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= Group Members =
{| border=1 cellpadding=3 style="width: 60%"
|-
!Name
!Student Code
!Email address
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| Pleun Hutten || 1310925 || p.m.hutten@student.tue.nl
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| Jeroen Bakermans || 1007330 || j.bakermans@student.tue.nl
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| E.W. Pardijs || 1257811 || e.w.pardijs@student.tue.nl
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==Introduction==

[[File:Rivm graph.JPG|400px|thumb|left|The Development of the number of infections since february 2020 <ref> [RIVM (20-10-2020), https://docs.google.com/document/d/1vQWflH4fJI47ft3baWqCPEWj1ACAGsxp1jyeeKUK94Q/edit] </ref>]]

COVID-19 set the lives of many people upside down in March 2020. As can be seen in this graph <ref name='rivm'>[RIVM, 13-10-2020, 'Ontwikkeling COVID-19 in grafieken' </ref> we should not give free rein to the virus, because the number of infections will rise exponentially. Necessary measures need to be taken for prevention of the spread of the coronavirus. However, these measures have a big influence on society and the economy. A lot of sectors are financially hit, but this study focuses on a specific one: the event sector. On October the 13th the latest package of new measures was proclaimed to stop the 'second wave in the Netherlands. Group sizes are limited and all public gatherings are abolished. All festivals and concerts are being cancelled for the second time this year. Furthermore, in between the first and the second wave the event sector has not been able to get back to (the new) normal, like for instance the catering industry. At this moment, it is not allowed to organize events. Once the number of infections per day falls again, measures will be loosened carefully and hopefully the event sector can organize events in a safe way again. These last months it was only allowed to sit at tables at events, which is referred to as the 'seating rule' in this report. But might there be

an innovative solution that would nevertheless make standing and dancing during such events possible again? That is exactly what this project will investigate.

==Objectives==

The current COVID-19 crisis allows for no events at all. In the previous months, before the second wave, sit-concerts and -festivals were permitted. Interviews with the event sector revealed that the sit-festivals are okay according to the circumstances, so here are no substantial problems. Enforcement during sit concerts is manageable. However, there is a big wish for being able to move freely and dance. Assuming that events are possible in the first place, the seating rule does not allow for standing and dancing because keeping distance while dancing is hard and therefore unrealistic. Therefore, the goal of this project is to come up with an innovative and safe way to make the organization of dancing festivals possible in times in which the COVID-19 is lurking.

Before specifying the target group, it is important to discuss the current COVID-19 crisis and the expectations for the future. At the time this report was written (October 2020), the rising number of infections was alarming; experts spoke of a 'second wave'. As a consequence, new measures were taken: the catering industry had to be closed, the maximum group size was brought back to 4 and face masks were proclaimed to become a duty in public indoors places. Before the second wave, things started to get back to normal: the catering industry and sport clubs were opening their doors again, people could go to work, schools restarted physical education et cetera. However, the event sector was still deeply suffering from the consequences of the pandemic. As mentioned earlier, dancing events were not allowed and the capacity was drastically reduced. With the necessary new measures for stopping the second wave, the organization of events became even impossible because of the new maximum group size. This had the following consequences for this project: even if we had come up with a safe tool that serves its goal, it would not be realistic to assume that dancing events would be allowed again on short term. Additionally, it is expected that the virus will still be a substantial issue entering the autumn and winter. Therefore, the product could not be used on a short term, but whenever groups are allowed to be bigger again. Due to the unpredictability of the progression of the coronavirus no meaningful estimate for when large events are allowed again can be made. However, the second wave will end just like the first wave and then measures will be loosened again. In the business plan attention is paid to how to deal with the unpredictability of COVID-19.

More concretely: this study focuses on indoor and outdoor music events of many music genres. From pop, to electronic dance music, to house, to jazz: all festivals where dancing is desirable. However, this tool will not be suitable for music events where attendees usually go romping and mosh pitting, which is creating an open space in the audience and then run into it all at the same time. It is only suitable and desirable for events where attendees stay at approximately the same place to dance. The target group is very varied: from teenagers, to headbangers, to salsa dancing couples. Depending on the applying measures, the maximum number of people

might be prescribed or maximized for a certain terrain or hall. The developed tool is aimed for small scale music events but can also be upscaled to larger music events. Moreover, the product is specifically based on the demand on the Dutch market, as the measures differ per country.

The product is aimed at small scale events for two reasons. First of all, it is easier to enforce the rules with small scale events. Currently BOA's are already having a difficult time in the Netherlands regarding enforcement because of rebellious citizens, so security workers at events can have a difficult time as well. Especially when people are drinking alcohol, they could be less cooperative regarding social distancing.

Just like with restaurants and bars, it is possible for the government to keep the restaurants and bars responsible for making sure all guests follow the distance rules. Out of fear that bars and restaurants would get fines, some bars and restaurants decided to not open up again. <ref>[AD, 14-6-2020, 'Zorgen om naleving coronaregels in horeca: meerdere zaken gesloten', https://www.ad.nl/binnenland/zorgen-om-naleving-coronaregels-in-horeca-meerdere-zaken-gesl oten~a8b19d9d/]</ref> If these restaurants and bars have difficulty with enforcement, imagine having a large scale music event. Suppose controls would take place and the government inspectors say the rules cannot be enforced then it is not only the case that the organization gets a fine, but also that the music event might have to end. Of course this would be a huge disappointment for the visitors, but organizations will also lose a lot of money, since music event organizers are tied to contracts with caterers, security etc.
Also prior to all of this, visitors might not go to a festival as easily when they know they might be sent away because of people not adhering to the rules and government inspection with closure as a result.

Furthermore, the government has to give permission for the event. Given that spreading is more likely to happen at large scale events and that enforcement is difficult at large scale events, the government will probably not give permission for large events.

The use of this tool is limited to concerts and festivals, because people buy a ticket for these music events with the main goal of enjoying the music. It could be argued that this is also the case in bars and nightclubs. However, bars serve another goal: people go there to catch up with friends after a week of work. If our tool would be implemented in bars, it would be useless as it serves for listening to music and not socializing.

For the sake of clarity, the goal of this project is not to make the organization of concerts or festivals by itself possible again, but to make dancing at events allowed again even though the distance rules still apply. To this end, it must be verified that there is a demand for this product and whether it is technically feasible. Obviously, this hypothetical product has to be examined by governmental parties before it could be introduced on the market. Therefore, the ultimate goal of this project is to persuade the Dutch National Institute for Health and Environment (RIVM) and the cabinet to abolish the seating rule during events in COVID-19.

Deliverables

During this project the following deliverables are aimed for:

- Most importantly, at the end of the project it is aimed to deliver a detailed design. All technical details will be specified and sketches will be made.

- After making sure that there is a demand for the product on the market a feasibility study will be performed. This means that we will contact as many stakeholders as possible to gain information and feedback on our plan. Further below it will be discussed who these stakeholders are and what input they gave. Another part of the feasibility check is the calculating the cost-effectiveness and verifying the technical aspects of the design.

- A business plan. In this document not only the problem statement and solution, but also the target market, competition on the market, marketing and a financial plan will be discussed.

- A wiki page documenting:
    - The why and goal of our project.
    - The literature studies performed.
    - An extensive documentation on the communication with all sorts of stakeholders.
    - A detailed description of the idea and its requirements, constraints and preferences.
    - A detailed description of the technical aspects.
    - The feasibility check and business plan will also be included.

- A (video) presentation on the design, feasibility study and business plan.

Planning

{| border=1 cellpadding=3 style="width: 60%"
|-
!Week
!Tasks
!Milestones
|-
|Week 1 || Form groups, choose a subject, document problems statement, start planning and research. ||
|-
|Week 2 || Continue (literature) research, get into contact with stakeholders to find the exact problem statement, brainstorming on a solution for the problem. ||
|-

|Week 3 || Create preliminary design, interviewing, mailing and calling stakeholders and documenting on wiki || Complete preliminary design
|-
|Week 4 || Working on design, collecting input from stakeholders, working on wiki || Complete design
|-
|Week 5 || Finishing detailed design, calculating costs, interviewing stakeholders, working on wiki ||
|-
|Week 6 || Work on experiment plan and business plan and document this on wiki || Working prototype
|-
|Week 7 || Document results on wiki page, produce presentation video || Finishing deliverables
|-
|Week 8 || Last touches on wiki || Complete wiki, complete presentation
|}

=Development of idea=

At the beginning of the project the aim was to make events possible again while restrictive measures for limiting the spread of the COVID-19 still apply. Many events got cancelled or had to scale down extremely. Our group aimed to develop a prototype that made sure that attendees remain distanced from each other and that would allow music event organizers to scale up in a safe way. This resulted in the design of a 'coronabeeper': a device that continuously measures the distance to other devices. Once two devices come within a radius of 1.5 meters from each other an alarming signal will go off. If everybody on a festival wears such a device, this can significantly contribute to enforcing a safe distance. However, changing objectives was necessary after having a few discoveries.

First of all, it was found out that a similar product already existed, namely the WATpod. This device is mainly used in a company environment to make sure that personnel respects the social distancing rules. Therefore, it was decided to build a model on top of the WATpod that works together with the WATpod instead of developing a prototype. This would add some features to the WATpod for improving its user-friendliness. The model would for instance make it possible for people from the same household to come within 1.5 meters without being warned. Furthermore, by tracking the movements of all individuals the coronabeeper can make sure to punish the right person, namely the one that was moving. Finally, registering the number of warnings per person enables security to warn the right people.

However, it was decided this was not the problem to be solved after receiving input from an interview with de Effenaar. According to de Effenaar, there are two main problems. Firstly, the

capacity: in de Effenaar they could only sell 1/13 of the normal number of tickets because of the measures. The introduction of the coronabeeper would not change anything to this. Secondly, it is currently not allowed to stand during events <ref name = 'Het coronavirus en de horeca en evenementen'>[Rijksoverheid, (n.d.), Het coronavirus en de horeca en evenementen, https://www.rijksoverheid.nl/onderwerpen/coronavirus-covid-19/ondernemers-en-bedrijven/horeca]</ref>, because keeping distance and enforcement are both easier while being seated. De Effenaar told us that 'the sit concerts are okay as they are; it is what it is'. A coronabeeper appeared to be useless in this situation as there is sufficient distance in between the seats. According to de Effenaar, the fact that dancing is not possible is a big loss. Therefore, it was decided to follow up on this problem statement and design a suitable solution that allows for dancing parties again.

To this end, a literature study was performed in order to find out how to accurately measure distance. This literature research resulted in the conclusion that the Ultra WideBand (UWB) is more suitable for creating a product for social distancing than for instance Bluetooth, GPS and Wi-Fi.

The research was undertaken about a comparison with Bluetooth low energy (BLE) and Ultra-Wideband (UWB) technology<ref>[Colmer, Morgan. (2019). UWB Vs BLE Whitepaper.]</ref>. This states two main reasons for using UWB instead of BLE. The first reason is that the UWB time of flight is better than the BLE receive signal strength indication. The second reason is revealed by stating an industrial trend in using location technology at the company, Apple. Nevertheless, the company has been promoting BLE for years, it has replaced IBeacon BLE technology by UWB. This is because UWB has brought the possibility to use more applications and higher quality. Also, the location accuracy and data rates are higher than BLE since UWB operates in a wide frequency range (approximately 500 MHz) while BLE does in around 2 MHz.

Another research regarding UWB introduces a concept of indoor positioning technique and provides a SWOT-analysis (strengths, weaknesses, opportunities and threats)<ref>[Alarifi, A., Al-Salman, A., Alsaleh, M., Alnafessah, A., Al-Hadhrami, S., Al-Ammar, M. A., & Al-Khalifa, H. S. (2016). Ultra-Wideband Indoor Positioning Technologies: Analysis and Recent Advances. Sensors (Basel, Switzerland), 16(5), 707. https://doi.org/10.3390/s16050707]</ref>. Additional research compares different positioning techniques including UWB and explains why UWB has gained attention as a positioning skill<ref>[D. Dardari, R. D'Errico, C. Roblin, A. Sibille and M. Z. Win, "Ultrawide Bandwidth RFID: The Next Generation?," in Proceedings of the IEEE, vol. 98, no. 9, pp. 1570-1582, Sept. 2010, doi: 10.1109/JPROC.2010.2053015.]</ref>. Furthermore, in terms of the cost, UWB is also cheaper than other technologies and consumes less power.

UWB has an accuracy of 5 to 10 cm compared to roughly 5 m accuracies for Wi-Fi and Bluetooth. The data rate of UWB has been adjusted to 6 to 8 MB/s in contrast to the past in which it was 100 MB/s, for better use for mobile devices. Also, UWB consumes less power than Wi-Fi. However a disadvantage of UWB is that Wi-Fi and Bluetooth are better at interacting with mobile devices. <ref>[Connell, C. (n.d.). What's The Difference Between Measuring Location By UWB, Wi-Fi, and Bluetooth? Retrieved from

https://www.electronicdesign.com/technologies/communications/article/21800581/whats-the-difference-between-measuring-location-by-uwb-wifi-and-bluetooth]</ref>

The input from de Effenaar and the performed literature research resulted in the idea of creating 'dance islands' for two people from the same household. The islands are fixed in such a way that the households are separated by 1.5 meter distance. All attendees wear headphones to which a tracker is attached. Once the distance between the headphones and the middle of the circular island exceeds the maximum radius for the circle, the audio of the headphones will be muted, which encourages people to stay on their islands. It was chosen to 'punish' customers by pausing the music instead of warning them via an alarming sound or vibration on the wrist. The distance measuring will be done by a sensor, which is added to the headphones. A beeper or vibrator can more easily be ignored or tampered with. The visitors come to a music event with the purpose of enjoying the music, which is why the headphones are valuable to them and will not be tampered with. Although in the headphones there also is a tracker integrated, it might give the customer a more anxious feeling to be constantly tracked by a wristband that can't be taken off than by headphones that can be taken off, which makes the headphones more user-friendly. A more in-depth description of the product will be given in the section 'Detailed description of idea'.

=Stakeholders=
In order to come up with a solution that would make dancing events possible again the stakeholders who have interest or power in this area of our problem statement have to be identified. Each stakeholder has a certain amount of power in this problem, they can influence how successful a solution is. Each stakeholder also has a certain amount of interest in a solution depending on how much they stand to benefit from a solution. A lot of information about stakeholders was obtained from questionnaires, interviews or other correspondence with the stakeholders. The full questionnaires and interviews are available in [[Appendix_PRE2020_1_Group2]].

==Music event organizers==

Music event organizers are stakeholders with high power and interest in this solution, as they are the ones that will have to organize the dancing events the solution aims to make possible. Therefore it is important that they see value in it and want to use it. Music music event organizers and the entire event branch itself have been hit hard by the COVID-19, due to the measures taken to curb the spread of the virus mass gatherings are not allowed. Therefore no events, at least not on the scale of before the outbreak, could happen anymore. This means an incredible decline of revenue for music event organizers, an 85% loss of revenue was estimated as of August 2020. <ref name='teunis'>[Harm Teunis, Mathijs Smit (2020, August 14) 'Zonder nieuwe steun verdwijnt helft banen evenementensector'. RTLnieuws </ref>

The biggest problem mentioned by an music event organizer that was interviewed is the decline in capacity due to the 1.5 meters distance rule, reaching the number of guests required to be

cost-effective is nigh impossible. This problem was stated whilst the Netherlands were in the lowest risk level, locations could receive as many people as they want as long as the 1.5 meter distance between people could be kept. Several of these risk levels have been distinguished by the government in the official route map, depending on this risk level the strictness of the measures is determined.<ref name = 'Routekaart coronamaatregelen/'> When the risk level is higher there is a maximum capacity which makes reaching a profitable guest count impossible. Another problem mentioned was the fact that events could only be held where guests stayed seated, this reduced the amount of events held due to only a certain type of event working well with a seated audience. The interviewed music event organizer did believe that a solution to make dancing events possible would make a difference for music event organizers. <ref name ='appendix'> [[Appendix_PRE2020_1_Group2]] </ref>

==Artists==

Associated with the music event organizers are a plethora of different stakeholders, a lot of businesses rely for a big part on music event organizers hosting events. Artists for example are for a big part dependent on events for income. Some of these artists are, as previously stated, in genres where sitting concerts are highly unconventional. Especially for these artists, but also the others, a solution that makes dancing possible again is very important.<ref name ='appendix' />

==Silent disco rental companies==

Silent disco rental companies also rely partly on business with music event organizers, all of the three silent disco rental companies interviewed have mentioned the business to business revenue grinding to halt.<ref name ='appendix' /> Silent disco rental companies also have the infrastructure and contacts in the sector that would allow them to distribute a product within the event sector.

==Event visitors==
Another stakeholder with high power and interest in a solution are the visitors of events, these are the stakeholders who should actually like to use the solution. If this group does not think a solution is good, then they won't visit events that make use of it. If users don't want to use it, then the dancing events will logically not happen.

We have held questionnaires asking visitors of events about their experiences with events during the COVID-19. When compared to a normal year a decline in event visitations was noted for the questioned users, in a normal year all respondents visited at least one event whilst this year 33% reportedly visited not a single event. The respondents who visited an event during the COVID-19 crisis reported that they thought keeping proper distance was possible due to the ample space. However, the majority also stated that they didn't actively pay attention to keeping distance especially after alcoholic beverages are consumed. Due to this, it is clear that whilst

visitors may want to keep distance, they can't be relied on to keep this proper distance themselves.<ref name ='appendix' />

==Community==

Not many articles have been written on the effects of the quarantine, social distancing and social isolation, as life is far from normal. As more time passes by, the real psychological impact will become clear. However, there are some first researches in which provisional psychological effects have become clear. The lockdown-measures prevented the virus from spreading on a large scale, but the consequences for isolated individuals will be a problem in the future. Research of Hiremath et al showed that the measures cause psychological problems like depression, anxiety and panic disorder <ref name = 'Hiremath'>[Pavan Hiremath, C S Suhas Kowshik, Maitri Manjunath, and Manjunath Shettara. COVID-19: Impact of lock-down on mental health and tips to overcome]</ref>. There have even been reported suicides due to psychological effects of social isolement and all other inconveniences <ref name = 'Gonzalez>[J.M. Gonzalez_Diax, J.F. Cano, V. Pereira-Sanchez. Psychosocial impact of COVID-19-related quarantine: refelections after the first case of suicide in Colombia. https://www.scielo.br/scielo.php?script=sci_arttext&pid=S0102-311X2020000607001&tlng=en]</ref>. General research on social isolation also reveals that social isolation evidently harms mental health <ref name = 'Rohde'>[Rohde, N., D'Ambrosio, C., Tang, K.K. et al. Estimating the Mental Health Effects of Social Isolation. Applied Research Quality Life 11, 853–869 (2016). https://doi.org/10.1007/s11482-015-9401-3]</ref>.
Naturally, people need social interaction, which is exactly what was deprived from us in lockdown. Coming together and making fun at a concert or sports event could significantly contribute to minimizing the psychological problems that are caused by the corona crisis. Of course, events were already possible in an adapted version. However, the majority of the event sector will remain highly restricted as long as visitors are not allowed to stand and move freely.

==Municipalities==
Local governments as well play an important role as the responsibility for deciding which events can take place in their region and which ones are not allowed to take place has been delegated to them. The municipality could also decide to allow an experiment that will reveal whether the idea works out the way it was aimed. Within a municipality the mayor can also decide on additional safety measures.<ref name ='Evenementenbeleid'> CCV. (2020). Evenementenbeleid. Retrieved from
https://www.raadsledenenveiligheid.nl/veiligheidsthemas/evenementenbeleid </ref>

==Safety Regions==
The 'Veiligheidsregios' are the bodies that are responsible for the safety of the regions inhabitants. The Netherlands are divided into 25 of these. The safety regions are allowed to determine safety measures for the entire region, consisting of multiple municipalities. The national government can take over this responsibility as well if it concerns public health. <ref name='lokalemaatreglen'> Rijksoverheid. (2020). Lokale Maatregelen Tegen Verspreiding

Coronavirus. Retrieved from
https://www.rijksoverheid.nl/onderwerpen/coronavirus-covid-19/nederlandse-maatregelen-tegen
-het-coronavirus/lokale-maatregelen-tegen-verspreiding-coronavirus</ref>

Government

The government are powerful stakeholders in this problem, these are the ones who are responsible for determining the measures against COVID-19. They are however also partially responsible for the economy, they have an interest in a well performing economy and also have the power to control it partially. It is in their interest to combat the virus as hard as possible through instilling measures curbing the spread, depending on the number of infections they decide the circumstances under which events can take place in. They also have an interest in keeping the sectors from suffering from the coronavirus outbreak afloat. As of August 2020 the government had made a total of 782 million Euros available to the cultural sector, of which the event sector is a part. <ref>Rijksoverheid. (2020). Coronavirus en cultuur. Retrieved from: https://www.rijksoverheid.nl/onderwerpen/coronavirus-covid-19/openbaar-en-dagelijks-leven/cultuur </ref> For the government to approve of an alternative to the seating rule it would have to be safe and it should be demonstrated that a solution allows for events to be held whilst keeping proper distance. As a solution is beneficial for the music event organizers it will also be beneficial for the government as it relieves a part of the financial pressure.

RIVM
The RIVM, the National Institute for Public Health and the Environment is a research institute in the Netherlands aimed toward furthering public health. The government's policies concerning public health are supported by the RIVMs research results. Therefore the RIVM is also a powerful stakeholder for our solution, as their opinion could influence the government's opinion on our solution.

Manufacturers

Obviously, if this device gets through the testing phases and it is approved by all governmental institutions, it must be manufactured on a larger scale.

Security

The introduction of this gadget will affect security companies. These last months the number of security employees in places where many people come together has risen significantly. The introduction of this product might change the role of security at events. They no longer have to enforce distance within the dance islands', but mainly show the attendees the walking routes and signing towards the bar and bathrooms and enforce distance outside the dance islands.

=RPC's=

==Requirements==

* "The headphone warns the user when they leave the island."

This is done by muting the music on the headphones once it has left the boundaries of its island. The visitor can resume listening to the music only when he or she returns to his or her predefined area. The microprocessor will give a signal and short circuit the music, which will result in pausing the music. This way attendees are actively reminded to adhere to the rules.

* "The tracker measures the distance from the middle of the circle to island-members with an accuracy of 5 to 10 centimeters."

The distance measuring must be reliable for the system to correctly determine if a headphone is in or outside of its dance island. If there are too many false negatives, causing headphones to be muted whilst inside a dance island, then the product will become less appealing to event visitors. Being punished whilst complying to the rules would not be appreciated. Likewise, too many false positives, and the safety is compromised as people could still listen to music whilst violating the distance rule. The distance measuring is done via an UWB, which has an accuracy of 5 to 10 centimeters.

* "It should not be possible for attendees to switch islands during the festival."

The goal of this tool is to separate households and ensure that proper distance is kept between these households. If attendees could switch islands then households could mingle and violate the distance rule. Each headphone is linked to a single island and will only play music within that island and exchanging headphones is discouraged by demanding a deposit on the headphones. At the entrance, the guest receives a headphone that is personalized because it is specifically for his or her island. At the exit, the deposit will be returned if they return the same headphone.

* "Attendees should not be able to tamper with the headphone tracker."

If attendees were able to tamper with the headphone tracker, by for example disabling it, attendees could freely listen to music anywhere and therefore wouldn't be encouraged to stay in their dance island.
By making the tracker inaccessible by putting it in the headphones this risk is being dealt with. Moreover, the deposit will only be returned to the customers when the headphones are in their original state.

* "Attendees should not be able to tamper with the beacon in the middle of the stationary island."

Again, if attendees were able to tamper with the beacon in the middle of the island, they would be able to violate the social distancing rules without being punished. This is solved as follows: the sensor in the middle of the island is taped on the ground and attached to cable for power. When the beacon is removed and not powered anymore the headphone tracker's requests to the beacon will timeout and therefore the audio will remain muted.

* "The tracking system adheres to the privacy rules."

Tracking attendees can come with complications regarding maintaining the privacy of the attendees. It must be clearly communicated to the customers in advance that the tracking is necessary for making dancing possible. It is not possible to just track visitors according to the GDPR. It should be clear to the attendees what is done with the data the organizers gather.

* "The costs for the music event organizers for using this technology should be outweighed by the benefits."

Music event organizers and headphone rental companies should both benefit from using this gadget. The add-on could allow the headphone rental companies to rent out more headphones to event organizers. Hopefully, the product will give positive publication and create a feeling of exclusiveness, which will create willingness among event attendees to pay extra for a ticket. This will consequently allow music event hosts to raise the ticket price. Moreover, visitors agreed that they would be willing to organize a dancing event with this technology if losses do not get any bigger than they are with the seating rule. This is because the dancing has a substantial added value. Furthermore, with the product less security is needed to enforce distance, so that means less security costs for the music event organizer.

==Preferences==

* "The product should have an error rate of zero."

More sophisticated software modelling or physical modelling with a circuit could be done with having a test phase. However, because of other constraints such as time and cost limit, this is difficult to realize in 8 weeks.

*"The product should be user friendly"
The user friendliness of the product is very important, for the success of the product it is necessary for attendees to not be bothered by using our product. The product is an add-on to existing silent disco headphones and does not affect the comfort of the headphones or the ease of use.

*"The product should be waterproof"
Being waterproof would increase the scope of events where the product could be used. A waterproof system could be safely used in outdoor events also in rain.

==Constraints==

* "There are only 8 weeks to design a solution."

This project only lasts for 8 weeks. Since the second wave of COVID-19 appeared, it was harder to get feedback on the product from some stakeholders, as they have other emergent tasks to do. Also, there is a time limit to develop the entire software program and design a circuit.

* "COVID-19 law regarding holding an event"

For general events, it is mandatory for visitors to have a fixed seat. This needs to be changed to realize our business. Also, since there is a limit to the number of allowed people at an event, this should be considered when designing islands and estimating a profit.

* "The unpredictability of the COVID-19 crisis."

The package of measures against COVID-19 is continuously changing. On 30th September 2020, the Dutch government advised people to wear masks in a public space. However, it has been changed that it is mandatory to wear masks indoors since Wednesday 14 October. The end-date of the COVID-19 crisis is also undetermined and uncertain.

* "The purpose of using this headphone is mostly for music events."

The headphone's main function is tracking a distance with people. If it is a small indoor party consisting of 5 people, then it is difficult to use it considering the dance island's size. Because a length of 7.5 meters is needed for 2 circles including the social distance which is 1.5 meters. Also, if the festival is a type such that people do not listen to music, then it would not fit with the atmosphere by wearing headphones.

* "This team is not specialised in electrical or mechanical engineering."

The team members specialise in Computer Science, Psychology and Technology and Biomedical engineering. Therefore, designing concrete electrical circuits is difficult. Instead the choice of theoretical diagrams was made.

=Detailed description of idea=

In short, the idea is to have a silent disco with 'dance islands'. This dance island is a stationary circle of which the periphery of this island is indicated on the ground. The islands are positioned in the venue or festival terrain such that whilst being inside of this island the attendees assigned to that particular island are guaranteed to not come within 1.5 meters of people inside other islands. Dance islands are designed for two persons. Every attendee listens to the music through a pair of headphones just like in the preexisting silent disco systems. Our idea concerns an add-on to these headphones, the headphones are coupled to the reference point in the middle of the island. The distance between the headphones and the reference point is continuously measured. If this distance exceeds the radius of the circle, the wearer of the headphone is positioned outside of the island and therefore the music will be muted. This encourages visitors to stay inside of their island.

Of course, the attendee is permitted to leave the island to go to the bar or toilet, provided that he adheres to the walking routes. Security will enforce this. Attendees going to the toilet or bar pass the perimeter and the music through their headphones will be muted. When going to the toilet they can either leave their headphones at their island or hang them around their neck. This way security can recognize attendees heading for a drink or for the bathrooms.

In conclusion, this tool will focus on what happens on the islands and not on what happens outside. This is because music event organizers have already taken steps to manage the crowd outside of the circles, with for example security and premarked walking routes.

'''Number of people per island'''

There were conversations with multiple parties about the number of people per island. De Effenaar said they only sell 2-person tickets, but they have a few exceptions e.g. a cancelled concert that is scheduled later again. Because of limits to practical implementation de Effenaar is aiming at offering only 2-person tickets in the future. However, it would be of added value if they could sell group tickets for e.g. 4 or 6 people. The music venue said they cannot check whether groups saying they are a household are actually a household.

To see how food and beverage outlets handle 'fake households' and how they chose the number of people allowed per table, we asked a bar. They said they made sure there is always a place to keep enough distance and security enforces that people do not sit on each other's lap and that they keep seated.

In the catering industry in the Netherlands only people from the same household are allowed to be within less than 1.5 meters or of each other <ref name = 'Het coronavirus en de horeca en evenementen'>[Rijksoverheid, (n.d.). Het coronavirus en de horeca en evenementen, Rijksoverheid,

https://www.rijksoverheid.nl/onderwerpen/coronavirus-covid-19/ondernemers-en-bedrijven/horeca]</ref>

A group of 2 people cannot get a fine <ref name = 'Corona en regels voor afstand houden' >[Rijksoverheid, (n.d.). Corona en regels voor afstand houden, https://www.rijksoverheid.nl/onderwerpen/coronavirus-covid-19/openbaar-en-dagelijks-leven/afstand-houden]</ref and are actually allowed to sit at a table at a food or beverage outlet, as of May 2020 <ref name = 'Twee mensen mogen in horeca aan tafel binnen anderhalve meter zitten'>[NOS, 23-5-2020. Twee mensen mogen in horeca aan tafel binnen anderhalve meter zitten, https://nos.nl/artikel/2334838-twee-mensen-mogen-in-horeca-aan-tafel-binnen-anderhalve-meter-zitten.html]</ref>. For example, a boyfriend and girlfriend who do not form a household should be able to come close to each other. Every other group of 3 or more people that do not form a household needs to respect the distance rule of 1.5 meters. Of course, visitors could abuse this rule and a group of friends that do not form a household could say they are a household and then the food and beverage outlet cannot be held accountable for acceptance of the group. Therefore the terrain could be shaped to maximize the number of people, i.e. making multiple 6 person islands.

A music event organizer we spoke to said that most people that go to a music festival go there with their friends. Not with their household. We do not expect this to be different during COVID-19.

As the director of Koninklijke Horeca Nederland Dirk Beljaarts said (paraphrased): "do not go look for loopholes in the rules, because that could come back as a boomerang and then the food and beverage outlets get into trouble". <ref>[Misset Horeca, 19-5-2020. Mensen uit zelfde huishouden hoeven in horeca geen 1,5 meter afstand te bewaren, https://www.missethoreca.nl/horeca/nieuws/2020/05/mensen-uit-zelfde-huishouden-hoeven-in-horeca-geen-15-meter-afstand-te-houden-101335773]</ref>

Beijaarts makes a strong argument, it is important to act in a safe and moral way. The experiment can show what is possible with keeping safety in mind. When organizing the experiment, the event sector is being represented and it is undesirable to hurt the sector's reputation by acting in an unsafe and immoral way.

Allowing 6 people households while it is known that most people go to festivals with friends and not with their household is therefore not an option. Therefore it is not possible to organize the terrain such as the respondents of the second survey have said they wanted <ref name ='appendix'> [[Appendix_PRE2020_1_Group2]] </ref>. About 6% responded they want to visit in couples, 27% with 4 persons and the vast majority with 67% answered 6 persons. Although it

would be the most satisfying for the users, given the current rules it is irresponsible and unrealistic. Since we want to cooperate with the government, we do not want to consciously violate their rule, although it could be legally allowed.

Then there is also the issue of enforcement. Suppose 6-person groups are allowed. Then it is also harder for security to know who belongs to which group. It is for example permitted for 2 people who are not from the same household to have less than 1.5 meter distance <ref name = 'Corona en regels voor afstand houden' >[Rijksoverheid, (n.d.). Corona en regels voor afstand houden, https://www.rijksoverheid.nl/onderwerpen/coronavirus-covid-19/openbaar-en-dagelijks-leven/afstand-houden]</ref

This way it is easy for security to enforce the distance rule: if there are more than 2 people not respecting the 1.5 meter distance, then security can intervene. However, if groups of 6 people are allowed then how should security enforce this? Who belongs to which (self-declared) household? People could mingle up in different groups of 6 people and then security only has a more difficult job, while the opposite is desired: helping security with our product.

Therefore it is chosen to make only 2-person dance islands. Suppose families would be interested in these events or other currently unforeseen developments will happen, then it is always possible to scale up the number of islands in cooperation with the authorities.

'''Walkthrough'''

Now it is time to take a walkthrough to the practical execution of the product.

A guest arrives and his ticket is being scanned. He enters the building or the area and gets the headphones, after which he goes looking for his island. Before receiving the ticket, he pays a deposit for the headphone with our technology. The islands are separated with 1.5 meters in between. There are also pathways where guests can walk. These paths have signs showing directions, so that guests do not cross.

There is a reference point in the middle of the island. This reference point contains a sensor that measures the distance to the tracker that is attached to the headphone. The reference point is taped on the ground and attached to cables for power. The sensor cannot easily be destroyed when accidently stepping on the sensor. When a guest tries to remove the reference point, the reference point will not get any power and the music will stop. It will be communicated

beforehand to the guests that they are not allowed to remove the reference point and that they will not get the deposit back when trying to remove the reference point. This way staff can relatively easily remove it, while guests cannot, since they would be seen by security and get a warning to stop.

When everybody has been directed to their island the music starts. People start dancing and would like to have a drink. However, when attendees leave their island their music will stop. To minimize the time spent outside the island, the suggestion for using Airchip will be made to the music event organizer. This is an app for ordering drinks at a distance to avoid queues at the bar.

When the drink is ready and there are no people waiting at the bar before him, the guest gets a notification on his phone to pick up the drinks. The guest steps outside his circle and stops hearing any sound on his headphones. He will walk on the one-way pathways to the bar and pick up his drinks there. He walks back and as soon as he steps into the island, he starts hearing music again.

A suggestion for the music event organizer would be to install a big green or red light near the toilets. The light is green when there are toilets available and the light is red when all toilets are occupied.

When the music event ends, the music will stop. Guests put off their headphones and personnel will collect the headphone at the island and give the deposit back. The personnel going to the islands prevent a queue at the exit.

'''Terrain map'''

[[File:Exp sketch v2.jpg|600px]]

Above is a picture of how the terrain could look like. There will be dance islands with a diameter of 3 meters. This way 2 persons can dance freely in their dance islands. A suggestion for the music event organizer is to use (luminous) tape or spray to indicate the circle. At the two places where guests are allowed to enter their dance island the name of their island is marked on the ground (e.g. A1 on the top and left pathway). A decision has been made to group the dance islands in groups of 4 with 1.5 meters in between the islands to save space. In between the groups of islands there will be 3 meter pathways to make sure people are guaranteed to have 1.5 meters distance.

=Detailed description of the technical aspects=

Distance measurement

It is needed to be able to measure the distance between each headphone and the center of the island that the headphone belongs to. To accomplish this Ultra WideBand (UWB) transceiver will be used, one on every headphone and island center. Using ultra wideband to measure distance can lead to an accuracy of around 10 cm, UWB also will not suffer from interference from the FM system already used by the silent disco system to transmit music. <ref>Yang, JingYi & Yan, Ming. (2018). Implementation of UWB indoor location and distance measurement based on TOF algorithm. MATEC Web of Conferences. 173. 03018. 10.1051/matecconf/201817303018. </ref> Multiple ways of measuring the distance exist, the two that would make sense for our use case are by measuring the time of arrival or the round trip time of a transmission between a headphone and the island center.<ref>[Hossain, Iqbal & Minhas Talat (2012). Distance Measurement Using Ultra Wideband.]</ref> From this time the distance between the two can be calculated, since the propagation time of transmission through the air is a constant. To measure the time of arrival, one transceiver would transmit to all headphones the time of transmission, each headphone would compare this to the time of arrival. Such calculation would require a synchronized clock between the two which is not available in our case. Thus calculating the round trip time: the headphones poll the island sensor to which the island's center responds. By comparing the time from the transmission of the poll request and the island's center response, the RTT and thus the distance to the island's center can be calculated. If no response is received from the island within a certain threshold it is possible to assume that the headphone is too far away and thus still outside of the boundaries of the island. RTT measuring introduces more room for error however due to the time taken to handle a message weighing twice as much when compared to TOA measuring. Controlling this process and performing the computations necessary can be done by a microcontroller, of which the ATmega328 is the model assumed here.

[[File:SequenceDiagram1.png|800px|thumb|left|Sequence diagram depicting communication for distance measurement.]]

There are multiple headphones to each island and multiple islands to each event. It is therefore necessary that a headphone sensor's poll request is responded to by the right island's sensor and that an island sensor's poll acknowledgement is also handled by the correct headphone sensor. Therefore each island and headphone should be identifiable by a unique identifying number. Polling requests will be accompanied by the sending headphone's ID and the accompanying island's ID, the same holds for polling acknowledgements. A device will only handle a received transmission if their ID matches up to the ID in a transmission, be it a headphone listening for an acknowledgement or an island's center listening for a polling request. Therefore it is ensured that communication between sensors is only between the intended sensors, it can't happen that the wrong island responds to a polling request or that a polling acknowledgement is handled by the wrong headphone.

[[File:ClassDiagram.png|600px|thumb|left|Class diagram]]

Headphone Behavior

The headphone has only two real states, silent or playing music. How this state is decided is depicted in the following State Diagram.

[[File:StateDiagram.png|400px|thumb|left|State diagram for headphones]]

The sequence of activities for a headphone between turning on and turning off is depicted in the following activity diagram. Firstly the device will boot up, the program will be loaded and sensors started up, after this the headphone must be paired to an island beacon. After the headphone is paired it will continuously measure the distance to the island beacon, depending on the result of this measurement the music will be either turned on or off. The headphone will endlessly loop until it is turned off.

[[File:ActivityDiagram.png|800px|thumb|left|Activity diagram depicting headphone's behaviour]]

Battery Life

Due to the nature of the product, it is being used whilst moving around, albeit limited to within an island and being an attachment to existing headphones. Our solution must be powered by battery, being powered by the same battery as the headphones is the most practical way to accomplish this. The power drain of our solution must therefore not be high enough to diminish the battery life of a headphone to the point where it is unusable for events. Following is an estimation of the impact our addition will have on a headphone's battery life. The RF-309 headphones on which our addition is based contains a 500mAh lipo battery, which gives for a battery life of up to 10 hours, therefore the headphone is estimated to have around a 50mA current draw.

The microcontroller used to control our solution has two main modes, active and idle mode with a current consumption of approximately 1.5 mA and 0.25 mA respectively.<ref>Atmel, ATmega328 datasheet, retrieved from:https://ww1.microchip.com/downloads/en/DeviceDoc/Atmel-7810-Automotive-Microcontrollers-ATmega328P_Datasheet.pdf</ref> Depending on if the headphone is communicating with the beacon or not it is in one of those modes. Without testing providing a definite estimation of what percentage of usage time will be spent in idle mode is not possible. However, whatever this percentage is, it is insignificant compared to the headphones that the impact on battery life is not significant.

The UWB transceiver used to communicate with the beacon also has multiple modes, a sleep mode with a 550 nA current consumption and an idle mode with a 13.4 mA current consumption. Again being used whilst not communicating and whilst communicating respectively. Here the percentage of time spent in active mode is more relevant. <ref>Decawave, DWM1000 Datasheet, retrieved from:https://www.decawave.com/sites/default/files/resources/dwm1000-datasheet-v1.3.pdf

</ref> However, as no meaningful estimate can be provided the worst case will be assumed which is that the chips are in active mode 100% of the time. In this case the power draw is thus approximately 65 mA, which results in a battery life of approximately 7 hours and 41 minutes. Enough to be used for the duration of an event.

=Input from stakeholders=

This section will deal with the feedback that was received from all stakeholders on the dance island idea.

First of all, the most direct users of the product are guests at festivals and concerts. In a first survey amongst adolescents, it was found that it is often possible to keep sufficient distance to other attendees at events during COVID-19. However, the majority confessed that they usually do not actively and consciously keep distance from others. Therefore, it was also asked whether they would feel comfortable being tracked. 75% of the respondents answered that they would find tracking a good idea if it would enable them to dance and move freely. In the second survey, the concrete plan was presented to the adolescents. Approximately 80% of the respondents would like to attend an event at which you can move freely while your movements are tracked by your headphones if this allows for dancing. Moreover, they agreed that pausing the music would absolutely encourage them to remain in their circle. Finally, usage of this technology means extra costs for the music event organization, which will probably be partly compensated by raising the ticket prizes. Therefore, it was asked to attendees whether they would be willing to pay an extra 5 to 10 euros for enabling dancing events in COVID-19 times. 70% of the respondents answered that this would not be a problem for them.

Secondly, a second group of stakeholders for whom a lot is at stake is the music event organizers. The concrete plan was sent to a lot of music event organizers and other music event hosters. Although all these companies were extremely busy with the new measures and their consequences, we received some valuable input. Many reacted that the current situation obviously does not even allow for any events, which makes it hard to imagine how this plan would work out in practice.
Firstly, all parties reacted enthusiastically. They long for dancing events! If it works well and everything is approved by all authorities, many said that they would be open to try it.
Another frequent reaction from the organizers was that it has to be affordable. The organizers have to deal with more costs and working hours. In the business plan it will be explained how to make events with this tool viable.
Thirdly, a music event organization addressed a problem that must be paid attention to: in an earlier version of the idea the dance islands were designed for 2, 4 or 6 people from one household. A music event organizer confirmed that groups that attend festivals are rarely from the same household. In the catering industry the same problem dominated over these past months. There are many groups of friends, who do not live together, that fake that they are from the same household. The catering industry is not allowed to check this and this is thus tolerated. Moreover, it is not their responsibility, but of the customer. What a table at a restaurant

distinguishes from a dance island is that it is possible to keep 1.5 meters distance at a table (if you report this in advance when making a reservation), which is not the case on a dance island. The dance islands are designed in such a way to simulate a music event environment; there is enough space to move freely, but not to keep sufficient distance. To this end, it is important that all island-members are from the same household. It would be morally unjustified to stimulate friends to forge into being housemates. On top of that, if the measures allow friends to go to festivals together without keeping 1.5 meter distance this gadget is obviously useless. Based on this input, it was decided to reduce the maximum number of people for an island to 2 instead of 6.

Thirdly, the direct customers of the hypothetical company are the headphones rental companies. Via phone calls and email correspondence the feasibility of the proposed solution was discussed. The implementation of the product would come at an additional cost almost doubling the prize of the base headphones. Even with this cost however our modification is still generally seen as worth it. If the modified headphones are actually necessary for holding dancing events and widely accepted by both users and stakeholders, the demand for the headphones would be significant enough to make the additional cost worth it. Some of these additional costs must however be carried over into an increased rental cost for the music event organizers, which might have consequences for the ticket prices. It would also help greatly if our modification of the headphones could be undone as soon as the COVID-19 crisis is over. If the headphones could be restored to their original functionality the risk would be significantly smaller for the rental companies. This could also relieve the financial strain due to the sensors used in our solution still keeping a percentage of their value. In conclusion, if governmental parties would be willing to tolerate dancing events with the headphones with trackers and there would be a demand for such parties among customers, then headphone rental companies have faith in the feasibility of the product.

Before this product could be introduced on the market, it must be approved by several governmental parties. We contacted the municipality of Eindhoven, the KVK Coronaloket, the safety region of Brabant Zuidoost, the RIVM and the following political parties: VVD, D66, CDA, Groenlinks, PvdA and the SP. They all had the same message: they appreciate it that we are looking into innovative solutions to help the event sector and its customers. Furthermore, they noticed that the idea looked solid. However, all said that they could not promise anything due to the unpredictability of the infectious virus. For instance, we asked the municipality whether an experiment could be conducted in Eindhoven when the virus is under control. They could not promise us anything because of the uncertainty and their dependency on other parties, such as the safety regions and RIVM. However, we are confident that an experiment will be allowed as soon as measures are loosened and that this will contribute to persuading the right parties to abolish the seating rule. Finally, it was hard to find out which parties exactly should approve our tool as all of them gave us the runaround.

Lastly, research was done into investments. Several potential investors, such as Brabant startup fonds and investors at the TU/e, were approached to ask them whether they would hypothetically be interested in investing in this product. Moreover, information was collected on

(corona) start-up challenges. Unfortunately, hardly no reaction was received from these parties. Therefore, it is decided that the first investment will come from the company founders themselves and it is assumed that after a successful experiment it would be easier to find investors.

=Further considerations=

The development of this product requires some more depthly thinking about the pros and cons of this technology and about possible problems that might come up when implementing it.

The advantages for the users have been described above. The social distancing gadget will make standing events possible again in times in which COVID-19 is amongst us, which means that customers can have entertainment, while music event organizers and artists profit from this.

Not only the advantages, but also the ethical disadvantages must be paid attention to. Obviously, this tool only gives the desired result if every visitor on the terrain carries a headphone. As a consequence, each visitor must remain within his or her circle as much as possible. This means that someone who does not want to be monitored all the time, cannot be admitted to the festival terrain. So customers have no choice but to compromise on wearing this gadget, otherwise they will be excluded from the event. It can be argued that this is not entirely ethically neat. However, this would be the only way to make (dancing) events fully corona-proof (with of course extra measures for hygiene). Therefore, from the current situation in which dancing is not possible at all, this tool improves the situation by making dancing possible again for people who are willing to be monitored. The second survey shows that more than 3 out of 4 respondents are willing to wear headphones that monitor their movement. <ref name =’appendix’> [[Appendix_PRE2020_1_Group2]] </ref>

Besides the ethical considerations, some practical things must also be paid attention to.

Firstly, how to make sure that attendees do not switch headphones and this way switch islands? The goal of the dance islands and the distance in between these islands is that households do not mix up. All headphones are coupled to a specific reference point. This way it can be verified at the exit whether you have the right headphones. By asking a deposit of 10 euros at the entrance and checking whether the right headphone is handed in, switching headphones will hopefully be reduced. Furthermore, security will of course keep an eye on the headphones and will intervene if they see attendees exchange headphones.

Also to make sure that customers do not remove the tracker, it will be assembled in the headphones. When going to a music event the user wants to hear the music so the tracker will be part of the deal. The expectation is that attendees will not mess with their headphones as they risk losing their music. Also, another one is that the tracker on the headphones will give a less anxious feeling of 'Big Brother is watching you' compared to the tracker being around your

wrist, as you can take off your headphones when going to the bar or toilet. The deposit that is charged on the headphones will also restrain tampering with the tracker.

Moreover, the reference point in the middle of the island should also not be easily tampered with. This issue is fixed, since removing the reference point means it would not get power and therefore the user will not hear music again.

Regarding the enforcement of the distance at the pathways: in the Walkthrough section some suggestions are made to prevent queue forming at the bar and toilet. However this product focuses on making sure that enough distance is kept between dance islands while dancing. Security is still needed to enforce distance outside the dance islands.

Taking the scale of events organized with our product in consideration: suppose that the experiment is successful, the seating rule gets abolished when using our product and the business is going great. Then a next step could be to scale up events. Possibly to change the maximum number of people that are allowed at events.

However, it is first needed to change the seating rule. If the seating rule cannot be changed then it could be an option to talk with governments in other countries and see if it is possible to operate there. Also if the product would be successful in the Netherlands, it is still possible to go abroad.

Taking one step back. Before changing the seating rule, permission from the local authorities is needed to organize the experiment. At the moment of writing, October 2020, it remains unclear when this is possible again. Therefore it could again be an option to get permission in another country. Furthermore, at the lowest risk level, the seating rule does not apply. <ref name = 'Routekaart coronamaatregelen'>[Rijksoverheid (n.d.). Routekaart coronamaatregelen, https://www.rijksoverheid.nl/documenten/publicaties/2020/10/13/risiconiveaus-en-maatregelen-covid-19]</ref> However, we want to make sure our product is possible at the three lowest risk levels (watch full, worrisome and serious)

To conduct the experiment an music event organizer is needed. We had contact with several music venues and music event organizations and they were very enthusiastic. However, we did not get any final approval, since they first want to know whether permission will be granted from the local authorities. Therefore, it should be arranged to get an music event organizer to organize the event with our product.

=Experiment plan=

Make dancing possible again. That is the goal, but how to achieve that? Currently it is mandatory for food and beverage occasions to assign the guest to a fixed seat at a table or at

the bar <ref name = 'Het coronavirus en de horeca en evenementen'>[Rijksoverheid, (n.d.). Het coronavirus en de horeca en evenementen, Rijksoverheid, https://www.rijksoverheid.nl/onderwerpen/coronavirus-covid-19/ondernemers-en-bedrijven/horeca]</ref>

. This also includes music venues and festivals. By conducting an experiment it is desirable to show the Dutch government that using our product it is possible to safely dance at music venues and festivals again and convince the government to change the seating rule.

==Getting permission==

To organize the experiment, we need an exemption from the municipality. We contacted multiple parties: the municipality of Eindhoven (Gemeente Eindhoven), the safety region of the southeast of Noord-Brabant (Veiligheidsregio Brabant Zuidoost, VRBZO) and the Dutch government (Rijksoverheid). The VRBZO told us we need to get an exemption of the emergency ordinance from the municipality, but with the stricter measures that were introduced on the 13th of October by the Dutch government <ref>[Rijksoverheid, 13-10-2020. Gedeeltelijke lockdown om besmettingen terug te dringen, https://www.rijksoverheid.nl/onderwerpen/coronavirus-covid-19/nieuws/2020/10/13/gedeeltelijke-lockdown-om-besmettingen-terug-te-dringen]</ref> it became impossible to get such an exemption. By the measures that were announced on the 13th of October all food and beverage outlets had to close and all events were forbidden.

When the measures will be loosened such that events are allowed again, the municipality might give an exemption to the emergency ordinance. Unfortunately nobody knows when the measures will be loosened and we did not get an answer to what the exact criteria are to get such an exemption. However, Finally Fiesta, a festival with fixed seats where dancing near the seat was possible, received an exemption from the municipality of Alkmaar. With our product we think it is possible to organize music events in a more safe and responsible way than Finally Fiesta. Therefore it is realistic to think this experiment will get permission as well.

Our initial plan was to organize a small dancing event (with a maximum of 200 people) at a music venue or an outdoor location. The exact number of attendees could be aligned with the municipality. Furthermore, an agreement with an music event organizer is needed to perform the experiment at their terrain. Due to the strict measures a music venue we talked to said they first wanted to know what the municipality says before they commit to the experiment.

==Hypothesis==

As can be seen in the results from the survey <ref name ='appendix'> [[Appendix_PRE2020_1_Group2]] </ref> 17 out of 21 attendees that went to an event during COVID-19 could keep sufficient distance to other attendees. However, only 5 out 21

respondents said they actually actively keep this distance. It was concluded from this that just common sense is not enough to make sure that attendees stay at a safe distance and that extra extra measures are necessary at a festival terrain. The results from the survey also showed that attendees are willing to wear headphones that track their movement if that makes dancing possible. Additionally, respondents endorse that they will be stimulated to stay in their circles if the music will be paused when crossing the lines. From the input that was received from attendees and stakeholders it became clear that it has appeared to be very complicated for attendees to follow the signing and to respect the distancing rules at toilets and bars. Therefore, the following hypothesis is formulated:

Participants will stay on their dance islands, except when they want a drink or need to go to the toilet. It is expected that participants will violate the walking routes and have a hard time keeping sufficient distance from other households outside of the islands on the pathways and at the bar and toilets.

==Discussion==

A disadvantage of this experiment is that it is a controlled environment. Because of safety, it is prefered to have more security available, but then people might start behaving differently. Also the average person that is willing to participate in this experiment might behave differently than the average person that will visit events with our technology in the future.

'''What will be done with the outcomes of the experiment?'''

If the experiment would actually take place, then the outcomes will be shared and evaluated with the music event organizer, the municipality of Eindhoven and safety region Brabant Zuid-Oost. If everything went right and the attendees and local authorities are satisfied, these results will be used to introduce the product nationally to the academic world and the music venue and festival industry. Depending on their reaction, it will be proposed to the government to allow standing events with this product.

=Business plan=

==Executive Summary==
===Opportunity===

====Problem Summary====

There are three problems that silent disco rental companies face that we could help with. We would make dancing possible again at a music event. Also, we deal with the financial part of those companies. Lastly, we deal with the COVID-19 regulation problem of a music event that has been enforced by the government.

====Solution Summary====

Social DistDancing is our company name created by 5 students. We make sure that people keep the distance by assigning two people in a circle, called a dance island so that the circle can be 1.5 meters away from other circles. Also, we deal with the uncertainty regarding COVID-19 by making sure that our add-on(extra sensors) on the headphones can be undone. And, we conducted interviews with authorities and music event organizers and did surveys with users.

====Why Us?====

Social DistDancing has considered both the technical part of our product and the human factor which can affect the user-friendliness. The technical part is done by specific diagrams aided by research on sensors. And the practical implications have been researched through multiple interviews, conversations and surveys. Also, our ultimate ambition is to see when people can relish dancing at a music event place again which brings a positive effect on their mental health as well. <ref>[Lakes, K. D., Marvin, S., Rowley, J., Nicolas, M. S., Arastoo, S., Viray, L., Orozco, A., & Jurnak, F. (2016). Dancer perceptions of the cognitive, social, emotional, and physical benefits of modern styles of partnered dancing. Complementary therapies in medicine, 26, 117–122. https://doi.org/10.1016/j.ctim.2016.03.007]</ref>And this desire leads to the competent development of our product.

===Expectations===

====Forecast====

A region's risk level is determined by the government, GGD, RIVM and safety regions.<ref>[Dashboard Coronavirus COVID-19: Government.nl. (n.d.). Retrieved from https://coronadashboard.government.nl/]</ref> Currently, the risk level of COVID-19 varies from level 2 to level 4. Once this risk level is decreased to level 1 or 2 and the regulation on COVID-19 is loosened, Social DistDancing plans to rent this technology out to customers. Yet, we will aim to perform a test phase from January in 2021, if the COVID-19 crisis allows this. During this test phase, Social DistDancing could gain extra assessments from music event visitors or our customers and adjust details for an actual demonstration in May or June. We aim to sell our idea to headphone rental companies. Also, if COVID-19 is over that is when we are not obliged to keep 1.5 meters from each other, Social DistDancing gives an option for our customer to detach sensors from the headphone. And then sell the sensors or rent the headphones as before. So there would not be much loss for all involved parties.

==Opportunity==

Problem & Solution
Problem Worth Solving

In the problem summary section, three problems are briefly mentioned that we would solve for our customers.

The first problem is making the dancing activity possible again at a music event. To achieve this goal, our company must solve how to make dancing possible while following the government's guideline on COVID-19, specifically sticking to social distancing. Moreover, we should design our product such that people can use it in a natural atmosphere while respecting social distancing.

The second one is dealing with a financial part of business stakeholders. To compensate for the loss caused by COVID-19, Social DistDancing would like to offer this product so that headphone rental companies could expect a profit by renting it to music festivals. Although the net profit including the loss of the headphone rental companies might be lower than their goals, it has an added value by using our product.The added value is such that vitalizing a music event by making dancing possible in the long term. Also, we would like to work on the uncertainty problem of this business when COVID-19 is over. That is when the attached sensors of the headphone become not desired anymore.

The last one is resolving the regulation of the government on a music event. As the second wave of COVID-19 has appeared, the decision has been tightly made that it is not possible to host public music events in general in the Netherlands.

Our Solution

Our solution for solving the problem is as follows. For a detailed solution, please have a look at the Detailed description of the idea and Detailed description of the technical aspects on Tu/e wiki page, PRE2020 1 Group 2. We first create dance islands with a diameter of 3 meters and assign two people on the same island. The sizes of the dance islands would be big enough considering the minimum dancing movement range which is 0.5 - 0.9 square meters<ref>[Retrieved from https://www.greatmats.com/how-big-of-a-dance-floor-do-i-need.php]</ref>. A distance of 1.5 meters will be maintained between islands. But a guest does not need to keep a distance inside the island because we assume people from the same group are from the same household. The distance of a headphone from this beacon is constantly measured. When a person goes out of the circle, then the ultra-wideband sensor (UWB) inside the headphone and the beacon would recognize that and send a warning to the staff. In this case, the uniqueness of our product would be scalability and an ability to restrict the behaviour of the crowd in a natural way. Since we will know how many people would come as a group and already know the size of dancing islands, it is handy to fit the size in the area of any festival venues. Also, if we would allow guests as an individual without assigning them on an island, it would be difficult to control their behaviours.<ref>[Doukas, S.G. (2006). Crowd management: past and contemporary issues. The sport journal, 9.]</ref> And they would feel less responsibility to keep the distance with each other.

In order to reduce the expenses of our customers, Social DistDancing would like to adapt our technology to the original headphones of rental companies instead of making our own headphones. Also, we deal with uncertainty. That is the uncertainty coming from when silent disco headphones rental companies do not need the extra sensors such as UWB anymore after COVID-19 is diminished or disappeared. So that people are not obliged to keep social distancing. In this case, we make sure that our extra sensors on the headphones can be undone. There are two options then. First, the companies could keep those sensors just in case there might be a third or fourth wave in the future within 5 years. The other option is selling those sensors. Regardless of those options, Social DistDancing uses sensors with proper quality from original manufactures. In this way, customers could re-use or sell them and do not dissipate the cost.

Furthermore, in order to deal with the regulation problem on a music event, Social DistDancing has conducted interviews and contacted people who are related to opening festivals such as organizers and authorities. Also, we did several surveys to meet the music event visitor's needs as well. For a detailed response, please have a look at the section Stakeholders and Input from stakeholders on Tu/e wiki page, PRE2020 1 Group 2.

===Target Market===

====Market====

Our main target customers are silent disco headphone rental companies in the Netherlands. There are around 70 companies. Also, the median of the revenue is $506,000. However, the detailed explanation is as follows.

====Market Size & Segments====

Our main target customer is a silent disco headphone rental company in the Netherlands. Social DistDancing first would like to sell our technology in the Netherlands, and then expand our business range to a global market once the size of the business gets bigger.

The size of music events using headphones is huge in the Netherlands. One example that can show the number of demands of headphones is the Lowlands festival. This is the world's biggest silent disco. With the number of headphones supplied, there have been 10000 headphones in 2017, 20000 headphones in 2018 and 30000 headphones in 2019. <ref>[World's biggest silent disco hits 30,000 headphones. (2019, December 10). Retrieved from https://avmanagement.net/worlds-biggest-silent-disco-hits-30000-headphones/]</ref>

Also, Social DistDancing has searched the number of headphone rental service companies to figure out the market size in the Netherlands. There are approximately 63 headphone rental service companies in the Netherlands. Doing research on the revenue of this industry was done by a specific business website. <ref>[Hit Your Number. (n.d.). Retrieved from https://www.zoominfo.com/]</ref> The range of research has been done by 8 silent disco organizer/rental companies where 1 company is in the Netherlands, others are in Australia and

the UK. There was a limit to know the revenue of large samples. Therefore, Social DistDancing included research about other countries' cases as well. The revenue varies from $192,000 to $5 Million. With the population size of 8, the median is calculated as $506,000.

===Competition===
====Current Alternatives====

There are four alternatives to our product.
1) A coronaproof party suit with a helmet
2) A wristband that detects a distance to other people and gives a signal
3) A platform
4) A table with fixed seats

First there is Micrashell. This is a coronaproof party suit with a helmet.<ref>[Micrashell. (2020, September 18). Retrieved from https://production.club/micrashell]</ref> This product is equipped with LED, sensors, speaker, camera and resonator system.
Secondly there is a wristband that can detect a distance and give a signal.<ref>[Social Distancing Wristband Wearables. (2020, August 06). Retrieved from https://www.mokosmart.com/social-distancing-wristband-wearables/?gclid=CjwKCAjwzvX7BRA eEiwAsXExo0NsgyjpCwymgNDEFtRBbO64tVZ21_XGuItvGrKc-N9fIjrnqjx98hoC994QAvD_BwE]</ref>

Thirdly there is a platform where 5 people from the same household can go on.<ref>[Virgin Money Unity Arena. (n.d.). Retrieved from https://virginmoneyunityarena.com/]</ref> And the distance between platforms is 6 feet which are approximately 1.8 meters. This was implemented in August at Virgin Money Unity Arena in Newcastle of England. And 2500 tickets were sold out in minutes.

Lastly, there is the table with fixed seats. According to Dutch regulations it is allowed to organize a small scale festival where every visitor has a fixed seat where he/she can eat and drink and where the visitor is allowed to dance next to the table. Finally Fiesta, a festival that took place on the weekend of 7 till 9 August 2020 in Alkmaar, is an example of this option. There were two shifts per day with 250 people per shift. That meant a total of 1500 tickets were sold. <ref>[3voor12, 10-8-2020. Hoe organiseer je legaal een coronaproof feest?https://3voor12.vpro.nl/artikelen/overzicht/2020/augustus/Alkmaar-coronaproof-dansen-fe stival-finally-fiesta.html]</ref>.

[[File:Finally-Fiesta-23.jpg|400px|thumb|left|The Finally Fiesta event <ref>[Partyflock (n.d.). Finally Fiesta, https://photo.partyflock.nl/970417/main/Finally-Fiesta-23.jpg]</ref>]]

"We have three meter pathways with one-way traffic", Mechielsen said. The tables are at least 1.5 meters apart and in between the tables people can walk to go to the toilet or the bar.

====Our Advantages====

Social DistDancing would like to introduce our advantages to each alternative.

Micrashell has equipped several sensors, cameras and some technology systems. For a good quality camera and speaker, it would already cost a lot of money for only one suit. Our product is more cost-effective since Social DistDancing only needs one external sensor on an existing headphone. Also, Social DistDancing would assume wearing the suit would not be user friendly since there are some statistics that people who find wearing a mask is already burdensome. <ref>[Vargas, E. D., & Sanchez, G. R. (2020, August 31). American individualism is an obstacle to wider mask-wearing in the US. Retrieved from https://www.brookings.edu/blog/up-front/2020/08/31/american-individualism-is-an-obstacle-to-wider-mask-wearing-in-the-us/Figure 1]</ref>Although the research is limited to Americans, Social DistDancing could assume it happens to the Netherlands.

The wristband would not be ideal for a festival. There are two reasons. First, people tend to lose control of their behaviors more in a bigger crowd than a smaller sized group. Our product has subgroups inside the crowd which leads to better control on people to make them keep the distance. The last reason is people can easily ignore the subtle LED/vibration/sound indication in a noisy environment and that indication comes out when they do not keep the distance.<ref>[Tronstad TV, Gelderblom FB. Sound exposure during outdoor music festivals. Noise Health. 2016;18(83):220-228. doi:10.4103/1463-1741.189245]</ref> Our product makes use of a headphone which enables a natural controlling on people by stopping the music.

The platform would not be ideal for a bigger scaled festival or indoor music event. If the festival is on a huge scale, then people who are far away from the stage would not enjoy the music as the people who are close to the stage. Also, there are way fewer people for an indoor music event unless it is an exceptionally huge dome or arena.Furthermore, one of the music venues we talked to, the company has to hire people to build up the platform for those fewer people and it might be take a lot of time and manpower to build the platform and reuse the material. With these advantages over those three alternatives, Social DistDancing believes our product is strongly competitive.

Social DistDancing is also better than the option with a table and fixed seats. People at a music festival like to have fun and do not want to constantly check whether they are close to their table. They can easily forget when they are having a good time. Finally Fiesta hired ladies with water guns that sprayed visitors when they did not respect the distance rule. They also spoke to visitors in a "playful" way with 4 volunteers and 2 security guards. In the evening there were 4 extra security guards, organizer Mechielsen says. With our product, the guests do not have to constantly think about the distance and less security or volunteers are needed. Our product does that job for them!

Execution

Marketing & Sales

As defined above our target market is rental companies of silent disco headphones. To reach those companies advertisement needs to be done. This can be done in various ways, for example via mailing the companies ourselves. Social DistDancing will try to contact many companies who rent out these headphones, tell them about the idea Social DistDancing has and try to convince them of the goal the company aims for. This is possible because there are around 70 rental companies, so this can easily be done via email. These marketing campaigns will be directed to the companies that are in this business. Furthermore, when the company is launched Social DistDancing also assumes that word-of-mouth marketing will take place in this branch. By conducting the experiment, Social DistDancing will also get publicity on the news for example.

At the end of the line the event sector will use our product the most. When the event branch likes the idea, which Social DistDancing already has received some feedback on, they will probably order more Social DistDancing headphones which ultimately leads to more sales for us. The music event branch wants to organize events again, this is seen in multiple stakeholder interviews. So, the music event branch will demand the Social DistDancing products from the rental companies. As can be imagined this will likely increase the chance that rental companies want to do business with Social DistDancing.

Position of our company

The COVID-19 crisis started in the beginning of March in 2020. In the Netherlands events are only allowed when the visitors have a fixed seat assigned. Social DistDancing wants to change this in making dancing allowed and manageable for the organizers. So, the market Social DistDancing operates in is fairly new, which gives the company a good position in the market. We are the first company with this idea which also increases the position of the company. As stated in the competition part our product has many advantages over the alternatives. The goal of the company is to launch as fast as possible, our aim is to launch our company in the beginning of May. The research and test phase should be finished by then. The COVID-19 crisis is an uncertain time. How long it stays is uncertain and to reduce the risk it is important to launch as early as possible.

Pricing

The normal price margin for normal growth is around 5%. However, the aim is to go higher with our price margin. This is preferable for a company like us because

Social DistDancing is a "hype company". Meaning that Social DistDancing will rise fast and sadly die out when the covid-19 crisis is solved. To maintain enough profit the prices will be higher than the normal 5% on the costs. The profit margin Social DistDancing will use is 15%. This is possible because the company is one of a kind in its field. As explained in the sections, competition and position of the company, we have a stronger position than an average company. Rental companies already responded well to our design and although the costs for them would be high they responded that the investment is worth it for them. This foreshadows a good future for the company. More detail about the exact prices can be found in the financial plan at the end of the business plan.

Public relations

As a team from Eindhoven University of Technology, Social DistDancing benefits from being in a great position. Companies are more inclined to talk to us due to the fact that our university is a well known establishment in the Netherlands. It is easier to get a prominent review from professors who are well known in the scientific world as well. This can strengthen our position in the market if we get approval of a university as ours. Furthermore, contact with the event branch and rental companies is already made. Many responded enthusiastically about the idea. These relationships are good for the company, they could be our test cases to find out if this is a healthy business and that the company can make profit selling these tracking devices to the rental companies. This can all be done before the big launch resulting in lowering the risk of losing capital.

Operations

In the startup phase of the company we will do as much as possible ourselves. Social DistDancing can rent a van from one of the owners and will deliver the products ourselves in the startup phase. Later on we might want to outsource the delivering service. Same goes for storage, when the company grows bigger it is possible to rent a warehouse.

Sourcing and fulfillment

The individual components will be sent to SocialDistDancing from various places around the world. There are three main companies where the components will come from. The sensor DWM1000 will be bought from semiconductorstore.com. Furthermore, the microprocessor will be bought from the company AVNET. The assembly of the parts will be done by PCBcart. The assembly of the product to the headphone will be done by us. These companies are trustworthy and quality of the components are guaranteed. The products can be bought in bulk which lowers the price. However, first the precise demand needs to be established and a test phase must be held to establish this.

Technology

The product is an add-on device for silent disco headphones to track attendees of an event. The silent disco headphone that is used the most is the RF-309 Headphone. The events could differ from large events to small events and outdoor to indoor. The technique is scalable so when the terrain is large enough more islands can be made. The technique measures the distance from a reference point, this is called the beacon. This measurement is done via ultrawideband which is accurate enough to measure the distance that Social DistDancing prefers, scalable for short distances. The processing of the data is done by an ATMEGA328. This is a small microprocessor meaning that it can be hidden nicely on the side of the headphone. These two ultra wideband sensors, one at the beacon and one on the headphone, the receiver, will continuously communicate with each other measuring the distance from the beacon to the headphone. When a visitor of the event exits his or her area the music will be paused at the headphone. The visitor can resume listening to the music only when he or she returns to the area he or she should be in. The microprocessor will give a signal and short circuit the music, this will result in pausing the music. The idea is that visitors are actively reminded to adhere to the rules. The rules, being, staying in your designated area. When investors want more details on how it works exactly they can contact us. When both parties come to an agreement the technique can be explained more in detail. At this moment the precise working is company secret.

Milestones

The major milestone is to start testing the product by conducting the experiment as soon as possible January if the COVID-19 crisis allows this. The test phase will then start to establish if the product will work in a real life setting. The aim to start on a larger scale is in the beginning of May. When, in the process, Social DistDancing finds out this can be realized earlier this deadline will be moved forward. Social DistDancing wants to be ready before the festival season begins so we can utilize this season the most.

Other notable milestones are finding investors and the first rental company who wants to work with us. After mailing a lot of rental companies, the first potential customers are already found. This is already a great milestone for the company because tests can already be done to find out how profitable this will tend to be. Furthermore, participating in innovation challenges and winning them are milestones the company is hoping for. To get more investments winning prize money is a goal.

Key Metrics

The key metric that will be followed is how much profit there will be made per year. Another key metric is how many companies Social DistDancing is working with. It is a good measurement to see how healthy the company is. The aim is to order in two batches from the manufacturers.

First for the test phase, where we can establish how healthy the company is and how well the technology works. In the second phase a large amount of components will be ordered. From the test phase it is predicted how many components are needed to get the company through the spring and summer season, for now this is assumed to be 2000 headphones. In the spring and summer most of the events, in a year, are held. That is why Social DistDancing choses to launch at that moment. There could be a third phase when the COVID-19 crisis is not over yet. If this is the case the second phase will be repeated until the crisis is over. The technique is usable outdoors and also indoors. So, in the winter the company can continue selling the products.

Key assumptions and risks

The biggest assumption the company takes is also the biggest risk. It is about the COVID-19 crisis. The company is based on this crisis and the problem that there is no good alternative to organize events where dancing is allowed. So, there was an assumption made that the crisis stays for at least until the end of the summer of 2021. The risk that comes with that is that Social DistDancing can never be certain if this would be the case, the future cannot be predicted. So, when the crisis stops before the beginning of May our company will have no market resulting in not being able to sell the product. The costs that are at that moment already made are dependent on when the crisis ends. If the crisis ends early on in December the loss will be minimal, the test phase has not even been started at that point. However, if the pandemic stops just before May the loss will be bigger, the components are already ordered and assembled.

The second assumption that Social DistDancing made is the fact that the government will not allow large events where the distance rule does not apply. We assume this will be banned until the end of the summer of 2021. If the 1.5-meter rule is abolished then the product will no longer be of use. However, it is assumed that in the spring of 2021 larger groups can attend events but still need to keep 1.5 meters distance from each other.

The third assumption is that the authorities will approve our experiment and will change the seating rule in case people can safely dance i.e. with our product. When we contacted the government, Kamer van Koophandel, municipality of Eindhoven and the safety region Brabant Zuidoost in October 2020 it was however not possible to get any information on how realistic it would be that the authorities will give us permission for an experiment and whether they will possibly change the seating rule.

The last assumption is that music event organizers have made a lot of loss during the pandemic and they are eager to try new ideas. This assumption, however, is almost a certainty with all the feedback from the different stakeholders.

Company

Team

The team consists of 5 students from the university of technology in Eindhoven. Social DistDancing is a multidisciplinary team with majors in Biomedical Engineering, Computer Science and Engineering and Psychology & Technology. This gives us a big advantage because we can work simultaneously on different aspects of the problem. This results in fast results and letting every team member excel in their specialty. The structure of the team is that every team member is equal.

We are a young team full of energy and a drive to tackle problems. This makes us an energetic and modern company. The character of the company is open. We are always open for feedback and easy to work with. We easily adapt ourselves to new partners which benefits us in maintaining good relationships with the companies we work with.

Advisors

We are advised by a team consisting of two professors from the University of technology in Eindhoven. There are weekly meetings on Monday and in these meetings the process is discussed and they guide us through the process of setting up this business.

They are not our only advisors; we also got some feedback from multiple companies and music event organizers. They guided us through some problems and came up with ideas where we as a team were stuck. Furthermore, a rental company came up with our final idea, the idea of making an add-on system for the headphones. This way we could tackle the problem when the COVID-19 crisis would end. This being, if the crisis ended we are out of business. With this small change investors can invest in us with less risk which results in more investors. They could store away the device for the next similar situation.

Mission statement

The main goal of this business is to make dancing possible in the event sector. The rules have changed since COVID-19. To make events possible the government decided that all the visitors have to stay at their table and have a fixed seat assigned to them. This is to reduce movement of the visitors. Sitting at a party is less fun in our view, so Social DistDancing wants to change this. Furthermore, this view is shared with many music event organizers and visitors after the research we have done.

'''Slogan'''

No standing, only dancing!

Business structure

The company structure is a general partnership. Everyone puts in work equally, the same goes for the investments done into the company. Social DistDancing needs to be registered in the

Ducth Chamber of Commerce KVK. Social DistDancing will also work with investors and make them part of the business. They can give advice where needed and can make decisions with the owners regarding next steps. This is the case when Social DistDancing stays for another year, in the first year we mainly do everything ourselves.

Location

The company is located in Eindhoven. This is a great location for our business because Eindhoven is seen as the technology capital of the Netherlands. The district we operate in is called Brainport Eindhoven. Brainport Eindhoven is a collective of companies who strive to innovate and make the future better, safer and cleaner. This is accomplished with technology playing a key role. The innovative strength of Brainport Eindhoven is that they work with multidisciplinary teams to reach goals. This is in line with our goal and our way of working and thinking. Companies and the university work together. We as a beginning company can see the benefits of such location and mentality. For example, the process of working with various music organizers. They did not hesitate to work with us to reach our goal. Especially in times of COVID-19, Brainport Eindhoven searches to help each other get through this time together. This is the main reason why this location is so good for a company like us.

Financial plan

To start the company, we first need to register at the Kamer Van Koophandel (KVK). This will cost the company 50 euros<ref>[Kamer Van Koophandel. (2020, October 22). Retrieved from: https://www.kvk.nl/inschrijven-en-wijzigen/inschrijven-onderneming-vof/]</ref>. This is paid for by the owners of SocialDistDancing. Firstly there needs to be an experiment. This experiment is to check whether the product works as expected and if stakeholders like the idea. Stakeholders already responded positively about the product; however, they have never seen it work in real life. The aim for this experiment is to test with 200 visitors, so 200 headphones are needed for this experiment. The full explanation of the experiment can be found in the experiment plan. The experiment will be financed with investment from the owners. The cost to produce the add-on for the headphones with the accompanying beacons is €4577. It is decided that the team uses loans or gifts from family and our own money to cover the costs of this experiment. The headphones used in the experiment can be obtained via the stakeholders. They already agreed that this was possible. The distribution of the experiment is done by us. One of the company owners has a delivery van that can be used in the first year of the company. If needed this can be expanded to a longer period. This way distribution can be done by us.
If the experiment is a success Social DistDancing wants to scale up. After the experiment we can show to investors that the product is a success. Stakeholders are even more excited and the local authorities see that it is possible to set up a event, where dancing is allowed, in a safe way. So, an assumption is made that investors would like this idea and would want to invest in us. After which we can scale up and make the company ready for the spring.

An investor that can be looked into is Brabant startup fonds. The board already contacted them, however they did not respond yet. Brabant startup fonds invests in innovative companies who are in the beginning stages. Furthermore, the company could contact stakeholders if they are

interested in investing in us. Of course when a rental company decides to invest in us they will get products after they are produced. This way they have an advantage over other rental companies. They would be the first rental companies who have these headphones and have a discount on the price if they order in advance.

The first year we will store everything in the homes of the owners. The delivery is also done by the owners to minimize the costs. When the COVID-19 crisis stays for a longer period, it is possible to scale up even more. One can think about renting a warehouse to store products. Furthermore, a delivery employee can be hired to receive the headphones from the rental companies and bring the products back to the rental companies. This can also be done by a third party, one example could be bol.com. Which route will be chosen is dependent on the investors choice. To have the delivery done by ourselves without a third party is better. So, in all likelihood this route will be chosen.

When measures are loosened, in a way music events are possible like it was before the COVID-19 crisis, the company will probably stop. So, that will probably be the end of Social DistDancing. The add-on will be removed from the headphone and the rental companies can sell or store it away for later use.

Marketing will not cost us anything except time. The marketing strategy that is chosen is just by mailing the companies. There are approximately 70 rental companies in the Netherlands. This can be overseen by mailing each company. Making advertisements on social media or on television is for our product not optimal. We want to direct the marketing directly to the customers of our product.

At last a website needs to be made to display our information. Also there needs to be a way to make online ordering possible or to make a quotation. We will make a website via jouwweb.nl this will cost 8 euro per month. This ensures that the website is safe to use and online payment options are included with this service, online payment options like IDeal.

===Price===

"'Standard package'"

The standard package consists of products for an island for two people. The costs of the materials of a standard package are €45,77. So, the total costs will be €45,77 euro excluding delivery cost. We have chosen for a profit margin of 15%. This leaves us at a selling price of €52,6355 rounded to €54 excluding delivery costs. So, this leaves us with a gross profit of €8,23 per standard package.

We recommend using these standard packages. As of this moment two people who are not from one household can come close to each other when going to events, for example girlfriend and boyfriend <ref name = 'Corona en regels voor afstand houden' >[Rijksoverheid, (n.d.). Corona en regels voor afstand houden, https://www.rijksoverheid.nl/onderwerpen/coronavirus-covid-19/openbaar-en-dagelijks-leven/afstand-houden]</ref>. So, our recommendation is to adhere to those rules and use the standard packages. However, it is up to the customers if they want to adhere to these rules. The individual headphones and beacons can also be bought.

''' Individual headphone '''

The costs for an individual headphone are €15,46. The profit margin on this product is 15%. This makes the selling price €17,80 excluding delivery costs, leaving us with a gross profit of €2,34 per headphone. To scale up the island instructions are given on how to do that by the owners. The code has to be changed by a single digit. In other words the beacon needs to be connected to more headphones.

''' Individual beacon '''

Individual beacons can be bought too. The cost of an individual beacon is €14,58. Adding the profit margin of 15% makes a selling price of €16,80 excluding delivery cost. This leaves a gross profit of €2,22 per beacon.

''' Delivery costs '''

The delivery costs are fixed at €10 per order.

===Estimation future plan===

The aim of the company is to sell 2000 headphones in the first year. For now we make an assumption that these are all standard packages, so a 1000 standard packages. The 1000 standard packages are an estimation, when needed this can be scaled up to more packages. The costs of the products are €45.770. This has to be bought with the help of investors. Another way could be that rental companies pay in advance. If rental companies pay in advance they will get their product a month later but they will receive a discount. If they do not want to pay in advance the price will be the normal €54 euro excluding delivery costs. If they pay in advance the selling price will be €52 euro excluding delivery costs.

The gross profit, with the assumption that every company buys the standard package, will range from €6.230 to €8.230 depending on if they order in advance.

===Summary===

To conclude the company is in the test phase. We firstly are going to do an experiment, this experiment will be paid for by ourselves. After the experiment the 200 models can be sold. This will result in a gross profit of €823. The second stage is attracting the investors and rental companies to invest in our company or to order the product in advance. With this we can scale up and can produce more headphones. The third stage is regarding the whole first year. This year we will do everything by ourselves and aim to sell 2000 headphones. In the last stage, we will look at what the possibilities are if we can scale up even more or that we have to be on hold because the crisis is over. When needed we can move on to the last stage earlier.

===Table of all the costs===

{| border=1 cellpadding=2 style="width: 60%"
|-
!Cost
!€
|-
| Per headphone || €15,46
|-
| Per beacon || €14,85
|-
| Website(per month) || €8
|-
| Distribution(per km) || €0,058
|-
| Registration KVK (one time)|| €50
|}

''' Cost buying in bulk'''

'' headphone ''

{| border=1 cellpadding=5 style="width: 60%"
|-
!Component
!Price per 1000
!Price per 5000
!Price per 10000
!Price per 50000
|-
| Assembly (pcbcart) || €0.21 || €0.13 || €0.07 || €0.03
|-
|PCB print (pcbcart) || €0.21 || €0.21 || €0.21 || €0.21

```
|-
|DWM1000 (semiconductorstore.com) || €13.37 || €13.37 || €13.37 || €13.37
|-
|ATMEGA328 (AVNET)  || €1.08 || €1.03 || €1.03 || €1.03
|-
|Relay (AVNET)  || €0.58 || €0.46 || €0.45 || €0.41
|}
```

''The beacon''

```
{| border=1 cellpadding=5 style="width: 60%"
|-
!Component
!Price per 1000
!Price per 5000
!Price per 10000
!Price per 50000
|-
| Assembly (pcbcart) || €0.21 || €0.13 || €0.07 || €0.03
|-
|PCB print (pcbcart) || €0.21 || €0.21 || €0.21 || €0.21

|-
|DWM1000 (semiconductorstore.com) || €13.37 || €13.37 || €13.37 || €13.37
|-
|ATMEGA328 (AVNET)  || €1.08 || €1.03 || €1.03 || €1.03

|}
```

'''Selling prices'''

```
{| border=1 cellpadding=3 style="width: 60%"
|-
!Product
!Normal price (€)
!Price when paid in advance (€)
|-
| Standard package || €54 || €52
|-
| Headphones  || €17,80 || €17,30
|-
| Beacon || €16,80 || €16,30
|-
| Delivery || €6 || €6
```

|}

=Logbook=
==Week 1==
{| border=1 cellpadding=3 style="width: 60%"
|-
!Name
!Total Hours
!Tasks
|-
| Jeroen || 9.5 || Meetings (1.5 hrs), brainstorming (1 hr), literature study on state of the art (7 hrs)
|-
| Pleun || 10.5 || (Preparing and) meeting (2 hrs), reading other wiki's and brainstorming (1.5 hrs), writing on introduction, objectives, stakeholders, users needs and ethical considerations (5 hrs) and literature research psychological part (2 hrs)
|-
| Dayeong || 11.5 || Meetings (1.5 hrs), looking up wikis of previous projects + searching for 8 technology literature (6 hrs), Reading papers and making a summary on State-of-the-art (4 hrs)
|-
| Rik || 10 || Meetings (1.5 hrs), researching for subject, reading and summarizing papers regarding the technical aspect of our product and the financial impact of Corona
|-
| Erik || 9 || Meetings (1.5 hrs), meeting prep, brainstorming and looking through previous wikis, writing on plan, looking for more relevant papers
|}

==Week 2==
{| border=1 cellpadding=3 style="width: 60%"
|-
!Name
!Total Hours
!Tasks
|-
| Jeroen || 5.5 || Meeting (1.5 hrs), Working on survey (4 hrs)
|-

| Pleun || 7 || Meeting (1.5 hrs), mailing and calling event agencies and music event organizers, working out answers from them
|-
| Dayeong || 4 || Metting 0.5 hrs + 1 hr + Wristband research 1 hr + contact(WATPod) + modelling(meeting) 0.5 hrs + brainstorming research 1 hrs
|-
| Rik || 5.5 || Meeting, researching legal aspect on forced use of face masks, coronabeepers etc., coming up with ideas for making festivals possible again and talking with Van Klink who knows about legal aspects on enforcement of the distance rule, model meeting
|-
| Erik || 10 || Meetings (1.5hrs) Tutor meeting (0.5hr) Brainstorm ideas and requirements (2hrs) Creating first sketch of UPPAAL Model of Wristband (5.5hrs) Meeting on model (0.5hrs)
|}

==Week 3==
{| border=1 cellpadding=3 style="width: 60%"
|-
!Name
!Total Hours
!Tasks
|-
| Jeroen || 7 || Meetings, Research new ideas, Implementing survey
|-
| Pleun || 10 || Group meetings, meeting at the Effenaar, relistening Effenaar-talk and writing a summary, brainstorming on new idea, updating wiki-page
|-
| Dayeong || 7 || Meetings, Doing research about new ideas, Making a diagram
|-
| Rik || 7.5 || Group meetings, meeting at De Effenaar, formulating requirements and coming up with ideas based on the Effenaar talk, work on model
|-
| Erik || 7 || Meetings + Tutor meeting (2hrs), attempt to fix time functionality in UPPAAL model (2.5hrs), Research into distance measuring protocols and sequence diagram depicting it, addressing scheme (2.5 hrs)
|}

==Week 4==
{| border=1 cellpadding=3 style="width: 60%"
|-
!Name
!Total Hours
!Tasks
|-
| Jeroen || 8 || Meetings, Working on the RPCs, Working on new survey, Brainstorm

|-
| Pleun || 9 || Meeting, working on Wiki (intro, objectives, rpc's, detailed description of idea), prepping interview Effenaar, contacting music event organizations, overthinking weaknesses/concerns/solutions.
|-
| Dayeong || 15 || 1.5 hr (meeting) + 4 hrs (design, researching on a terrain and human movement area, calculating the estimates of circles) + 5 (making activity diagram, use case diagram) + 1.5 hrs (Wiki) + 1 hr (meeting, documenting) + 1.5 hr (contacting to 12 music event organizers) + 0.5 hr (Researching irritating sensation as a punishment)
|-
| Rik || 8 || Meetings, working on cost effectiveness, thinking about and researching concerns and alternatives, cleaning up legal aspect section
|-
| Erik || 7 || Meetings + Tutor Meeting, Class + State Diagram, Explanation text for diagrams, Research possibility to mute music with microcontroller.
|}

==Week 5==
{| border=1 cellpadding=3 style="width: 60%"
|-
!Name
!Total Hours
!Tasks
|-
| Jeroen || 14 || meetings, Make mail for the local authorities, Start working on the business plan (Last 3 parts)
|-
| Pleun || 15h || Tutor meeting (30m), meetings, brainstorm on continuation, preparation meeting for de Effenaar (1h), talk at de Effenaar, processing interview and writing summary on it, contact corona-proof events in Eindhoven, contacting music event organizations, contacting YoungCreators, creating overview on mail-response, working on wiki (objectives, deliverables, stakeholders),
|-
| Dayeong || 14.5h || 3 hr (meeting) + 8 hr (researching relevant parts + documenting, creating a business plan) + 0.5 hr (contacting music event organizer) + 1.45 hr (meeting) + 1 hr (meeting + wiki)
|-
| Rik || 14h45 || Tutor meeting (30m), brainstorm on continuation (3h), preparation meeting for De Effenaar talk (1h), talk at De Effenaar (1h), working on experiment plan, reviewing objective, coming up with questions and remarks, searching for startup challenges, meeting (1h45m), tidy up meeting minutes (15m), discussion Whatsapp (15m), Finding relevant contacts, contacting Smart Distance Lab, music venues, Ministerie van Economische Zaken, Rijksdienst voor Ondernemend Nederland (2h30m)

|-
| Erik || 14.5hrs || Meetings + Tutor Meeting (6hrs), Estimate cost (1hr), Initial Email with rental companies, sending out in bulk, further email correspondence (3hrs), Phone Calls with rental companies + writing out result (2 hrs) New activity diagram and redone explanation text (2hr) Statistical significance survey (15min) Sunday meeting (20m)
|}

==Week 6==
{| border=1 cellpadding=3 style="width: 60%"
|-
!Name
!Total Hours
!Tasks
|-
| Jeroen || 14.5 || meeting, implement feedback email local authorities, Working on business plan, email investors, Call local authorities, Formally write the financial plan
|-
| Pleun || 0 || Tasks here
|-
| Dayeong || 15hr || 1.5 hr (meeting) + 3 hr (researching / contacting manufacturers to know the bulk price / marketing cost) + 2.5 hr(editing business plan and linking academic papers) + 1.5 hr (meeting) + 5.5 hr (reading feedback + editing business plan + correcting errors + researching event equipment service or silent disco headphones rental market) + 0.5 hr (discussing financial part)
|-
| Rik || 11h30 || Tutor and group meeting (1h30m), Working on Experiment plan (1h45m), Reacting to e-mails, looking at Pleun's comments on the Experiment plan, reading up on SSAs and Business Plan (2h), Group meeting (1h30m), Reading, researching, thinking about business plan, sending e-mails Veiligheidsregio Brabant Zuidoost, Koninklijke Horeca Nederland, researching, thinking, writing, discussing number of people per island (2h20m), Whatsapp discussion on number of people per island, funding for business plan, costs (1h15m), Making experiment sketch (1h15m)

|-
| Erik || 0 || Tasks here
|}
==Week 7==
{| border=1 cellpadding=3 style="width: 60%"
|-
!Name
!Total Hours
!Tasks
|-

| Jeroen || 12.5 || meeting, Implement feedback from parts worked on, Calling veiligheidsregio & RIVM, Working on presentation & practicing
|-
| Pleun || 0 || Tasks here
|-
| Dayeong || 15hr || 2 hr (meeting) + 0.5hr (taking and minutes) + 4 hr (RPC + editing solution part of the business plan) + 1 hr (meeting) + 3 hrs (replacing 'we', checking grammar & spelling errors for the entire document) + 1.5 hr (elaborating RPCs) + 2 hr (making comments and editing) + 1hr (meeting)
|-
| Rik || 12h15 || Group meeting (1h15m), Tutor and group meeting (30m), Call with KVK CoronaLoket (30m), Uploading company name, contact with Veiligheidsregio Brabant Zuidoost (15m), Update experiment sketch with circles of diameter of 3m, editing Experiment plan and Detailed description of our idea, write on Operations and Key assumptions and risks sections of the Business Plan, put Legal Aspect section in the Development of Idea section (2h45m), 15-10 Group meeting (1h), Updating Experiment plan, reading and commenting Development of idea, fit Legal Aspect in Development of idea, read wiki, edit Further considerations (3h), Preparing presentation (1h45m), 18-10 Group meeting about presentation (1h15m)
|-
| Erik || 0 || Tasks here
|}
==Week 8==
{| border=1 cellpadding=3 style="width: 60%"
|-
!Name
!Total Hours
!Tasks
|-
| Jeroen || 10 || presentation, meetings, reading and placing comments on the wiki, editing the wiki
|-
| Pleun || 0 || Tasks here
|-
| Dayeong || 9.5hr || 3.5 hrs (presentation + meeting) + 2 hrs (editing business plan, bit of RPC, changing index) + 2 hrs (reviewing + commenting) + 2 hrs (meeting, going through comments)
|-
| Rik || 9h30 || Presentations (1h30m), Group meeting (1h), Update Wiki a.o. Number of people and Experiment plan (1h15m), Read and check Wiki (3h), Fix comments on wiki (45m), Group meeting (1h30), Last touches on wiki (30m)
|-
| Erik || 0 || Tasks here
|}

= References =