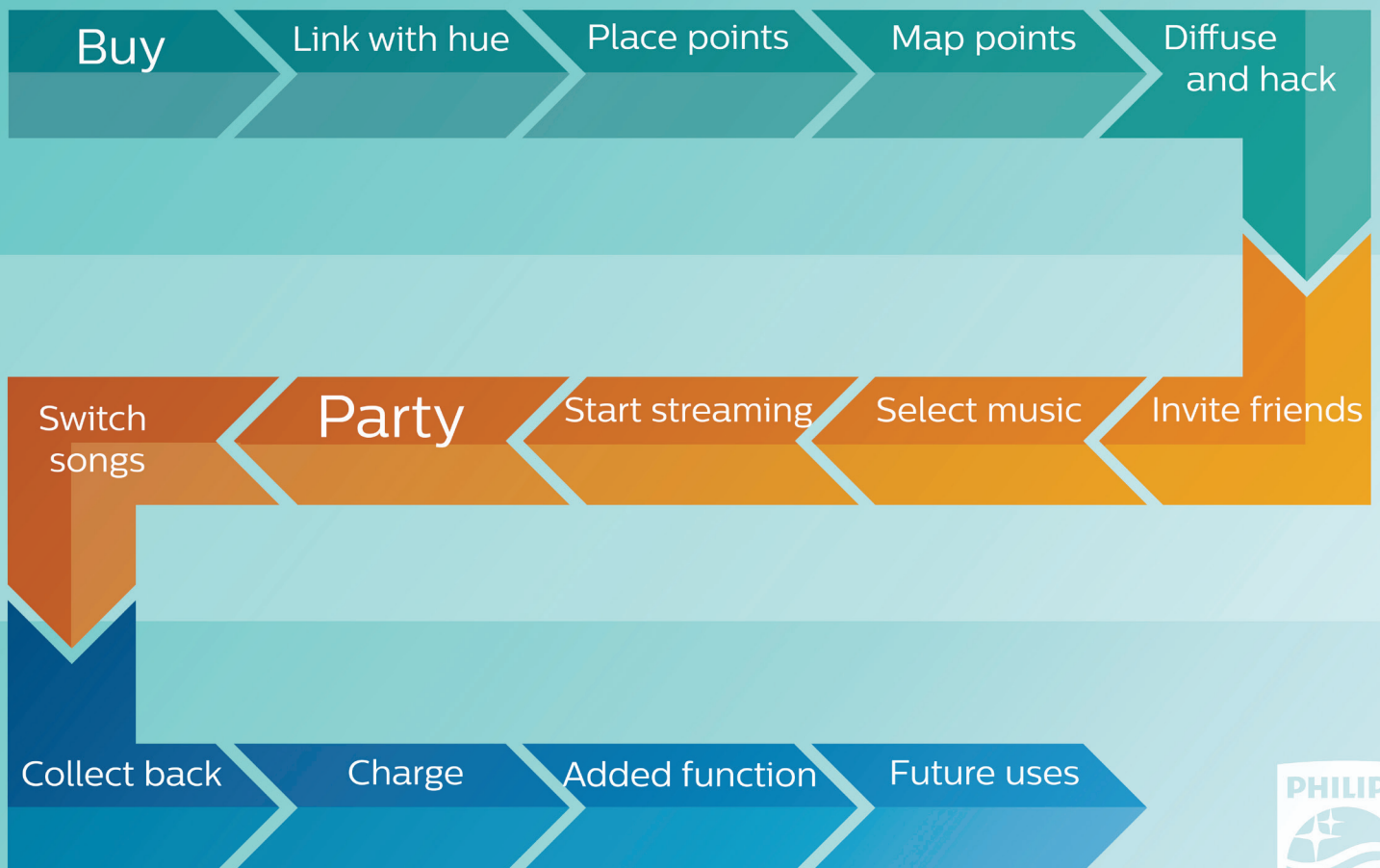
Figure 30: Content creation. The lightclips can be made by a musician, a video artist, an enthusiast or in the future an algorithm.

Roadmap

This part of the report explains the workings of the final design. The end result is not a product. The result is an experience. To accomplish the result, a number of individual parts makes up the total system. All parts are elaborated on individually in order to paint a clear picture of the workings of the entire system. This is down by the order the end user experiences the product. Figure 31 shows an adaptation of the customer journey. Each block is a step the user goes through. One by one every block is elaborated on; what the user does and what happens in order to make that possible.

Figure 31: Customer journey. The customer journey shows the steps a user experiences when owning the product. These steps will be used to explain the inner workings of the system.

Customer journey



Buy

First, the user buys a kit of lights. The lights come in a kit of multiple units instead of buying them individually, see figure 32. This ensures there is a number of lights ready to go directly from the box. The kit is expandable with the addition of more lights. There is no limit to the amount of connectable lights to the system.

Figure 32: Kit with multiple units.



Link with hue

The lights should be part of the existing hue system. That means they should be connected to the system. On top of the existing lights in the living room, the system is addressed as one unit in the app. So not every light point shows up as a single lamp in the app. It is a network of multiple lights. Figure 33 shows what this looks like in app.



Figure 33: Entertainment pucks in app
The pucks are seen as one light in the app. They are equal to the existing lamps.



Place points

When looking at the place of the points in the room, inspiration is taken from event stages. Earlier research has shown that placing multiple points shaped in lines and forms create larger elements. This is all done according to the gestalt principles. Sticking to these rules and giving them as guidelines to the user the best emulation of a festival stage is achieved. Figure 34 shows examples of gestalt principles. The user should adhere to their interior when placing the pucks. The gestalt principles are already present in furniture. Spacing the light evenly along edges of cupboards for example creates the desired result.

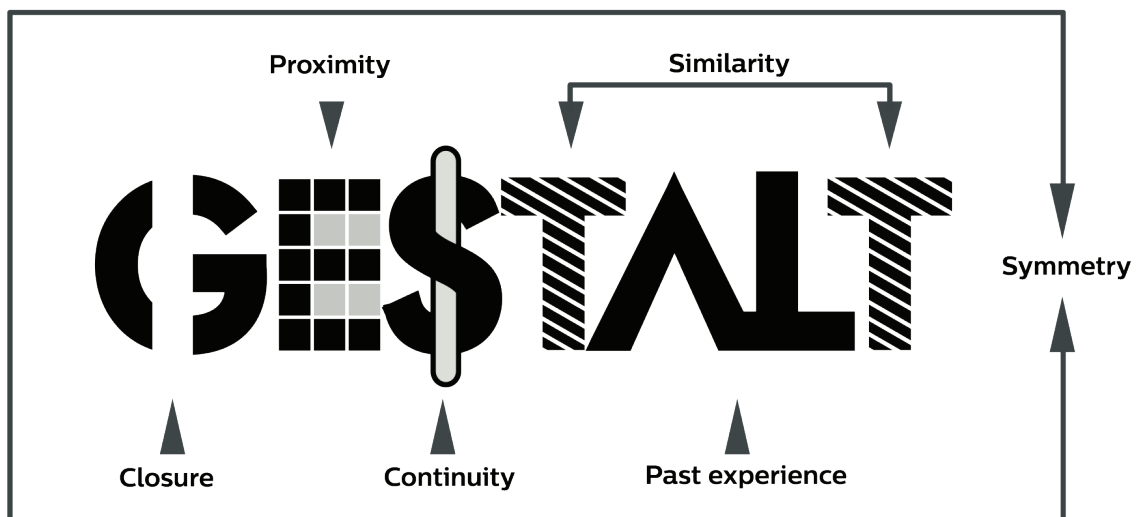


Figure 34: Examples of gestalt principles.

Map points

Once all the light points are placed the emulation of the festival stage is complete. However, the lightshow is not dynamic. In order to achieve a dynamic light show, the hue app should be able to control all points. This way the program can send light script information to the correct point at the right time.

The mapping of these points in the room should be as easy as possible for the user. The app will guide the user through the process.

Once the lights are spread through the room the user uses a smartphone with a camera. The room is photographed while the lights flash. The algorithm recognizes the places where the lights are and assigns a number to each one. These points are plotted to a 2D screen. This is the link between the physical world and the light program. The spacing of the lights in the room is now registered by the app. Figure 35 shows how the mapping looks in app.



Figure 35: Points are mapped in app. The dots in the screen indicate the locations where the lights are placed.

Diffuse and customize

The product consists of multi units that can have the same function. Figure 36 shows one unit. By having the same light source over and over, the effect of professional festival lighting can be simulated best. To simulate light beams that go through the venue, users are encouraged to use their own furniture and accessories in their light shows. That means that people can use their own vases, cupboards, DIY creations, etc. to be lit by the lights.

The lights can be used in three distinct ways:

- Uncovered light for high contrast and sharp shadows.
- Diffused lights for when the user want to look straight at the light.
- Collective lights. This is where there are multiple lights in 1 diffuser. This gives a pixelated effect and the large diffuser functions as a lit object. An impression can be seen in figure 37.

This way the user can experiment as much as they want. However, users can also use the provided options and have a working product straight from the box.



Figure 36: A diffused puck in a dark space.



Figure 37:
Multiple pucks under in diffuser create a pixelated light object

Invite friends

As was discussed during the first phase, visiting a music experience is a social activity. Therefore it can be quite natural to invite people over to experience the product together. It does not mean the product can't be used alone, but the preference and best effects are achieved together with friends or family. Inviting friends in figure 38.



Figure 38: Invite a friend.
An invitation to a house party with the hue system.

Select music

The user selects their favourite way of playing music. This can be through YouTube, Spotify, etc. Metadata from the show is send with the music and delivered to the hue app, figure 39. The music is send out to the speakers. The music app and the hue app are synchronized so that the light show and the music play simultaneously.



Figure 39: Connection with 3rd party apps. Apps containing music such as soundcloud, spotify or youtube send light data through to the hue app.

Start streaming

Lightclips are created by artists. These clips are tailored to the music and can look very abstract. They are intended for the lights to get information about timing and colour. The light clips are linked to the music as metadata. The clips and music are send to the end user. The user's app uses this lightclip to control the lights. The fact that the lightclip is made by the artist tailored to a specific song means that the end user gets a lightshow in their own home, the way the artist has meant it to be. Figure 40 shows the flow of data from artist to home party.

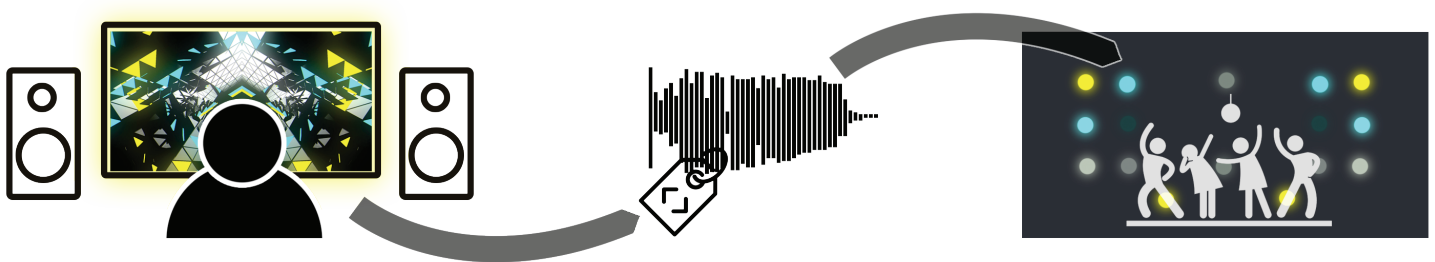


Figure 40: Data flow of light information.
An artist makes a lightclip for a piece of music. The lightclip is linked to the music as metadata.
The lightclip is analysed by the users hue system and streamed to the lights.

Party

When the user starts the music, the lightshow starts simultaneously. The light clip that was created by the artist is converted to the light show in real-time. Whether the user is playing back a concert registration of having a house party, the lights convey the beat and rhythm of the music. Figure 41 shows a living room with the system in place.



Figure 41: A living room with lighting. The lights are positioned and are playing back a lightshow that is synchronized with a piece of music.

Switch songs

When the user decides to play different music, the light script changes to the one that is created for the new track. So no matter what music is played, the system works. The light is even tailored to the music because a light artist has made the lightclip. For every style of music, there is appropriate lighting. Different lighting is used for different genres of music as shown in figure 42.



Figure 42: Different genres with different lighting. Every genre of music is suited for a lightshow. The intensity should be set by the artist.

Collect back

Once the party is over the user can collect the lights back. This can be done easily without disconnecting any wires because of the in-built battery. The internals are kept the same as a current hue product: the hue Go. The electronics are the same. Figure 43 shows the internals of the puck in an exploded view.

Once they are collected again, the user can spread the lights around again in any configuration to their liking. One thing should be noted: Once the lights are set-up in a different manner, the points should be mapped again. The hue app will then control as it is supposed to.

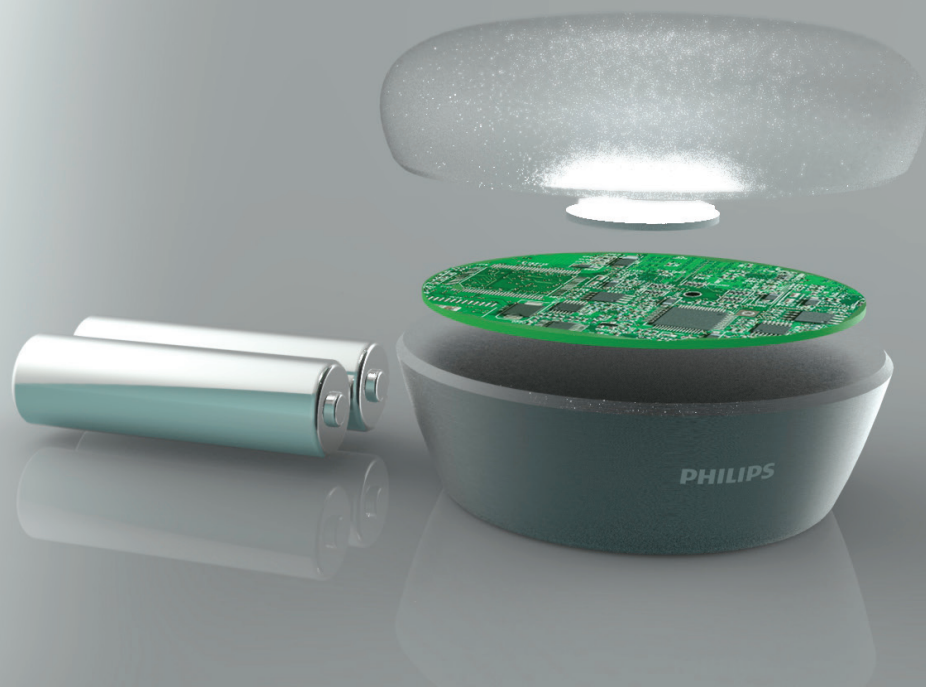


Figure 43: Exploded view of a puck.
The internals of a hue Go are used in the embodiment of the puck.

Charge

The fact that the pucks are wireless means that they have to be charged after use. Figure 44 shows a possible method this can be done; a big piece where multiple units can be charged simultaneously. This ensures that all the pucks are ready for use together.



Figure 44: Charging unit for multiple pucks. A charger provides the lights with energy.

Added function

If the charger is hung on a wall or even the ceiling, the unit can function as an individual light source. With all light points individually addressable patterns can be shown during charging. Even when fully charged it can be a piece of furniture that can illuminate a room. This way extra value is created for when the pucks are not in use for entertainment purposes. The way this could look can be seen below in figure 45.

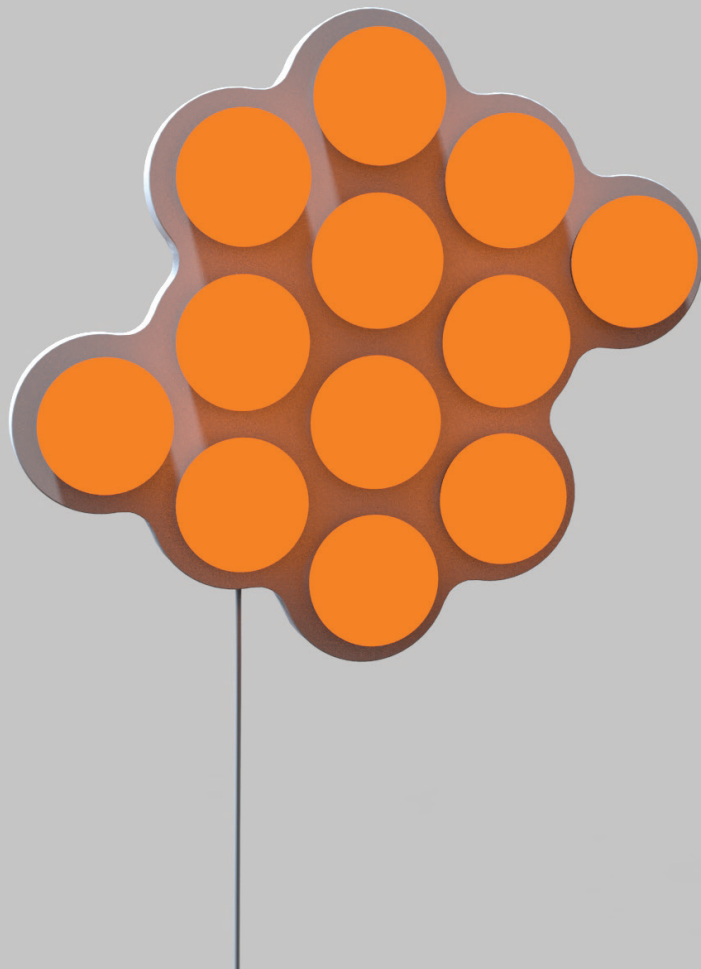


Figure 45: Charging unit for multiple pucks on a wall. Having a charger with all lights in it, can serve as a lamp by itself. The pucks have added value when not in use.

Future uses

The assumption is that the product will be used twice a month for a part setting. This means that most of the time, the product is not in use for what it is intended for. By exploring the possibilities of other uses extra value is added to the system. Figure 46 gives an example of another use besides the festival setting. Instead of placing the light points around the TV for entertainment purposes, in the future they could also be implemented as dynamic garden lighting for a summer evening for example. Also usage in gaming and movies are implementable functionalities. These are possibilities that have to be explored in further research. For now they are recommendations.



Figure 46: A garden lit up using pucks.
The pucks can be used to illuminate a garden when not in use for festival purposes.





Evaluation

A vibrant concert scene with a large crowd of people with their hands raised, illuminated by bright green and blue stage lights and fireworks in the sky. The word "Evaluation" is overlaid in white text on the left side of the image.

Prototype

When the final concept direction was established prototypes were made. The choice was made to start building as soon as possible. The reason being that light is hard to predict. The effects can vary easily from the initial expectation. Besides, light has to be experienced. The emotional effect it has on humans does not come across well when it is modeled or filmed. A first hand, full scale testing set-up was therefore essential to the project. Figure 47 shows the demo during installation in the light.

The prototype consists of two strings with ten LED pixels on them. These pixels are connected to a driver to power the lights and send color data. These drivers are controlled by a laptop with an algorithm to make the actual light show. The program used was MaxMSP. The prototype in working is shown in figure 48.



Figure 47: Prototype set-up at Philips in Eindhoven. In a living room the lights were installed and wired to a laptop for control.

Usage of the demo set-up

The prototype was used for multiple reasons. Firstly, the lights were used to test placement throughout the space. The shapes that were analyzed during the stage analysis had to be recreated in a living room. The prototype was used for this purpose.

Secondly, as it evolved from 6 lights to 20 lights, the computer programs were written and adjusted to control the lights. The final design took shape with the help of the set-up.

The last use of the prototype was to test the dynamics of the light. It was used to explore patterns of light in sync with music. The success of these shows was validated in validation studies at Philips and the university in Delft. This is explained in the next chapter.

Placement

The prototype's main purpose was to experiment with different light images that filled the living room. Having controllable LEDs on a strings granted the opportunity to test and tweak the design during the design process; finding out what did work and what did not. Do the lights have to be spread through the whole space or should they be in a 2D plane? How can furniture be incorporated? These questions could be answered with the emplacement of the LEDs. The light image derived from the final concept should be matched within the technical possibilities.

Algorithm

The computer program used to drive the individual lights was also part of the setup. At the start it was unclear what the input and output parameters would be. After experimentation it was decided on that the input should be video content. This content would then be converted into data for the light points. How the algorithm works will be explained in the next chapter.

The dynamics

Every single LED-pixel is part of a bigger system. By lighting up in succession different patterns in color and intensity through the room can be created. The interaction between the lights and music was a challenge to synchronize properly. What effects in dynamic light communicate the emotion of the music the best was tested.

The functionality and the inner workings of the prototype can be found in appendix B.

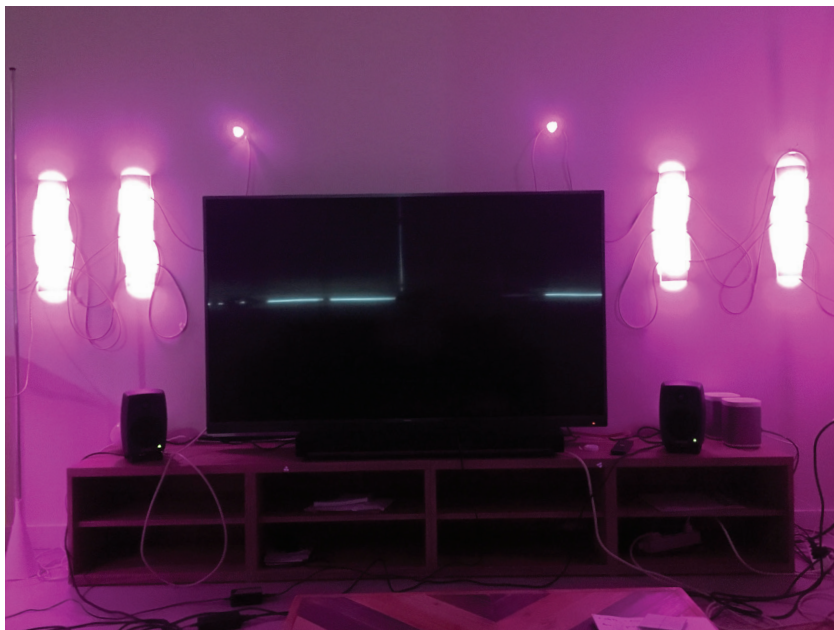


Figure 48: The functional prototype. The diffused collective lights display a lightshow. The TV was not used during testing.

Validation

To test the system a validation study was carried out. The main objective was to determine whether the system could deliver an immersive music experience.

The study was performed in two places with two different types of participants. The first study was held in Eindhoven at the design facility of Philips. The participants were all employees with an affinity for light design.

The second study was held at the faculty of IDE in Delft. These participants had no prior knowledge of the project and no affinity with Philips or lighting design.

All subjects participated in groups varying from 2 to 12 people. A total of 42 people took part in all studies combined.

Subjects were let into a living room where the demo was setup. It was explained that the goal of the project was to create a festival at home. That way the participants knew what to expect without any knowledge of the project. The demo was shown. A pop song and a dance song were used in collaboration with the correct lightshows.

After the demo, the participants were interviewed. In a semi structured interview the participants were asked what their reaction was to the demo.

The reaction of the participants was positive. All 42 people said that they felt more immersed in the music because of the lightshow. The applications where the system could be used were house parties and supporting concert registrations. It was pointed out that the lights were quite intense. In future iterations this should be made scalable.

In conclusion, the prototype did achieve the desired effect on the participants. Listening to music in a living room became an immersive music experience. This study proves that the system of individually controlled lights comes a step closer to a festival at home.

The total report of the validation study can be found in appendix C.

Figure 49: A validation session in Eindhoven
A group of 12 people watch the demo during the validation study.



Hue Sync

Philips Hue Sync is an app for PC and Mac that enables users to control their hue lamps in an entertainment setup. It can be used while watching a movie, listening to music and gaming. The app takes content from the entertainment source and an algorithm translates that to a light script for the lamps in real-time.

When watching a movie or playing a game the application creates a light script for your lamps based on the content that is played on the PC or Mac. By means of screengrabbing and a smart color algorithm, your Hue lamps are adapted in real time to the on-screen action.

The Hue Sync app can also analyze music and create a lightscript matched to the beat of the music. In real-time, with minimal latency, the lamps are adjusted to the type of music and the beat. The intensity can be adjusted by the user.

This application was introduced during this project. Although there is overlap between the outcome of this project and the Hue Sync app there are two main differences.

Firstly, music is analyzed in the hue sync app and an algorithm creates the lightscript. In the new festival experience an artist makes the lightscript. This content enabling feature gives the lightshow a human touch. A human can pick up variations and emotions in music that can't be recognized by an algorithm. The meaning of a song can therefore be translated into light more precise than currently possible.

The second difference is the addition of extra light points. A multitude of light arrangements can be made with wireless lights. Where the current hue lamps have a designated place in a luminaire, the new system can be adjusted by the user. Emulation of stage lights becomes a possibility.

To make these features reality, new lights have to be made and programmed to enable content creation by artists. The result is a light experience that is better adapted to the user. Therefore the new system does not compete with hue sync, but could be the next step or follow-up of hue Sync.



Conclusion

The initial assignment was, creating a festival at home. Research made clear that stage lighting is an important factor when attending music events. In light design terms, stage lighting consists mainly of play of brilliance. Simulating a festival in a living room meant bringing play of brilliance to the living room and creating light arrangements that mimic stage designs.

The current hue system allows the lamps to be used for entertainment purposes already through the app hue Sync. Music can be accompanied by a lightshow using the lights present in the living room. This project improves on the hue entertainment setting and the Sync app in two ways. This first way is by emulating stage lighting in the form of individual light sources. Multiple identical sources can create patterns of light. By having the lights switch on and off in rapid succession, dynamic light can be created. The show is perceived to have movement in it.

The second way is by having artists make lightshows instead of an algorithm generating them. A human can better identify nuances in songs compared to a computer. The resulting light show is therefore tailored to each individual piece of music.

By customizing the pucks and using them in a variety of ways a living room becomes an integral part of the light show. Simulating beams of light at music events is done by involving architecture, furniture and accessories into the light plan. Users are encouraged to experiment with the placement of the lamps and scattering of the light. This creates a lightshow customized to each user.

Light should be experienced in real life. Watching the effects via a screen does not yield the same emotional impact. Validation in a full-scale setup showed that users feel positive about the system. It enhances their immersion into music and gives a feeling of amazement with dynamic patterns of light.

As a final remark, this system is a prove of concept. The embodiment of the puck and specifics of the algorithm are not set in stone. The light experience is validated and received positively by users and the company. This is the base for continuation of the project and for Philips a new direction to pursuit.

Recommendations

Now the product outline is set, further steps need to be taken to make the design into reality. In this section recommendations are given for the continuation of the project.

Other applications

Having multiple identical units that can be individually controlled opens up a variety of lighting possibilities. Festival lighting can be simulated with the system. However, the lights can also be used for other applications. It is recommended to explore how the lights can be used for other entertainment purposes. Think about gaming and watching movies. Surround light is an example the system can be used for.

Besides entertainment purposes, it is recommended to explore a wider area of applications. Because all lights are individually controllable it could be useful for educational purposes or even interactive games for children.

Brilliance

During the research phase into the hue system the absence of play of brilliance became apparent. In order to deliver a complete light plan it can be helpful to introduce this into the product range. Whether this project is used or a new product is developed is up to the company. It is recommended to develop products that can add play of brilliance to the home domain.

Capabilities

The current lamp design is based on the internal electronics of a Hue Go. Because the light experience was deemed more important in this project, this proven product was used as a base. It is made from off the shelf parts, which give the system 3 operational hours before the battery is empty. House parties can last for a longer period. It is recommended that the capabilities of the puck are re-evaluated supported by research on usage of the system. Once established how users will use the system the final dimensioning should be determined. Off the shelf parts can be replaced by newly designed parts.

The resulting shape is also subject to change if the internal electronics would be changed. The current diffuser is also off the shelf. It is recommended that the capabilities of the puck are investigated on and the shape is adjusted to fit the necessary components.

Professional market

The algorithm of the system can be used to control any number of lights. This opens up possibilities to control a large number of lights. In a living room this won't be necessary but it can be useful in the professional market. A large number of lights can be controlled by video in the form of lightclips. This ease of use could be used to control lights for small clubs or exhibitors at business fairs.

Light and sound

During the project a lot of work went into ways of translating sound into light. Artistic freedom was used to create the demos. Every artist however would interpret the music differently. If in the future an algorithm would make the lightscripts, an understanding of the interaction between music and light is necessary. What light patterns correspond with what genres in music? How are dynamics in music translatable to dynamics in light? These questions should be answered to get consistent quality of light shows. Stage light designers are recommended as inspiration for this research.



Reflection

At the end of my graduation project it is time to look back and reflect on the last 7 months. During my master courses I became interested in lighting design. I have always been interested in music and sound design so I wanted to graduate on a combination of the two; music and light. I was very excited when I got the chance to graduate at Philips Lighting and work on project to create a festival experience at home.

Before starting the project I set learning goals for myself.

- I wanted to learn more about the behaviour of light
- I wanted to create a viable product for the company
- I wanted to experience working for a multinational

And as an additional goal:

I wanted to learn to program, as my skill was very minimal.

When I started at Philips I appreciated the openness of my colleagues. Everyone was prepared to help, answer questions and provide feedback. As interns we had a close group and followed each other's projects closely. The rest of the design team could be approached at any time. The level of collaboration struck me positively.

I followed internal program sessions in order to create my own algorithms. This way I improved my program skills. When working on my own project I tried to involve multiple people to get a wider range of opinions and insights. I feel I succeeded in doing this, especially within the design team.

During the process I had good guidance from my coaches at Philips and the TU. Both sides gave me useful insights and feedback. What caught me off guard is that the company and the university have different methods in designing. Because of that I sometimes felt like I was working on two separate projects. I had difficulties uniting the two sides. More intense communication could prevent this from happening in the future.

I was very pleased with the outcome of my project. With the help of my background in music I think I succeeded in creating a festival experience at home. The validation studies confirmed by believes and confidence.

I noticed some of my weak points during the process. The contact with the TU was not as frequent as it should have been. I trusted in the expertise at Philips and therefor had to little contact with people outside the company. I have always had difficulties in writing reports. Writing this report felt like a huge load and didn't come easy. The same is true for my academic writing. I feel I do think critically on an academic level but the execution in documentation lacks exactness.

Looking back I enjoyed my graduation project. I learned a lot, content wise and project wise. I hope this gives me a solid base to start my professional career.



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Appendix A

Interview quotes

Acoustic quality

Comparing to the CD or vinyl recordings. The recording is never better than the real performance. Therefore the performance is the ultimate way to experience the music.

Het is een soort dolby surround maar dan echt!

Music quality is important in the experience of music. That is why recordings will not match an event.

Imperfections make for a real experience. Imperfections in the music are not wanted but they indicate the realness. The listener knows the music piece is played live, the impact of the 'correct' parts have more impact.

Acoustics attribute largely to the music quality.

De beleving van de muziek als de band begint te spelen is heel helder. Dat komt omdat de muziek vooraf expres dof houden. Dat hoort er ook bij.

Ik stond helemaal vooraan bij Bruce Springsteen in de Arena. Hij speelde 4 uur lang en ik had het gevoel dat hij alleen voor mij speelde.

Het heeft meer betekenis als je het ook kan zien. Als het stil is en iedereen ligt in bed, dan heb ik de koptelefoon voor goed geluid en dan is het net of je er zelf bij bent.

Vinyl vind ik leuk. De muziek moet ook een beetje die kwetsbaarheid hebben. Dat de plaat soms overslaat.

De menselijke factor in muziek vind ik wel echt heel chill.

Als je die bass in je buik voelt geeft dat toch een extra dimensie. Dan voel je de muziek letterlijk.

Peripheral activities

De ZiggoDome is bijvoorbeeld heel snel leeg. Dan zit je na het concert zo weer in de trein. Dat samen gevoel is dan sneller weg.

Ik vind de balans tussen de groep en het festival zelf belangrijk.

Festival is vaak muziek geïnteriseerd, maar juist het sfeertje tussen de muziek door is heel belangrijk.

Op een festival hebben we de tijd, hoeven we nergens heen, dat is chill.

De journey tussen de muziek door voegt veel toe aan de festival ervaring. Lijm tussen de podia maakt het festival voor mij.



Het is belangrijk dat er verschillende dingen gebeuren. Dat je binnen de groep verschillende dingen gaat doen.

Het hele weekend is een grote gekte! Het is een stad apart. Los van de echte wereld.

Er is altijd muziek. Je kan altijd ergens naar een stage. Dat maakt dat alles mag en niks hoeft.

De groep waait vaak wel uit elkaar. Dan willen verschillende mensen naar verschillende podia, maar dat is ook goed. Ieder doet awt hij of zij zelf wil.

Stage lighting

Een podium zonder lampen en show is echt verschrikkelijk. Dat is echt NIKS.

Muziek staat bij mij wel bovenaan maar een show zonder lampen kan niet.

Lighting does not have a big role in the experience.

Een goed geregiseerde licht show.

Een show zonder verlichting vind ik niet mooi.

Als het donker is en de lichten gaan aan geef dat echt een extra dimensie aan de show.

De synch met vuurwerk en lichten en muziek geeft zo'n grote kick. Als alles samenvalt komt het echt binnen.

Een kick heeft veel impact. De impact word nog groter als er tegelijk een licht flits is.

Show elements

Shows met vuurwerk vind ik dan weer niks. Het heft iets engs, ik schrik ervan. Het neemt iets weg van de muziek zelf. Het is een beetje overdriven, te op het effect

De beleving van het concert doet mij meer dan de muziek zelf

In een groot station moet je vuurwerk hebben natuurlijk. Dat is leuk.

Als het grootschaliger wordt, dan heb je een grote vuurball, een hoop licht, herrie, dat geeft wel een extra dimensie aan de muziek. Maar is dat per se nodig? Het is een stukje beleving, een toevinging. Niet cruciaal.

Met beeld bij de muziek, kan je niks anders doen.

Het ene stuk muziek leent zich meer voor spektakel dan het andere. Maar het is niet nodig. Het gaat toch om de muziek.

Multisensory experience zal de individuele zintuigen erg versterken.

Het is mooi om met zn alle een nieuwe beleving te ervaren die iemand anders voor je bedacht heeft.

Die vuurspuwers vooraan die geven een hoop hitte af. Dan is het al warm, krijg je die gloed ook erbij. Geeft wel een soort van overweldigend gevoel.



Taste in music

Ik luister wel alleen als het echt mijn muziek is. Als ik de artiest te duur vind of mijn vrouw dat niet leuk vindt. Zij vindt U2 bijvoorbeeld niks.

Ik ga in eerste instantie voor de muziek. Daarna ga ik mensen er om heen verzamelen. Status Quo, zou ik niet heen gaan.

Stijl is wel bepalend, ik zou niet naar een rock concert gaan maar disco vind ik bijvoorbeeld wel leuk om te luisteren.

Beetje plaatjes draaien vind ik momenteel wel chill.

Midden in het veld, iedereen los en dan komt jou nummer; dat is even een moment voor jezelf te midden van een anonieme menigte.

Social activities

The experience does not have to be shared with others per se. The entire music event can be experienced alone and remain hold the same impact.

Het gaat mij om de sfeer in de zaal.
Als de apotiose van het concert komt, dan ga ik meedoen! Springen!

Feestvieren doe je met zn allen

Gezelligheid is heel belangrijk hoor. Ik ga niet met iemand samen die niet gezellig is. Als er een chagerijn de hele avond naast me zit, ga ik liever niet.

Alleen zet ik wel een CDtje op.

Het is ook handig als je samen bent dat de andere bier kan halen!

Na afloop ga je wat drinken. Dan geniet je samen nog even na.

Ik ga er niet alleen heen. Alleen kan je het gevoel niet delen. Je wilt toch met een groep of samen de beleving delen.

Je gaat samen al opgewarmd het concert in.

Als je samen bent, tik je elkaar aan, 'ze spelen dit nummer'

Ik ga vaak blind mee. Het zijn leuke mensen, dan boeit het mij niet zoveel welke muziek er dan is.

Je voelt je even 1 samen omdat je interesse hebt in bepaalde muziek of een specifiek nummer op dat moment.

Je gaat altijd met een groep. Ik ben 1 keer met 1 iemand samen geweest; dat vond ik heel awkward.

Het is wel bepalend met welke mensen in naar een festival ga.

Groeps gevoel is echt belangrijk. Wij tegen de buitenwereld, want die snappen ons toch niet.

Links voor!! Dat is standaard onze plek. Daar gaan we eigenlijk altijd heen op elk feest. Daar zien we dus ook bekenden. Zelfs zonder af te spreken soms!



Arm in arm met je vrienden naar al het vuurwerk kijken op zondag avond. Dan krijg je echt het gevoel dat we het samen als strijders overleefd hebben en hebben overwonnen!

Performing artist

Soms is het mooi om een optreden gewoon kaal te zien. Een akoestisch optreden van golden earring bijvoorbeeld, daar is niks bij. Er staat alleen op spot op. Geen vuur, geen rook, geen danseressen, geen schermen, niks. Ik denk dat dat nog leuker is dan al dat spektakel erbij.

Ik hoor de muziek en dan komt de rest. De muziek is de trekpleister en dan wil ik er misschien meer van weten en horen.

Je hoort eerst het nummer, dan ga je verder kijken: welke muzikanten spelen mee, hoe oud is die artiest geworden. Soms wil je dan meer weten.

Live muziek vind ik dan weer niks. Als ik zed an op gitaren zie spelen denk ik: Dit is al de 10000ste keer dat jullie dit doen. Ik vind t niet meer interessant.

Ik merk wel dat ik niet driven ben door een artiest en dan ook echt naar een optreden daarvan moet.

Ik moet per se die artiest zien en daar 6 uur van te voren gaan zitten, daar houd ik helemaal niet van. Zo ben ik niet.

Personal connection to the music

Music is heavily connected to memories. Memories are stored in music. When certain songs are heard, related memories surface.

Living in the moment versus Het verhaal.

Ik kreeg kippenvel toen de dirigent uitleg had gegeven over een bepaald motief. Daarna speelde het orkest een paar noten om het verhaal te illustreren. En dan kippenvel voor die 3 noten soms maar.

Pinkpop was wel een beleving

Het verhaal is heel erg belangrijk. Ik ben een enorme fan van Elvis Prestley. Zijn verhaal is een verhaal van vergankelijkheid, van destructief gedrag, snel dood gaan. Ik vind het hel mooi om een concert terug te kijken waarin je kan zien dat hij aan het aftakelen is.

Simon and Garfunkel was wel de reden om de sound of silence op de gitaar te gaan spelen.

De interesse in muziek is meer dan de muziek alleen, het is ook de band, het verhaal eromheen en de concerten ervan.

De ontdekkingstocht in de muziek is leuker dan de muziek zelf.

Ik ben constant bezig met soundcloud, spotify. Ik heb 18 uur per dag muziek op. Muziek is vaak een drager voor de sfeer zetten van een bepaalde ruimte.

Muziek is geen uitlaatklep maar meer een sfeer supporting element.

De meeste platen hebben niet echt een special verhaal achter de productie. Ze passen gewoon goed in de sfeer van de set.

Als er een nieuwe plaat gedraait wordt geeft dat een special gevoel. Alsof jij wel iets gehoord hebt wat de rest van de wereld nog niet mag weten.

Level of musical arousal

Live is gewoon een beleving.

Vroeger in de Jaren 80 stonden we te pogo'en. Nu hebben ze een theater tour, dan moet je in een stoel gaan zitten en luisteren naar de Dijk... Dat is niks voor mij.

Tijdens je favoriete nummers dan ga je springen en dansen

Wij willen ook altijd vooraan staan, wij willen er ook vroeg zijn. Biertje erbij en geacclematiseert zijn voor het concert begint.

Als ik thuis luister is het haast een soort meditatie, dan val ik erbij in slaap. Als ik naar een event ben geweest is het een soort pepmiddel: weg van de stress. Maar het is op zich wel vermoeiend, je hoofd komt vol indrukken te zitten.

Je tikt elkaar aan, zingt mee en springt tegelijk op de beat! Zo beleef je het samen.

Iedereen die meezingt of schreeuwt net voor de climax geeft heel veel energie. Dan ga je ook echt los als de kick erin komt.

Drugs/alcohol

Biertje erbij is wel gezellig, maar de muziek wordt er voor mij niet mooier van.

Waar ik zelf gevoelig voor ben is hoe andere mensen naar een feestje gaan. Ik ga graag naar en vriendelijk feest. Zo'n party waar iedereen aan de pillen zit, daar lijkt de sfeer wel open is iedereen eigenlijk op zichzelf. Dat is niet leuk.

Het eerste wat we doen als we binnen komen is bier halen.

Appendix B

Prototype

Prototype functionalities

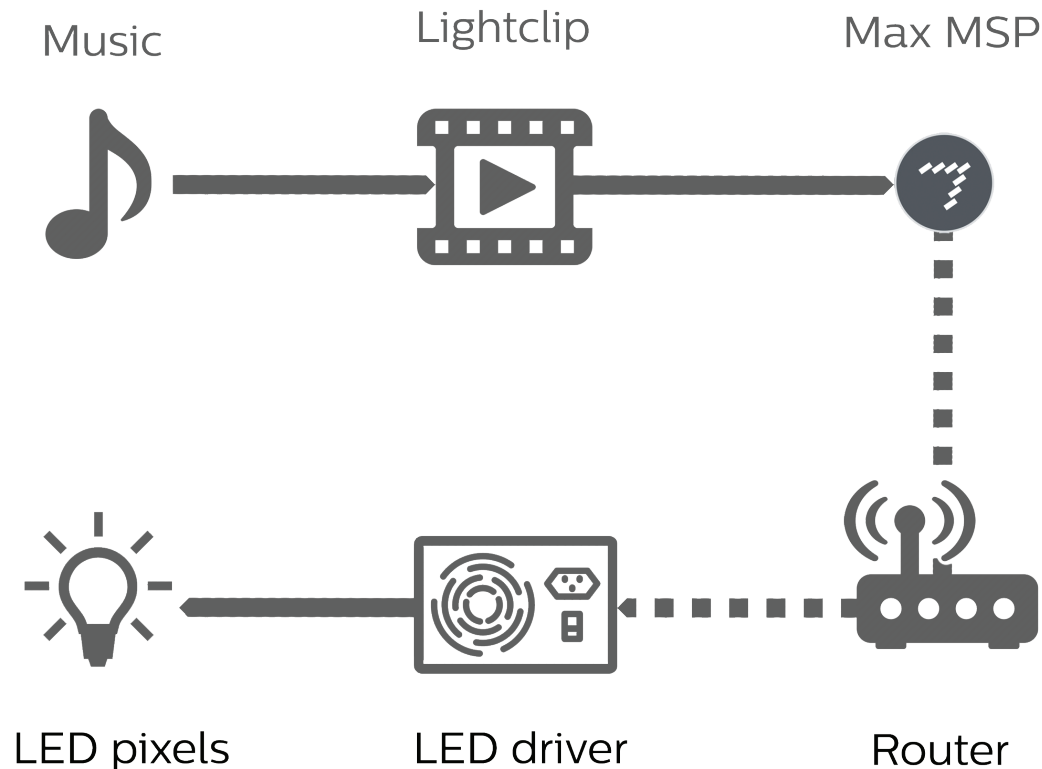
The total workings of the prototype will be explained next. All different sub-parts are elaborated on. The schematic below gives an overview how the data flows through the system. The whole system consists of six parts.

Iterations

The prototype of the system went through several iterations. The first test was a string of 6 LED pixels. Directly inputting RGB data controlled them separately. Movement could be simulated but usage was limited and slow. During the design process more control inputs were added as well as more LED pixels. In the end 20 light points was settled on as an appropriate number. Video files were used as input data. The patch was tweaked to get to the final demo.

Inner workings

All the individual parts work in collaboration with each other to create the final result. Following the data flow every part is addressed on what the exact function is and how it carries out its task.



Music

As a starting point in the system the choice of music is purely arbitrary. The system should work with every piece. For this demo songs were chosen that cover a large spectrum of music. A 1973 folk song by Paul Simon, a rock/pop song by Imagine Dragons from 2017, a Hardwell & KHSMR EDM track from 2017 and a Hardstyle track from Hardbass 2017. These songs show that the product works for all genres of music. The specific track itself should make no difference in the results. Listen to the songs on YouTube:

<https://www.youtube.com/watch?v=Zj2pTMtfkPI>

<https://www.youtube.com/watch?v=2ClrmVHODZ4>

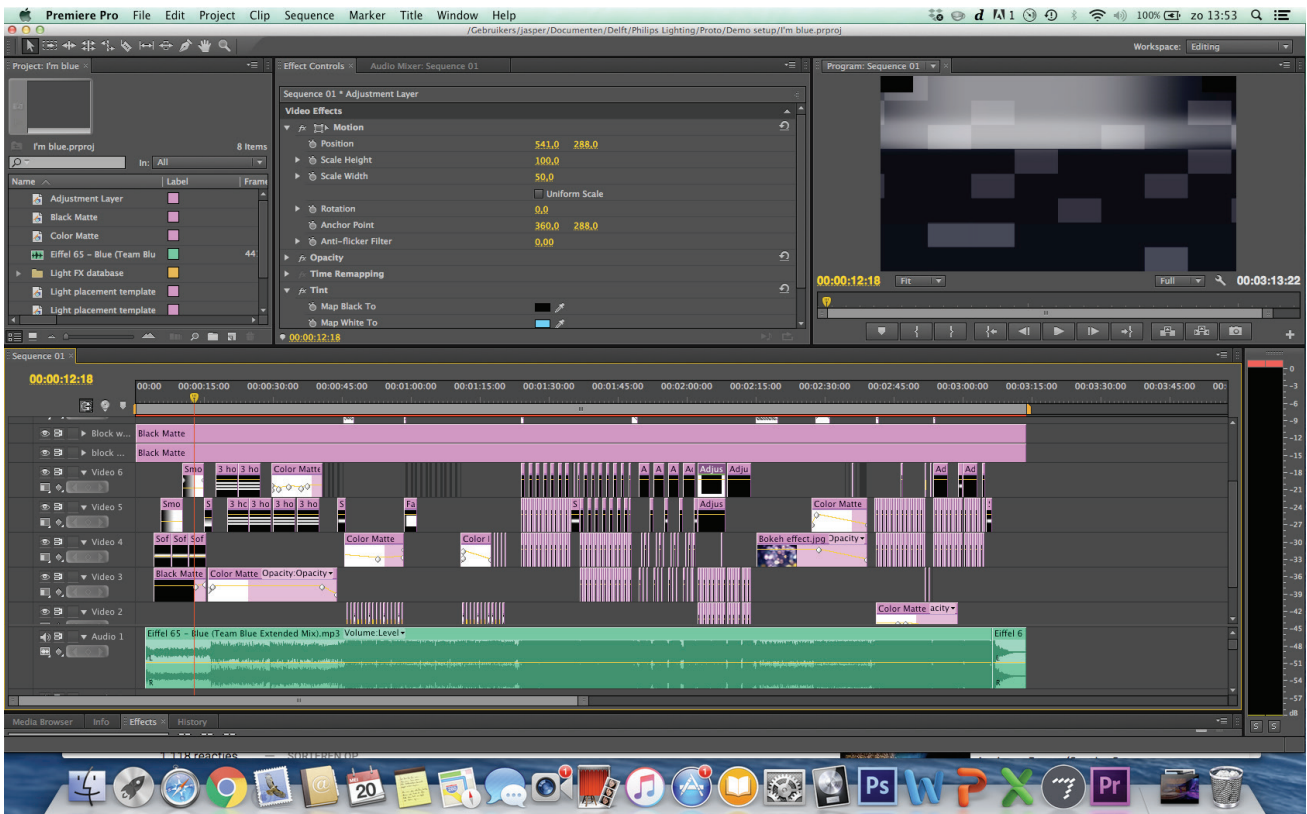
<https://www.youtube.com/watch?v=J701uclsrk>

<https://www.youtube.com/watch?v=7AR10XYkQk>

Making of light clips

The power of the product and the prototype is the fact that all content comes in the form of regular 2D movie clips. The algorithm interprets the video and a light script is send out to the lights. It is up to the artist what the content of the video is.

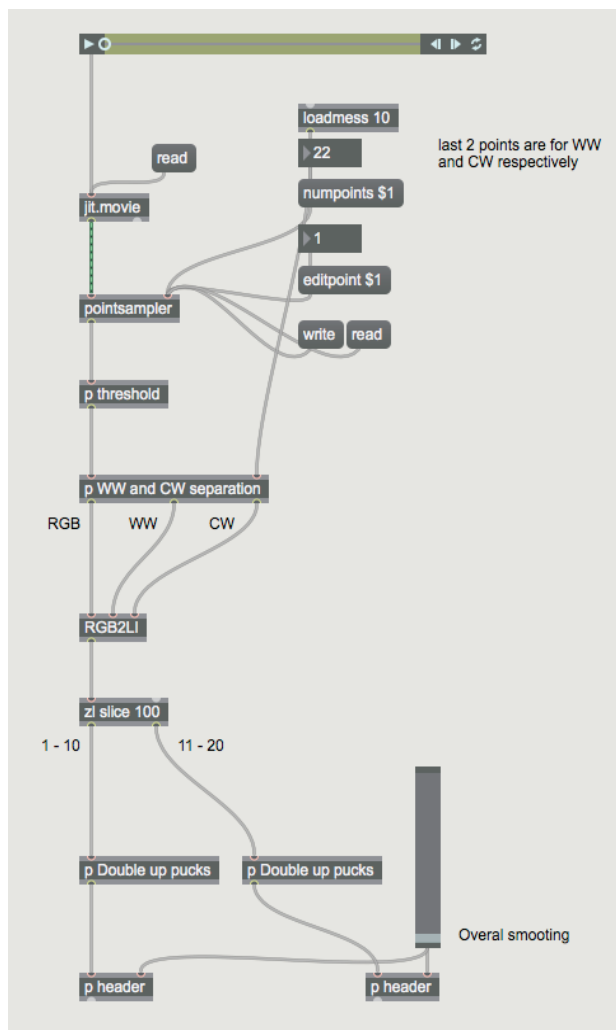
For the prototype the clips were made with Adobe Premiere Pro. The music was used a basis and different visuals were beatmatched to it. These visuals were abstract figures that created movement and color in the frame. A screenshot of the process can be seen below. The result was a lightclip with music and visuals. This movie was exported so it could be imported into Max MSP.



Algorithm

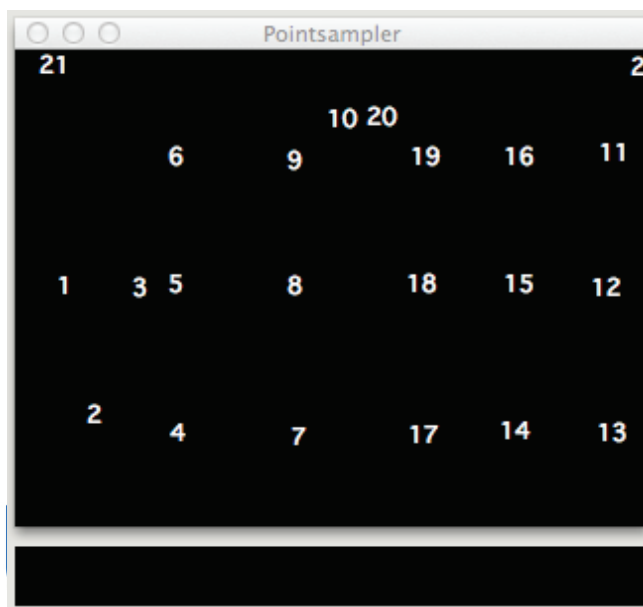
The program used to convert video input into light data is 'Max MSP'. It is referred to as Max. Inside Max a program was written that consists of multiple building blocks. These blocks have their function and collaboratively create the total algorithm. Figure to the right shows an overview of the chain.

The different blocks are discussed individually.



Point mapping

The first step is to map the individual points over the movie area. These points should be in the same position as the lights on the wall. Also the number of mapped points should be equal to the amount of lights used in the set-up. This way the lights react in the same manner as the points on the screen. This is the actual resemblance between the program and the real world. The operator places these points on the movie clip. See pointsampler for the mapping. In this case 20 lights were used. The 21 in the left top corner and 22 in the right top corner control all warm whites (WW) and cool whites (CW) respectively. These are used as flood lights to give extra accents to changes in the music.



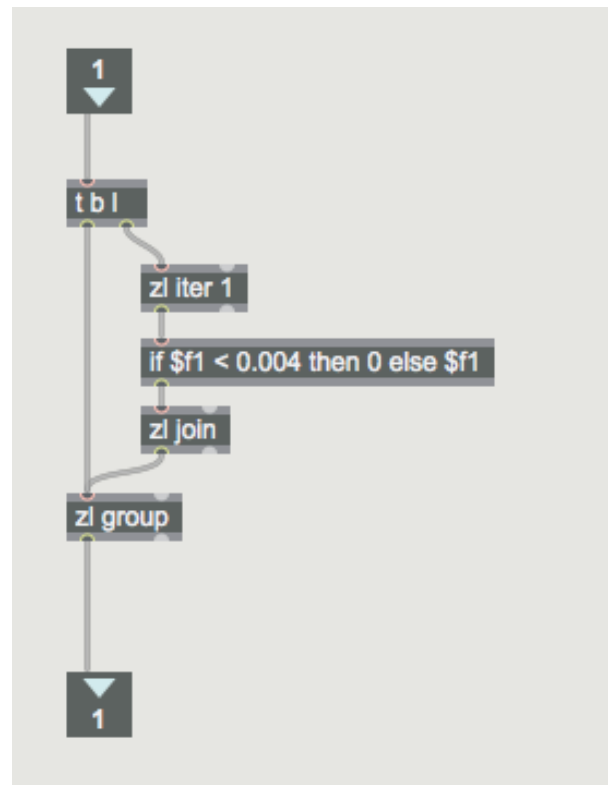
Point sampling

Once the points are mapped to specific pixels in the movie the program takes over. Max analyses the mapped points every frame and gives the RGB values. These values vary from 0 to 1. Where 0 is off and 1 is fully on. The following figure shows a screenshot where the colors from the movie are analyzed and shown underneath. This happens real-time. The list of RGB values for all sampled points is send through at each frame.



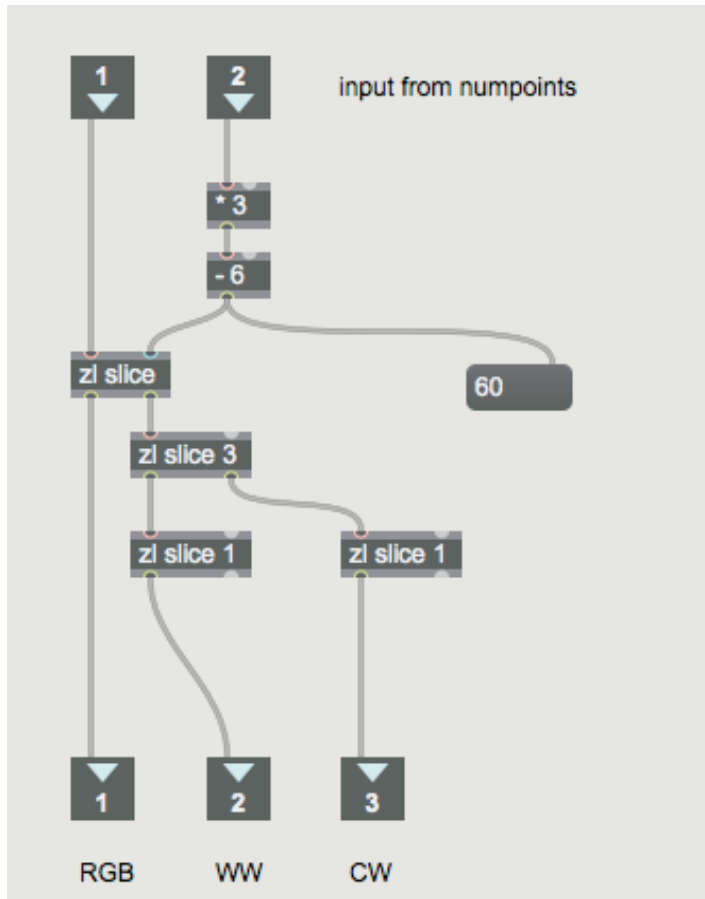
Threshold

It can happen that the movie is supposed to be black but the system does register a slight amount of color. While the light should be off it is faintly on. To combat this, only numbers above a certain value are let through. The rest is rounded down to 0 to ensure no light is on when it is not supposed to. Following figure shows the threshold value.



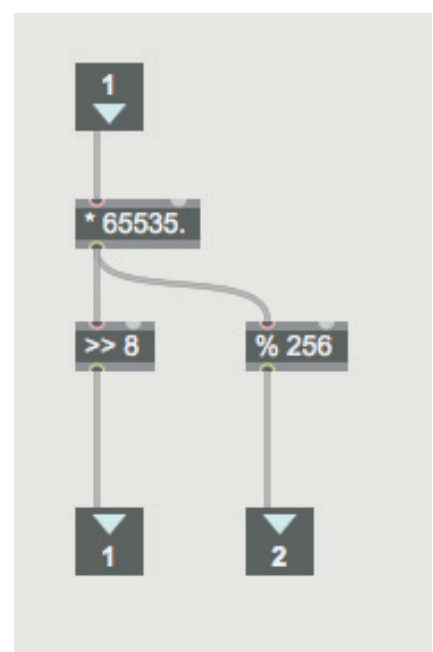
Splitting whites

As mentioned before the warm and cool white accents were added as extra points. These are split from the data string and added to all pixels as extra data. So instead of point 21 being an extra pixel it is the warm white value for all pixels.



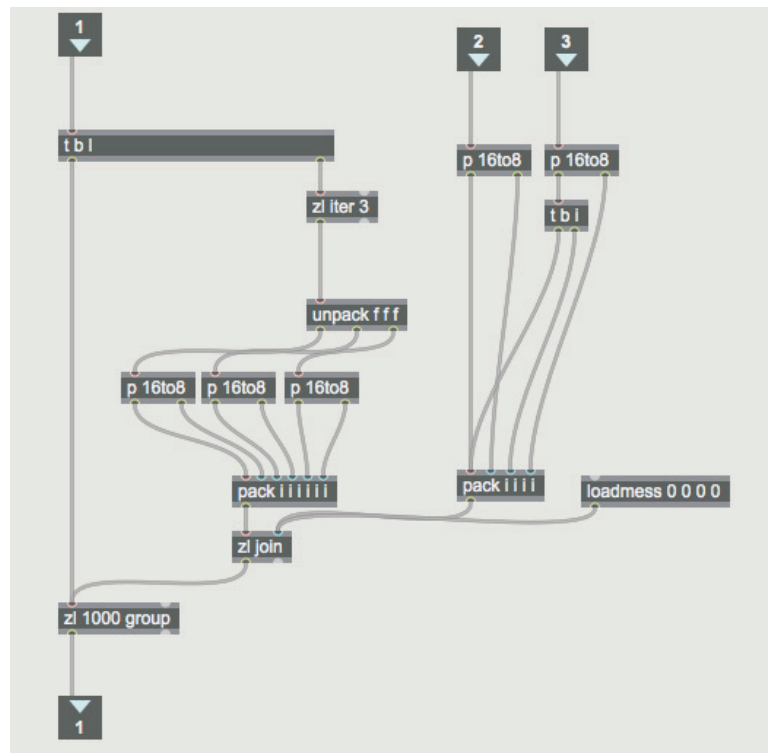
Data list conversion float to integer

The list with RGBWWCW values is still between 0 and 1. To make it usable for the LED drivers the values are converted to values from 0 to 255. However, when using 256 shades of each color the stepping from one value to another is visible when it comes to lower values. To combat this, the system uses deep dimming. That means that for every step there are 256 steps in between. This gives a total of 65,535 steps, which ensures a smooth transition between colors.



Conversion to lightinstruments

The lists are packed together in the order the LED driver can control the pixels. The pointsampler gives out all the red values then the green and then the blue. The drivers want the RGB values bundled per pixel so the lists are restructured to provide the correct data list.



Smoothing

The last step is to smooth the transitions between colors and between intensity. A dedicated slider is assigned to smooth out transitions for calmer music if deemed appropriate.

Sending

From there on the signal is send via the router to the LED drivers. The music is send from the movie clip to an external sound card and than to the speakers.

Router

The router makes for a dedicated Wi-Fi network. This network is used solely for communicating the data stream. It receives information wirelessly from the laptop and sends it out to the drivers. This wireless set-up gives more flexibility during testing; the laptop does not have to be connected to the LED pixels directly by wire.

Drivers

In the demo there are 2 drivers. Each of these drivers is connected to the mains. They receive a constant stream of data about the LEDs they are powering. This data is sent along the string of pixels. The drivers are limited to a total of 12 pixels. In the set-up a total of 20 is used. These are split 10/10 over 2 drivers.

LED pixel strings

Each LED pixel has 5 possible colors to address: red, green, blue, warm white and cool white. Mixing these together gives all the colors and all shades from warm to cool white. The pixels are soldered together in a string. Each one is individually addressable. The string is plugged into a driver and gets power and data from this.

The string is positioned throughout the room. The location of each pixel is plugged back into the algorithm to map where the points are. By having the lights line up with the pointsampler set-up the lights react appropriately.

Appendix C

Validation study

1 Introduction

A demo setup was made to simulate an immersive music experience in a living room. Multiple lights were spread through the space, which are individually addressable. Through time the color and intensity can be adjusted. Synced with different songs this creates a festival at home.

Does the demo show the envisioned result and is it in line with the design vision? That question was answered in a validation test. The concept was validated internally within the company and externally at Delft University of technology. This study focuses on the validation of this system. Does the product provide the expected experience and what is the impression of people seeing and hearing it?

2 Study 1 (Philips internal)

The first validation study was held with employees of Philips Lighting. All participants were part of the design team or had a design related function. The demo was set-up in the testing area of Philips Lighting. The accessibility to the test vicinity and affinity with light were the reasons for the employees to participate. The study was held in the prototype area at Philips Lighting. To goal was to inform co-workers of the results of the project and get an opinion on the experience the product provides.

2.1 Method

In a living room setting a prototype of the product is displayed. A lightshow is demonstrated. Informal interviews were conducted afterwards.

2.1.1 Participants

27 people participated in the validation study. They were divided up into a group of 2, a group of 3, a group of 12 and a group of 10 people. The first group of 2 people did have prior involvement in the project. The rest of the groups had no foreknowledge of the project.

4 sessions were held.

2.1.2 Apparatus

- Prototype system consisting of 20 lights
- Laptop
- Speakers Genelec
- Living room
- Blinds for a dark room

A pen and notebook were used to take notes and write down comments

2.1.3 Procedure

The participants were let into the living room with the demo setup. The initial assignment was explained so the participants knew that the goal was to create a festival at home. Then the demo was shown with 2 different songs and light scripts. After the demonstration the participants were interviewed in a semi-structured manner. The questions were asked to the group as a collective. The individual answers were noted.



2.2 Results

During the 4 sessions, all participants answered positively to the questions.

The answers to the questions can be found in Appendix 2.1

All participants gave a positive reaction to the system. Initial impressions were good. The demo was described as good, exciting and friendly. All participants found that the lightshow enhanced the music, making it a more immersive experience. The structure and emotion of the music were made stronger by the system according to the participants.

The correct synchronisation between lights and music was named to lift up the energy within the music. When the lights flash simultaneously with the beat, the music has more impact. One session mentioned colour as being subjective. Therefore the specific choice colour of lights is up to the artist.

The people from 3 sessions would use the system in their own homes. People from the other session would only use the system when it is scalable. They wanted the option of dimming down the effect of the lights for other genres of music.

The participants said the main applications would be to relive memories of music events, make concert registrations more immersive and improve house parties. The participants of one session found the system inviting to stand up and dance. A real concert experience is not replaceable by this system but it could form a welcome addition to a DVD. 3 participants mentioned the possibility of scaling up the system and use it for professional lighting at events.

Being people from Philips, they asked how the integration with hue would function. HueLink was mentioned in 3 sessions. Instead of having an algorithm create a light show, the participants were in favour of having an artist create the show. One participant said that this content enabling could be the next step in hue entertainment. As an extra remark one participant asked how the TV could play in with the lights.

2.3 Discussion

All participants were positive about the demonstration. The participants saw potential in the concept as a future product. It has to be noted that all participants were working for Philips Lighting. They can be biased; the results were company minded.

All people agreed that sync is key. If the synchronisation between the lights and music would be off, the system would not achieve the desired effect. This is therefore an important aspect to get right in the design of the lightshows and the system in general.

Hue entertainment is focussed on connecting lights in a living room to the entertainment system. This means that the lights react to a movie, music or gaming. The system could be the next step in hue entertainment.

Overall the participants were positive about the system. They felt it brought the festival experience to the living room. Music during a house party or concert registration would be more immersive. Businesswise, the participants said it was the effect Philips wants to achieve in the future. It would make entertainment more immersive.



3 Study 2 (External participants)

The second part of the validation study was held at the university in Delft. Participants with no prior knowledge of the product were invited to experience the demonstration. The study was set up the same as the first study. The goal was to validate whether the product answers to the design vision with external participants.

3.1 Method

In a living room setting a prototype of the product is displayed. A lightshow is demonstrated. Informal interviews were conducted afterwards.

3.1.1 Participants

15 participants took part in the second part in the study. They were divided into 4 sessions with 2 participants and 1 session with 7 participants. The participants were recruited at the university in Delft.

3.1.2 Apparatus

- Prototype system consisting of 20 lights
- Laptop
- Speakers M-Audio
- Living room

A pen and notebook were used to take notes and write down comments

3.1.3 Procedure

The participants were let into the living room with the demo setup. The initial assignment was explained so the participants knew that the goal was to create a festival experience at home. Then the demo was shown with 2 different songs and light scripts. After the demonstration the participants were interviewed in a semi-structured manner. During the interview more of the design was elaborated on if the participants asked for more information about the workings of the system. The questions were asked to the group as a collective. The individual answers were noted.

3.2 Results

The demo was shown to multiple participants at one time during each session. The questions were asked to the collective group and noted down as such. Individual answers were not taken into consideration in this study. The answers to the questions can be found in Appendix 2.2

When a first reaction was asked, all participants in the sessions were positive. 5 out of 5 sessions mentioned that they found the effect representing the festival experience. All participants said that they felt more immersed in the music because of the lights. It was mentioned that stimulating more senses, hearing and vision, made the experience more intense.

Synchronization and contrast in the lights were mentioned during all sessions as being essential features. All participants pointed out lights' flashing on the beat were giving the music more impact. Colour and movement of the lights was not mentioned directly. When asked, participants pointed out that the specific colour or movement of the lightshow is not important.

All participants said that house parties were the main application for the system. Also reliving memories of concerts was mentioned by 3 out of 5 sessions.

The experience of a music event cannot be substituted according to 4 out of the 5 sessions. 1 session mentioned the possibility of disabled people using this system because they can't attend an event.

3 sessions mentioned that they could see more potential uses for the product. Garden hangouts, gaming and wall panel lighting were named as possible future applications.

3.3 Discussion

The demonstration was well received by the participants. All reactions were positive. This indicates that the experience the product delivers is compliant with the design vision.

All participants noticed the synchronisation of the lights and music. This indicates that this is an important aspect. The lightshow should be beat matched as well as build up like the music itself. An artist or amateur enthusiast should program these shows. Content enabling was seen as a positive feature of the design.

The participants would mainly use the system for house parties. They didn't see the product as a substitution for visiting an actual music event. After explaining how the actual product would function, the versatility was mentioned. Different applications were brought forward.

Overall the outcome of the study confirms that the product complies with the design vision.

4 General discussion

The concept was well received in both studies. The participants at Philips were positive as well as the participants in study 2. The music had a guiding role and was perceived more intense with the addition of the lightshow. Participants mentioned that the product came close to a real immersive music experience at a festival or concert.

Synchronization between sound and lights was pronounced to be an important aspect. Colour and movement within the demo were not mentioned. The assumption is that as long as there is use of colour and movement in the show, the specific type of colour or movement is not important.

It is to be noted that people without a background in light design mentioned the synchronization between lights and music, whereas people from Philips were more focussed on the meaning of the music and the emotional effect it has.

The parallel with Philips hue was drawn. The current music functionality of hueLink was not meeting the expectations of the participants whereas the demo did fulfil their expectation.

The participants found the product useful in multiple situations. House parties, after parties and concert registrations were seen as situations where the participants would use the product in their own lives. Surround light gaming and garden parties were seen as possible uses too. Participants see the product as a means to improve their own parties instead of bringing the festival experience to their homes.

Giving the user the freedom to place the lights was deemed a good feature. Users should be able to configure their own experience. The content enabling aspect was seen as a positive feature in the design. The participants advised to give the user freedom in using the system.



Appendix C.1

Interview questions

1

What is your first impression?

2

The goal was to create an immersive experience. Do you feel you experienced the music more intensely with the addition of the lights?

3

Do you feel there is a correct match between the lights and the music?
Think of: Synchronization, Colour, Movement, etc.

4

How do you see this product being used in your own life? Think of house parties, pre/after parties, concert registrations?

5

Do you think this is an addition to festivals or a substitution?

6

Do you want to add anything? Any comments or things you want to ask?

Appendix C.2.1

Answers from Study 1 Philips sessions

1

- Friendly, inviting to dance and socialize
- Good, builds on HueSync. The next step in hue entertainment
- Exciting! Great party feeling (vrijmibo)
- Really awesome. This is what Huesync should have been

2

- Yes, the meaning and emotion are conveyed better
- Yes, the music get much more attention drawn to it. It gets much more focused on.
- Yes! 'gezellige sfeer' Close to the festival feeling
- Yes, this captures the party lights well

3

- Colour is really subjective. The second song worked better. More energy in the music makes for a better light show.
- Sync is key. It feels good together
- It makes sense. Energy in the music is translated to energy in movement
- Clearly more attention went into the second track. The beat matching works well. Also the build-up throughout the song.

4

- Great as a social stimulus at house parties
- Should be scalable to different genres and intensities of music. Than concert registrations would become more immersive
- This would work great for a concert in your own home.
- House parties mainly. Saturday night with friends

5

- Addition, great to relive memories
- This system could even be scaled up to the professional market. So it can be a substitution. But at home it is an addition to festivals.
- Not a substitution. It is an extra for a DVD or music stream.
- It will never substitute completely. Nice to relive concerts you visited.

6

- Even with heavy music it has friendly quality
- No extra comment
- This would work with TV imagery
- Really cool! Next step for hue entertainment



Appendix C.2.2

Answers from Study 2 Delft sessions

1

- Very good
- Very nice, especially the good synchronization
- Leuk, it is quite intense
- I found it really nice, where can I buy stocks?
- Nice! The energy of the music is conveyed very well with the movement of the lights.

2

- Yes, music impact and light flash work well together
- Yes, lights react immediately to the music
- Yes, there is not much escaping from the light
- Yes, I am a bit sensitive so the flashing lights had me captured.
- Because more senses are addressed it feels there is no escaping from the music in the room

3

- Contrast in the show was good. The sync with the music was good in directly reacting to the beat but also the structure of the songs. The system addresses more senses, which makes impact more dramatic.
- Colour was not important. The synchronization was good.
- The shows were good in sync. Huesync suffers from lack of correct synchronization with music. This is what I would expect.
- It reminds of a festival with a stage and good music. The same effects were recognizable.
- It is up to the artist to create the correct movement and colour. What this is specifically does not matter. The synchronization should be on point.

4

- Memories of events and house parties
- House party heaven
- I would use it to listen to Rachmaninoff, with the effect dimmed down of course.
- For students this would be great for obvious reasons. This elevates every house party.
- Using this as a support for concert registrations.

5

- Addition. Although this could be used as a substitution for concerts that are far away or for disabled people unable to visit certain music events.
- Addition. For an immersive experience at home.
- Very versatile. Also suited for (amateur) musicians/ dj's to try on their own songs.
- Great as a support for the after movie of a party we visited. A good addition to elongate the total festival experience.
- A festival as an event can't be substituted. But using this as extra immersion in the living room is great.

6

- Versatile product, also usable in the garden, catwalk etc.
- The fact everybody can create content easily is cool
- It is good that amateurs can play with the system as well. Content enabling is a good feature.
- Where can I get a set to try at my next party?
- No further comment.



Appendix C.3 Pictures of lights setup at Philips and Delft.



The demo setup at Philips Lighting in Eindhoven.



The demo setup at the university of IDE in Delft.



