OVERPOPULATION - MEASURING PEOPLE IN CROWDED INDOOR SPACES

A smart system to avoid crowds

Author: Jesús Escudero Pérez

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Tutors: Martin Boehnel & Alexander Watson

ABSTRACT

This project is based on the Subject of Smart Design, in the University of Technology, Sydney, Australia. It revolves around the idea of looking for a topic/ issue and **addressing it with an electronic product**. After an initial research of general topics the problem chosen was overpopulation in public spaces, such as restaurants, museums, parks, etc.

This starting point is where the actual research began, choosing the right user, environment and unveil problems such as data privacy was **mainly empirical and based on real collected data**. After having a general idea the ideation started with possible ways of establishing a product system, that would help addressing the pleading problem. This part was also boosted by the elaboration of a functional prototype , that gave a much more reliable feedback. The final part is where all the detail where nailed down and where minor flaws where corrected, all the technical part is defined in this part.

All things considered this product addressed overpopulation focusing on an electronic product, there is a lot of room for improvement due to university limitations, but the idea was well accepted amongst the users and the interviewed people. **Organising people through an electronic product** is a way of relief not a solution to overpopulation which is a problem that concern us all and cannot be ignored.

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PROJECT

This project is the main part of a subject called Smart Design, coursed on the second year of the Product Design Bachelor's imparted in the University of Technology Sydney (Australia).

The project is based on the idea of redesigning a product with the help of electronics and coding. Also based on the idea of a standard design approach, with its own research, ideation, solution and detailing, besides three control presentations.

The final presentation consisted on a fully functional prototype of the product with the help of an open source Arduino micro-controller. The development of the project was constantly supervised by the assigned tutors and all feedback through the presentations was assured to be reflected on every step taken.

RESEARCH

Pick a filed to work or an existing product, look for relevant issues in the topic and collect data, surveys and interviews related to the problem found.

PROTOTYPE

Start addressing the problem with practical solutions and prototypes, the is an early ideation and prototyping so research is still open for further development.

PRODUCT

Developing the fully functional prototype into a fully functional one, further detailing and polishing mistakes that might exist on the product.

METHODOLOGY

The project statement is not a mandatory guideline for the project, it depends on every single student how the project is fulfilled and surpassed.

This is why I have followed an specific methodology, defining some previous phases so the following steps of the projects do not become weak and I can approach every problem with the due knowledge and information required.

These steps will be divided in:

- Exploration
- Research
- Ideation
- Refinement

This 4 main parts will include sub-topics and can always go back to the previous ones in order obtain valuable feedback. For example if further research is needed, during the ideation part this will be added to the previous part to continue the project with a solid approach.

EXPLORATION

This part involves detecting a problem in an specific area. Through techniques of exploration and with the help of the tutors the main objective of this phase is coming up with a topic to research.

RESEARCH

Following the topic, the objective of this part is gathering as much useful information as possible and the ending up with a list of relevant conclusions and design specifications.

IDEATION

The third part of the project involves exploring ideas that could solve the issue with the help of the previous research. Sketches, mood-boards and rough models will be performed in order to conclude this phase with a relevant idea.

REFINEMENT

In this final part, the main objective is to polish the rough idea and fixing any sort of detail that may affect the final result in a non-desired way. Testing will be performed to shape any needed final result, such as manufacturing, technical parts and blueprints. Presentation and renders are included as well in this part.

CHOOSING A TOPIC

The way we started exploring a topic to choose from was through the use of mind-maps. Listing the fields with possible issues helps visualizing the possible paths of action and having an overview of what might interest us or be relevant for the people we are designing for.

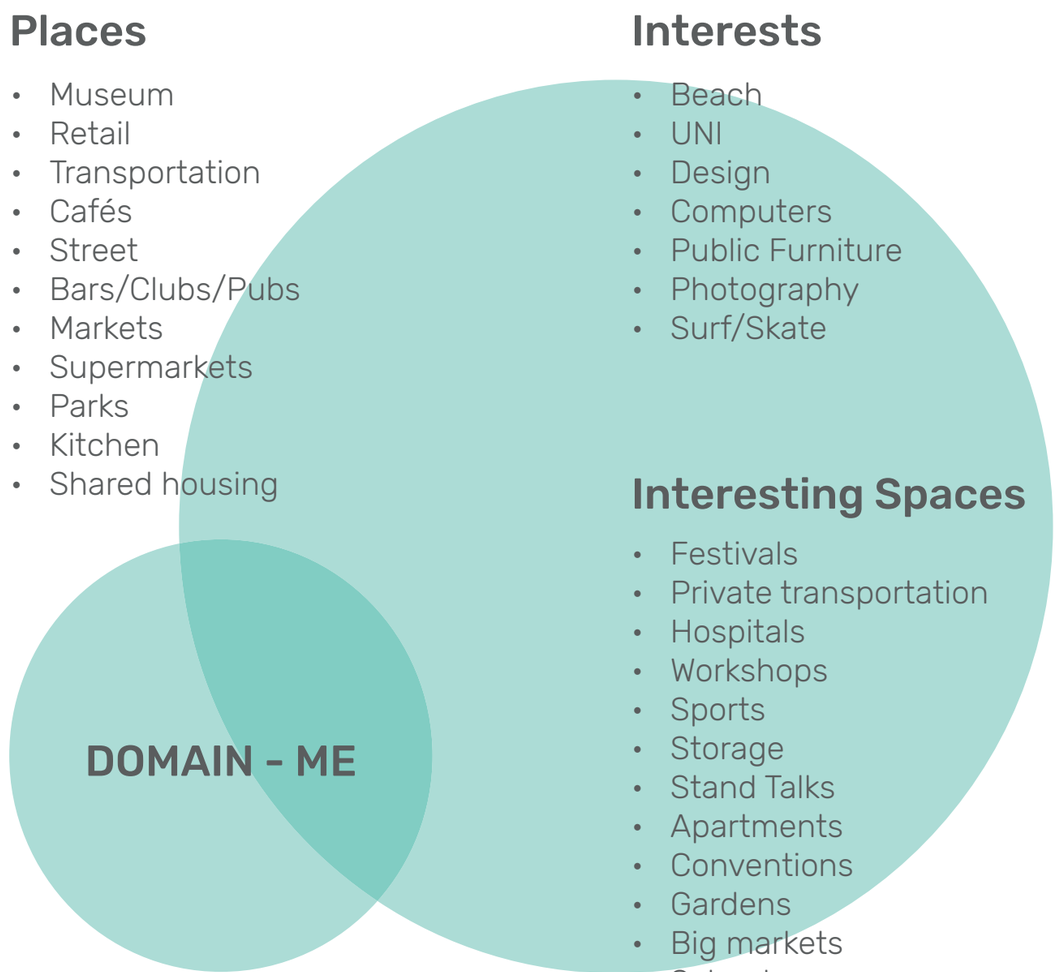
I started listing general areas where the research could be fulfilled successfully to induce relevant results. I also added another field with my interests to see possible combinations and finally added other places in the city of Sydney where things could be improved.

Again, this exercise is just a way of approaching a general idea of what the project could be focused in, and not a definitive way of selecting the line of action.

This exercise aimed toward spaces and the interaction with the people. Through the help of teamwork sessions and tutorials held by the subject tutors, I could conclude that the problem arose from a more general perspective. This lead me to focus on a whole space instead of something comprehended inside that space.

However a more general approach can always lead to ambiguous conclusions and bigger issues unveiled by the research, leading to an endless loop and turning the project into an unreachable or too complex solution.

Thus I'll need to breakdown the problem and come up with something tangible.



THE PROBLEM

Through observation I could recognise that the problem pointed not only towards one public space, but in all of them at once, specially in Sydney. We are talking about the problem of **overpopulation**, concretely the overpopulation in public spaces.

Combining some of the spaces we can conclude that most of them in such a touristy place in Australia become a problem to overcome, not knowing what to expect when you arrive to a public space might en up in huge disappointment.

The place you want to go is highly crowded and rowdy, but you don't really know where else to go. Overpopulation has become a real problem in the modern era, where populations are swiftly increasing without us noticing and making real state a big deal to find.

The main question to frame the problem would be:

How could we asses overpopulation in public spaces, so people can predict or avoid the density of people in an specific place and decide its plan again?

I further dug down in this issue applying the exercise of the 5 why's, so we can dive deep down into the question stated and observe with empathy.

The 5 Why's

The issue of overpopulation

Overpopulation is a problem, **why?**

Public spaces are crowded and therefore they are tedious and difficult to access, **why?**

People tend to go to the same places leading to high accumulations, **why?**

Trends and not knowing different places to go, **why?**

People follow most recommended places on the internet and what people talks about, **why?**

People don't have total awareness of the status of every place they want to go in their surroundings so they follow relatable information sources.

ADDRESSING THE PROBLEM

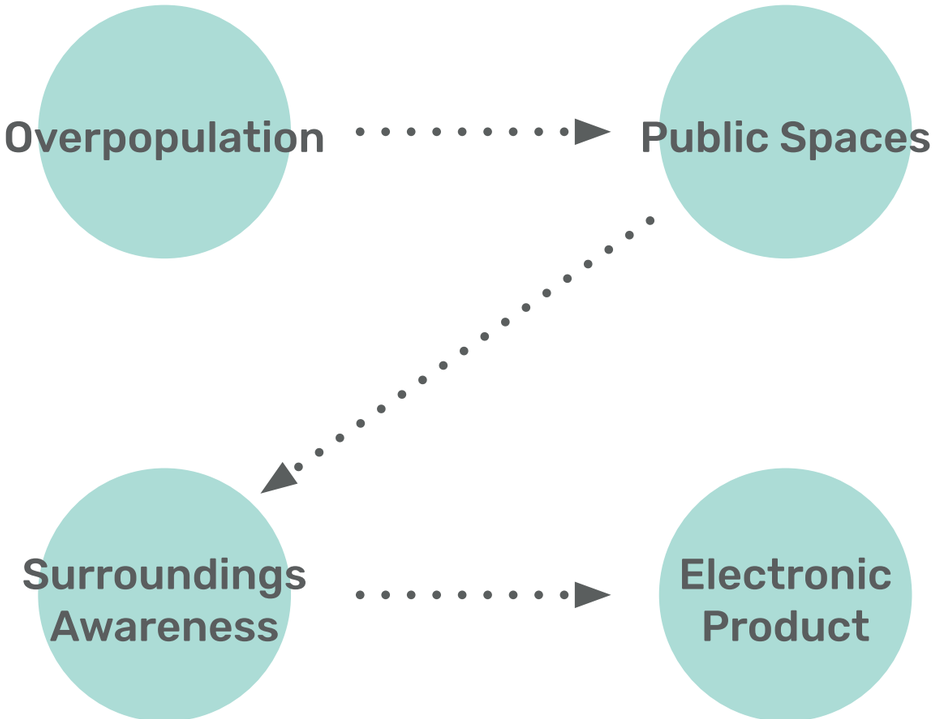
People don’t have total awareness of the status of every place they want to go in their surroundings so they follow relatable information sources.

This is the statement that will lead our project. I will shape this in the form of a question to guide the research.

How can I make **people aware of the status of every place they want to go in their surroundings so they follow relatable information sources** and thus avoid overcrowding a place?

We can’t forget that the main problem to overcome is overpopulation in public spaces. So first of all we will have to understand what people think about a crowded place and observe with empathy.

The project will consist on finding an electronic product that can asses this issue and fulfil an necessity in this case, avoiding crowded public spaces or at least letting people know beforehand the status of an specific public space.



RESEARCH

Gathering relevant information

RESEARCH WITH EMPATHY

One of the main aspects of this research is that is driven by the people and the main users, combined with constant feedback from the university classes.

The majority of the research is based on what people think, believe and experiment with the product development collecting primary data form reliable sources and relying on empirical experimentation.

However the most technical data and the, code, electronics is researched and developed with the help of an engineer tutor assisting to the classes.

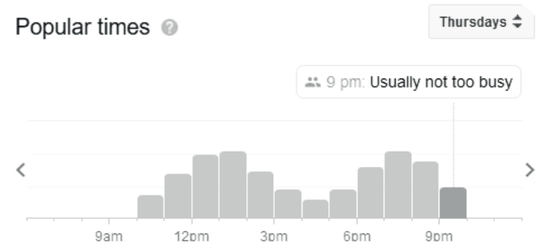
The point of this research is **developing the product in an empathic way, understanding the user and their needs and making it the centre of the most important decisions.**

EXISTING METHODS

As a first approach it is sensible to investigate what already exist in the market that is trying to address the same problem or similar.

GOOGLE
Google data collection is the main example and main reference as the most effective way of addressing the problem.

The system works in a way that collects GPS locations of places you have been through Google MAPS from specific IPs (People) and matches that in a time-line creating a graph that shows the amount of people and the time the specific time that amount of people was in that place.



Google's popularity graphs tracking people's accounts indicates the amount of people in an specific business.

UNIVERSITIES

On the other hand, there are some universities that try to assist their students accessing their libraries. Libraries, specially during exams are a really busy area in a university.

This is why some universities, University of Navarra for example, tried to implement some mechanic-electronic systems to let people know beforehand the amount of vacancy in such rooms. With the help of presence sensors and a counter at the entry of the library it can be estimated how many people are actually in the library. More info: click here.

CONCLUSIONS

I chose this two examples because they show the difference of a data analysis approach and a more product like solution. **However, both of them imply some flaws user and system related.**
The Google system implies accessing user's data violating their privacy, it can only show also the specific place you are looking for, not having awareness of your surroundings. The University system is not polished enough, it can easily be fooled and its accuracy relapses in people interacting with a tedious physical product, in this case the gates. Both systems can be greatly improved and even combined to come a better way of addressing the issue.

PEOPLE THOUGHTS

In order to get a quick insight and have an early feedback I interviewed some people I knew in the service sector of the market as well as some university students.

This allowed me to get a general impression to know if the problem is real and people perceive overpopulation the way it is presented in this project.

The main question was related to their domains, places they are used to:

What do you think about overpopulation as in crowded public spaces?

UNI LIBRARIAN

Students tend to look for other libraries when realising it is full, they expect it but is never certain. They could wait up to not a long time, but it is always a metter of luck finding a place to sit.

BAKERY OWNER

People seem annoyed when waiting and usually people don't expect the crowds. Customers tend to wait, busy sometimes means quality and they think is worth the wait.

UNI STUDENTS

It is awful to find the library/ workshops completely full, but they mostly complained about the uni canteen and close-by restaurants. It is more annoying for them not having a place to have lunch or even just rest with friends.

CONCLUSION

It seems like is not a major issue and people don't take it as a big deal. However it is still a tedious event and that nobody likes to encounter. **This means that improving this situation will be accepted as it helps making people's life easier.**

WHAT IS CROWDED?

First of all we have to specify the symptoms of a crowded place, What makes a place busy? What are the characteristics of a place full of people? Asking this question we can conclude that there are two physical parameters to determine if a place contains a high people density.

These parameters are: **movement and noise.**

Of course this case does this case does not apply to every single environment, for example a library could be crowded, but it doesn't mean people are going to be talking or moving. Other example would be a pub, music is constantly going on in the background, but again is not a sign of people being there, just background noise.

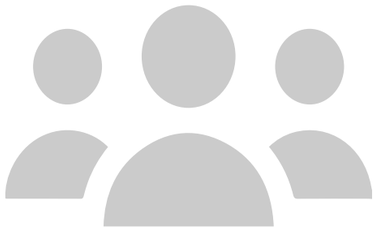
This is where the third parameter comes in, **presence**.

The status of a being present in a certain spots can be measured in different ways and this would display a boolean outcome of yes or no, or in other words If there is or there is not people on an specific spot.

Is a combination of these three parameters what we will use to determine whether a place is crowded or not, always according and adjusting them to the enviorment we will be working on.

NOISE

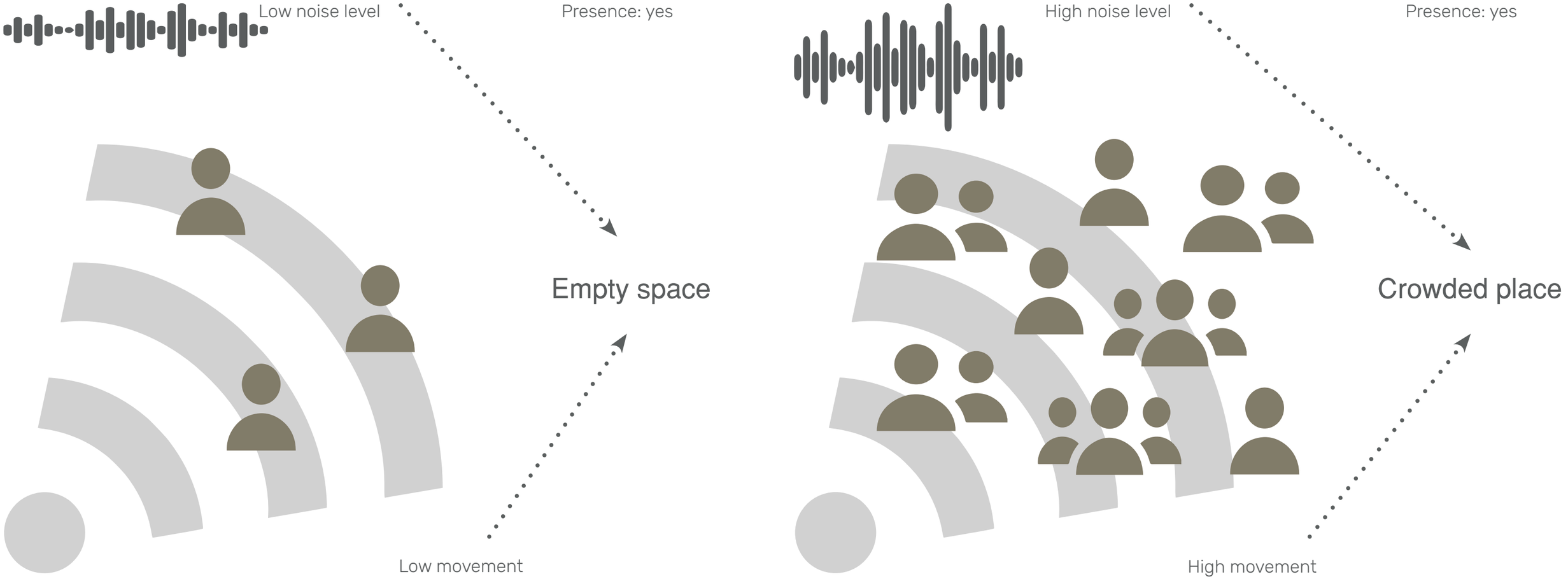
PRESENCE



MOVEMENT

BUSY STATUS

WAYS OF MEASURING



This diagram shows how it is aimed to be measured and interpreted,this will be achieved through the help of various sensors as the product has to be an electronic device.

INDOORS VS OUTDOORS

Once is set the way it is going to measure it is important to stablish the main points of doing it indoors against outdoors. This should unveil the main path to carry on the research and choosing the right decisions in terms of electronics, formal design and interaction with the users.

The research is aimed to identify the different aspects positive or negative of stabilising an electronic product in a different environment.

Once the main points have been stated the main medium can be evaluated. As displayed, indoors carries out less inconveniences but outdoors display a variety of really interesting scenarios.

So as a final conclusion, knowing that my resources are limited (university) and further research is needed for the electronics part **I have chosen to aim towards indoor environments.** Not because its ease, but because I can come up with more meaningful solutions based on real feedback and not speculative one. There are still a wide variety of applicable cases for indoor environments, where this product can achieve its full potential and become a great asset for businesses or public domains.

INDOORS

Power can be obtained form the building's line.

Being in a more confined space leads to more precise results.

People might feel observed by its presence or feel uncomfortable if they don't know what it is.

Systems such as bluetooth can be used to transfer data .

The product is under vigilance and therefore more secure.

Can be useful for museums or private establishments that decide to purchase the system.

OUTDOORS

Power can be far away and be distributed tediously. However I can be sourced from renewable energies such as sun or wind.

Wide open areas may need more powerful sensors and with bigger reaches.

Product might be stolen and suffer from weather's inclemencies/deterioration.

Larger reaches might need wi-fi networks.

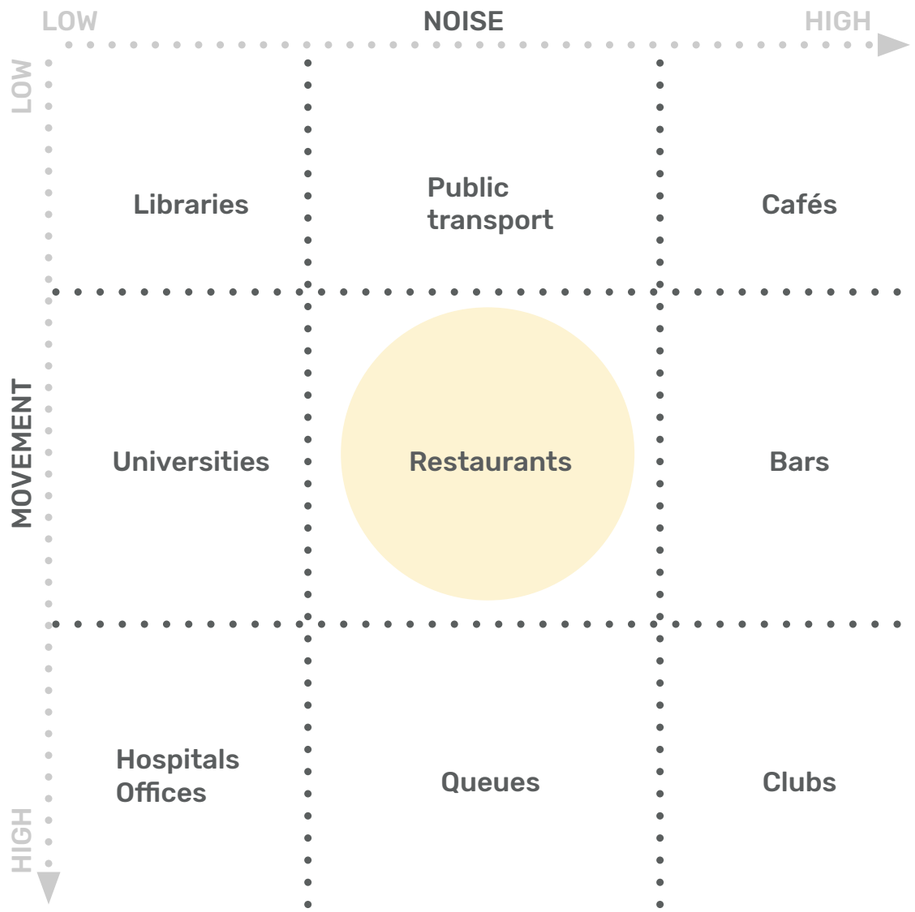
Can be useful for big events or public touristy areas such as beaches or public parks.

THE ENVIORMENT/USER

Now we have a start point, indoor spaces embrace many possible outcomes. This is why closing the gap and choosing a more specific area is needed. In this part we will analyse the possible indoor alternatives and specify into one to carry out further research.

I will not list places in this exercise but correlate the places with different parameters, for this case the ones I have mentioned before that lead the idea of the product , **movement and noise.** This way we can avoid the extreme environments and come up with a more balanced outcome suiting a more possible scenarios.

As displayed in the matrix, we can conclude **the most balanced environment to focus the project will be restaurants**. This way we can centre all the parameters and fluctuate around this matrix. The system will be more flexible if we start from a midpoint instead of a more extreme one.



PRIVACY ISSUES

When working with sensors in public spaces we cannot obviate the fact that people will see them and feel hesitant about their purpose. Privacy nowadays is one of the most concerning problems regarding to data.

Nobody is willing to show personal data, and companies are selling it for massive amounts of money. The polemic surrounding privacy issues increases with the pace of time. The internet, social media or any device connected to the web has access to your personal information, now more than ever before.

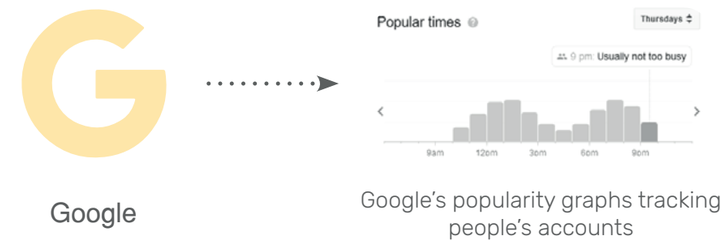
People are becoming aware of that fact, and they are demanding change and respect for their privacy. In our previous analysis is one of the main concerns to be treated and has to be considered throughout the design process.

Here are some examples proving the point, provided by the biggest companies in the market.

One of the biggest sale arguments of our product could be its privacy respect.

Apple

Apple's new campaign with the main focus on privacy



Google

Google's popularity graphs tracking people's accounts

Social media

Facebook CEO Mak Zuckerberg standing trial due to data scandal

PEOPLE DATA & SENSORS

However, stating the problem of privacy and people being comfortable with sensors cannot be overlooked that way. Further feedback is needed to evaluate what people really think.

A survey was performed through the platform of SurveyMonkey,the majority of responses were identified as **people from 18 to 25 years old**, people that use these kind of technologies. This is why further segregation will not be needed and we will use this as our **main user of the service**.

The survey represents how people feel with data, sensors and internet, giving us a general view about the viability.

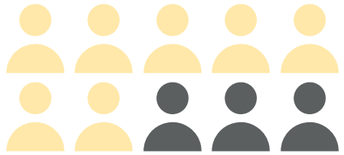
As shown in the research **people are not comfortable with this kind of products and this will need to be taken into consideration for the product development.**

Privacy has to be considered a main point in this project and it will aim to keep it as concealed and non-invasive as possible.

Do you care much about your privacy?

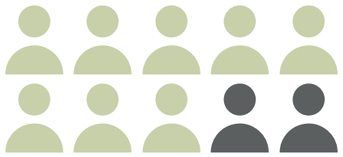
8 out of 10 people care about their privacy

Are you concerned about your data/personal privacy when using internet-connected devices?



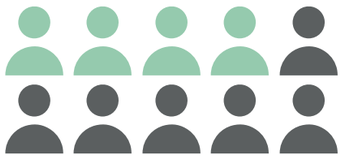
7 out of 10 people are concerned about their privacy when using devices

Do you think the internet is a safe place for the information you provide?



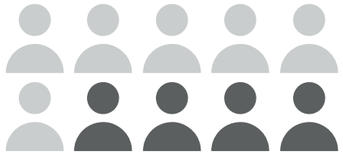
8 out of 10 people think internet is not a safe place for their data

Do you feel comfortable whenever there are cameras or sensors gathering information around you in public spaces?



4 out of 10 people feel comfortable with cameras/sensors around them

What if those cameras/sensors were connected to the internet? Would you be more concerned about them?



6 out of 10 people would feel less comfortable knowing those sensors are connected to the internet

(35 answers in total)

GENERAL CONCLUSIONS

After this research we have to conclude with a list of several aspects that must be included and considered through the design of the product.

This is what is called product design requirements, bullet points highlighting relevant aspects of the product. We will divide this list into two categories: Necessary and recommended.

RECOMMENDED

- The product have to be visible.
- The product should work on batteries.
- The product should not be visually disturbing.
- Batteries should last long.
- Aesthetically pleasing and easy handling.

NECESSARY

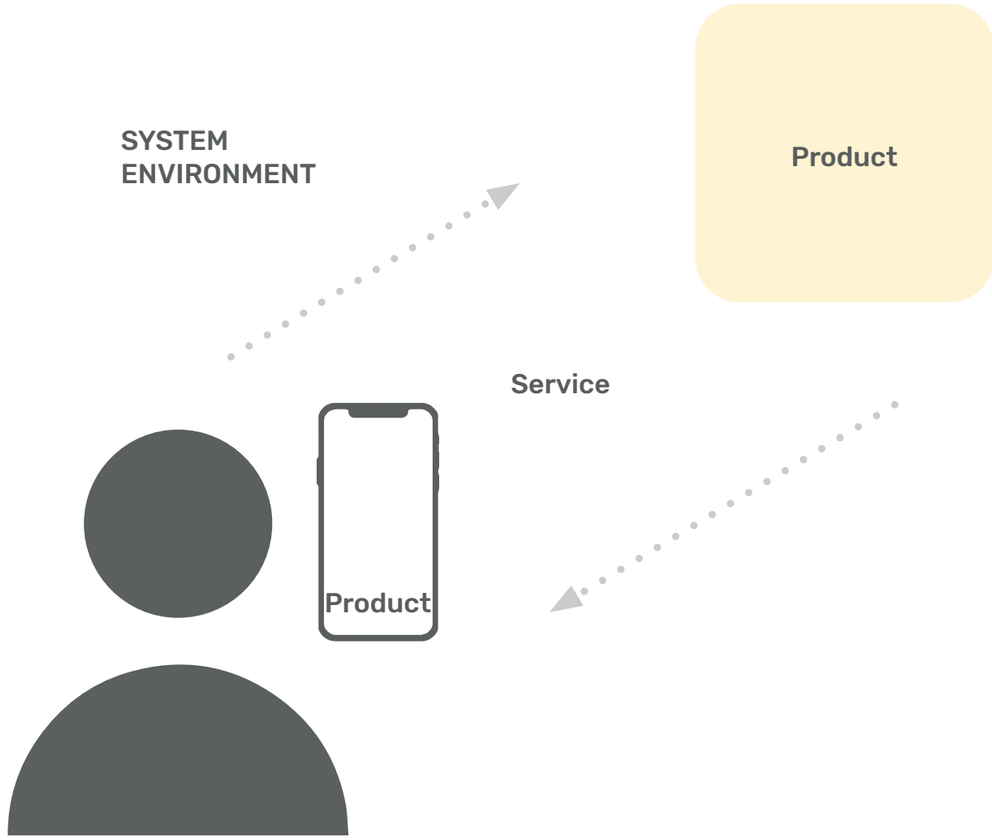
- The product has to address the issue of overpopulation in spaces such as restaurants or indoors domains.
- The product has to look friendly and display what it is doing so people feel less uncomfortable.
- The product needs access to the main power line.
- The product has to be different from existing solutions.
- The product has to be resistant to direct interaction with users.
- The product has to differentiate busy places from calmed ones.
- The data handled by the product needs to be protected or not being personal, related with the user.
- The product must be an electronic smart system.
- The product needs to be versatile enough to suit different environments and not have lose precision.

PRODUCT SYSTEM

Knowing all these conclusions we have to fit them into an electronic product. The product could be based on a single physical entity as an standard product, but we are going to focus the product in a more sensible way.

The product will be formulated in Product Service System more oriented to the modern designs and solutions. They information will be more easily displayed in a system environment and the product would be sold as a system for the users by the government or private domains.

This makes mores sense as the information can be accessed a easier and remotely with no need of approaching the actual product, offering more possibilities and viable solutions for the final design outcome.



IDEATION

Generating valuable outcomes

THE IDEA

Summing up all this first part we concluded that the product will actually be a product system environment aimed toward 18-25 year old users in restaurants, whose main purpose is estimate people density in real time based in noise and movement. So people can know the amount of people in one place and avoid overpopulation.

This system will be composed by two parts:

DIGITAL PRODUCT

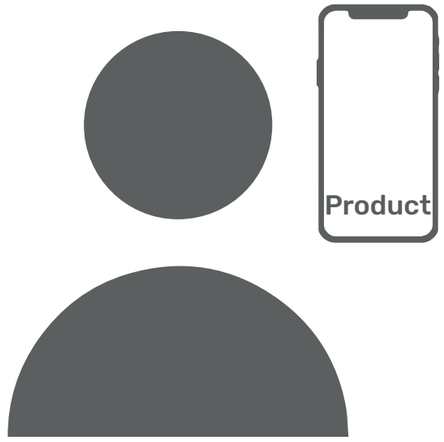
Will be the one in charge of letting the user know what the status of his search is, the density of people in an specific location or area.

PHYSICAL PRODUCT

Will be the part of the system in charge of collecting the status trough sensors and processing the information so it is usable by the user.

RESPECT PRIVACY

Will be one of the main selling arguments of the product, handling the product and making it work without collecting sensible data.

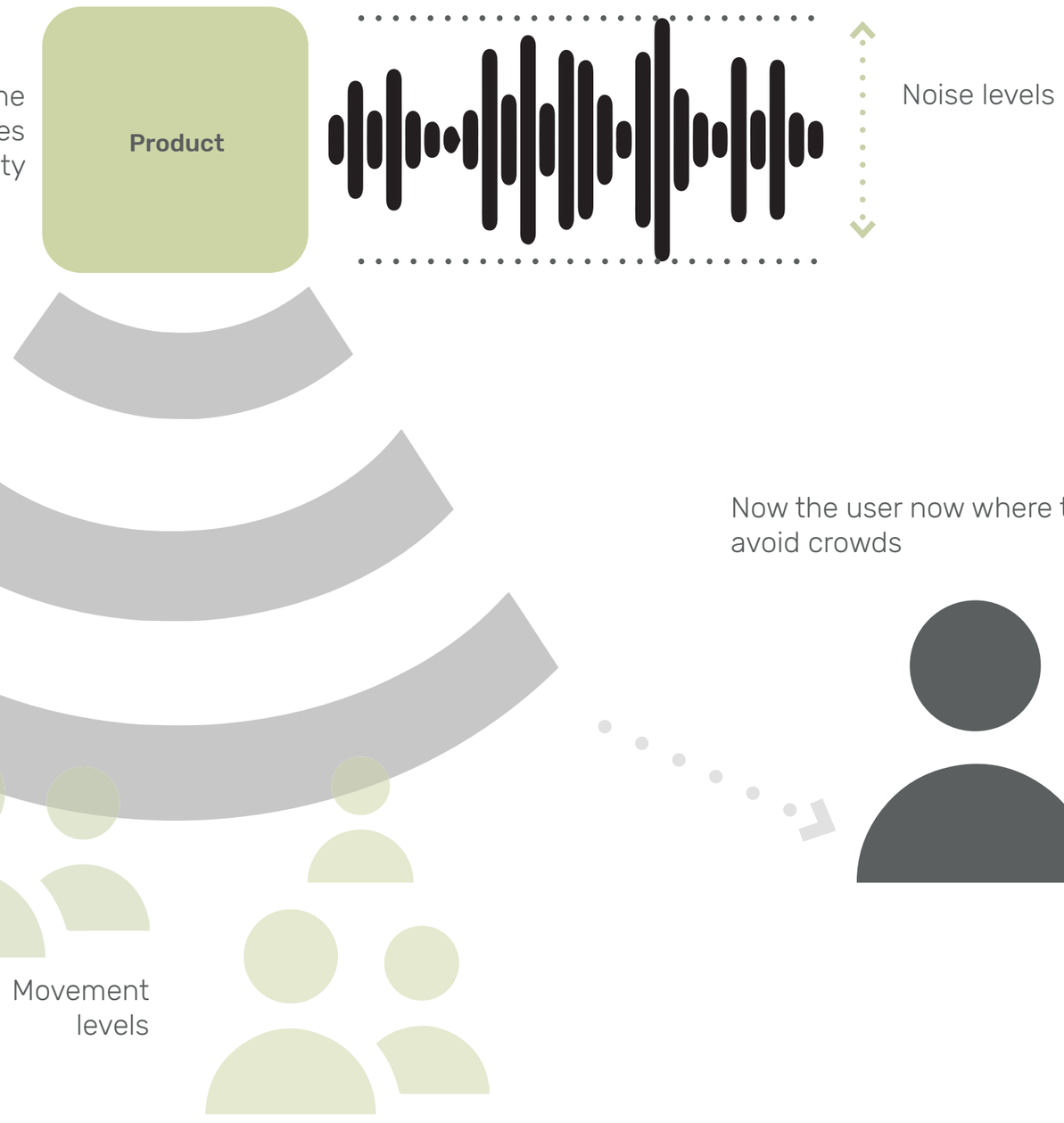


DEVELOPING FUNCTIONALITY

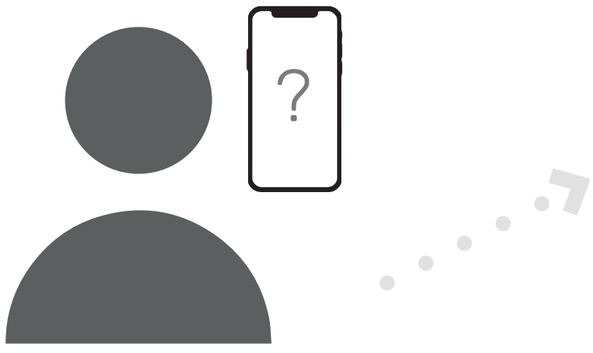
OBJECTIVE

Estimate people density in real time based in noise and movement. So people can know the amount of people in one place and avoid overpopulation.

The product detects the parameters and calculates people density



User checks the app to see how busy is a place in real time



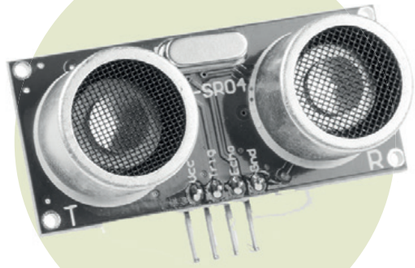
Now the user now where to go and avoid crowds

THE SENSORS

The functionality of the product is achieved with the help of electronic sensors controlled by a smart system. We will list an amount of sensors for each of the parameters and evaluate the pros and cons of each one choosing the right ones for our purpose.

Cameras are not observed in this study as is against what we have stated about privacy, the microphone however would be used to detect audio spikes and not record conversation, this should be highlighted further for the user's ease.

Ultrasonic



Detects presence
Measures distance changes (movement)
Reach up to 5m

Laser

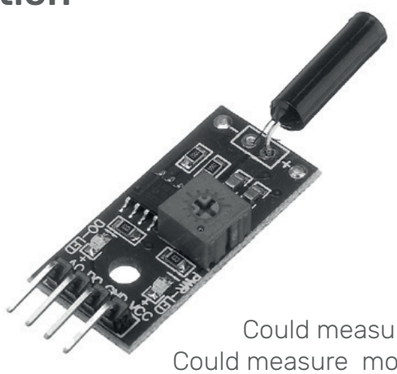
Measures distance
Really precise
Needs a twin receiver
Really high reach

Such precision and reach is not needed as we will be working on indoor spaces. Also the sensor needs a twin setup in front of one module.

Microphone

Measures noise
Low power
Could be imprecise if cheap

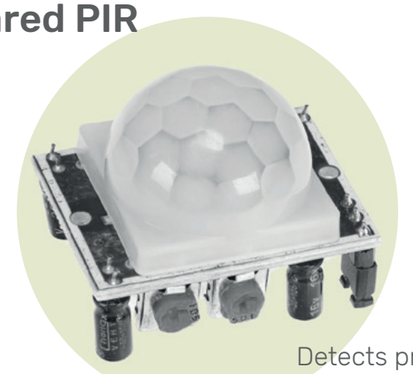
Vibration



Could measure noise
Could measure movement
Needs to be sensitive enough

The sensor is versatile, but it doesn't have the precision we require for our parameters making it become a weak decision.

Infrared PIR



Detects presence
Could measure movement (counts passes)
Reach up to 10m

Based on the technical aspects of each sensor we will use the following ones:

- Ultrasonic sensor
- Infrared sensor
- Microphone sensor

The other sensors have been discarded for being expensive, complicated or not complementary enough with the rest. The sensors need to be complementary to each other covering what the other cannot do or reach.

FORMAL APPROACH

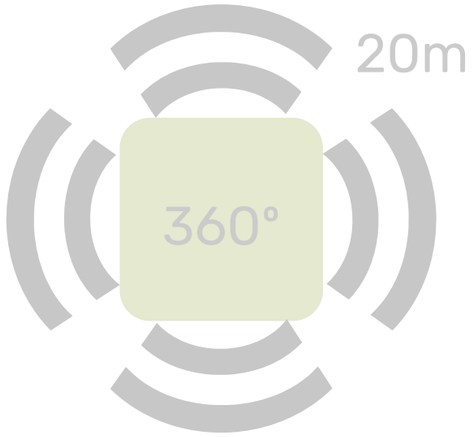
Now that we know what the product is going to contain further planning the aspects of our product is needed. Declaring what the product should look like and how should be displayed and used to perform its function will help the future parts of the project to be more agile and thus have more sense as a designer approach.

This statements are:

- The product needs to look friendly to the user and non invasive.
- The product has to cover the biggest area possible and perform its purpose.
- The product has to communicate its status to the user, showing that is working.

With all this specification we will correlate now what we have and see how we can set up our product.

COVERAGE



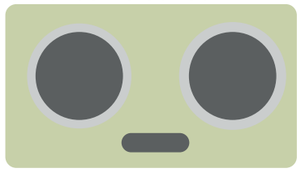
FRIENDLY LOOKING

USER INTERACTION

FORM THROUGH FUNCTION

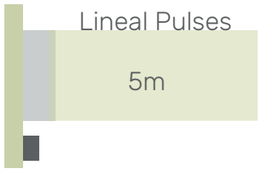
COVERAGE

Ultra-sonic sensor

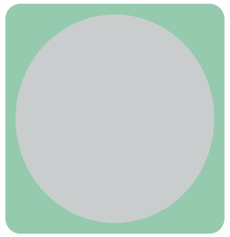


Lineal Pulses

5m

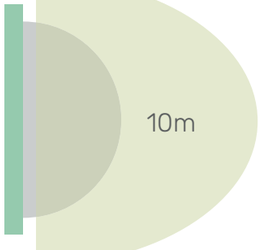


Passive infrared sensor



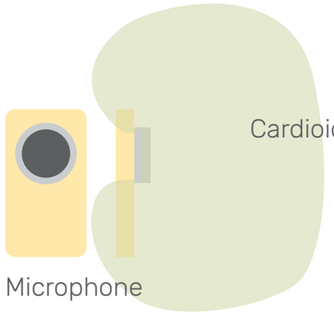
Dome area

10m



Cardioid pattern

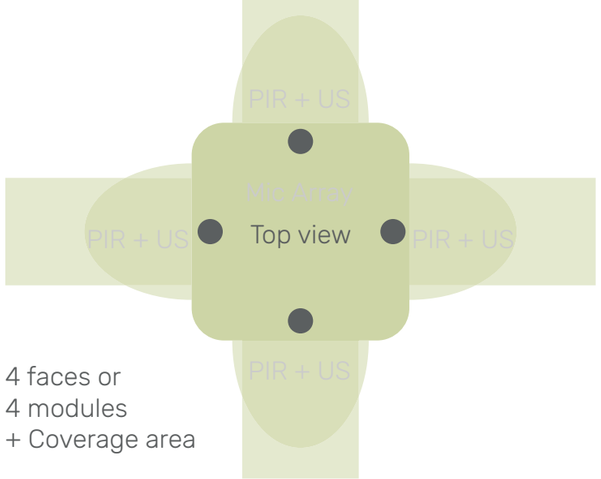
Microphone



The cardioid pattern of the microphone allows us to place it on top of the product so there is no loss or feedback coming from the back of the sensor, as it is pointing downwards.

Due to the limited range of the sensors we have to compensate the multiplying the around the product. This way we have a **360º view** of how busy is a place.

Moreover, we can now talk about **modularity,** being able to move four modules around as pleased to cover specific areas and **directionality,** we can locate where the parameters are coming form and estimate density by parts/directions in a room, depending on the intensity of the parameters.



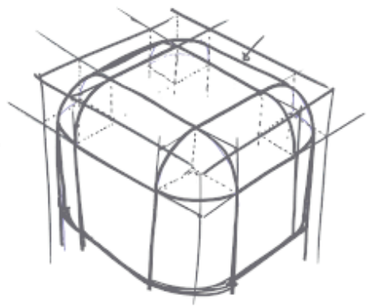
4 faces or
4 modules
+ Coverage area

FRIENDLY LOOKING

PAREIDOLIA
Is the tendency for incorrect perception of a stimulus as an object, pattern or meaning known to the observer for example seeing faces in inanimate objects.

We will use this in our favour to make the product appeal to the user subconsciously. This has been proven to work also in buildings and architectural design as the study *'Simulating Pareidolia of Faces for Architectural Image Analysis' Stephan K. Chalup 2010* carried out in the university of Newcastle, Australia that states "Humans are able to process rotated and distorted face-like patterns and to recognise emotions utilising subtle features and microexpressions."

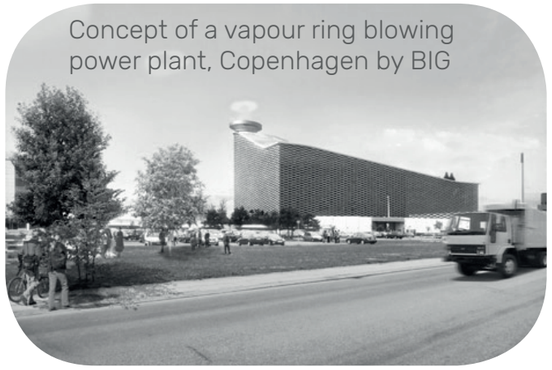
Soft transitions and rounded edges will help transmiting the friendly looking message.



Inspired by the film '*Princess Mononoke*', the spirits look friendly even if they consist of three dots.

USER INTERACTION

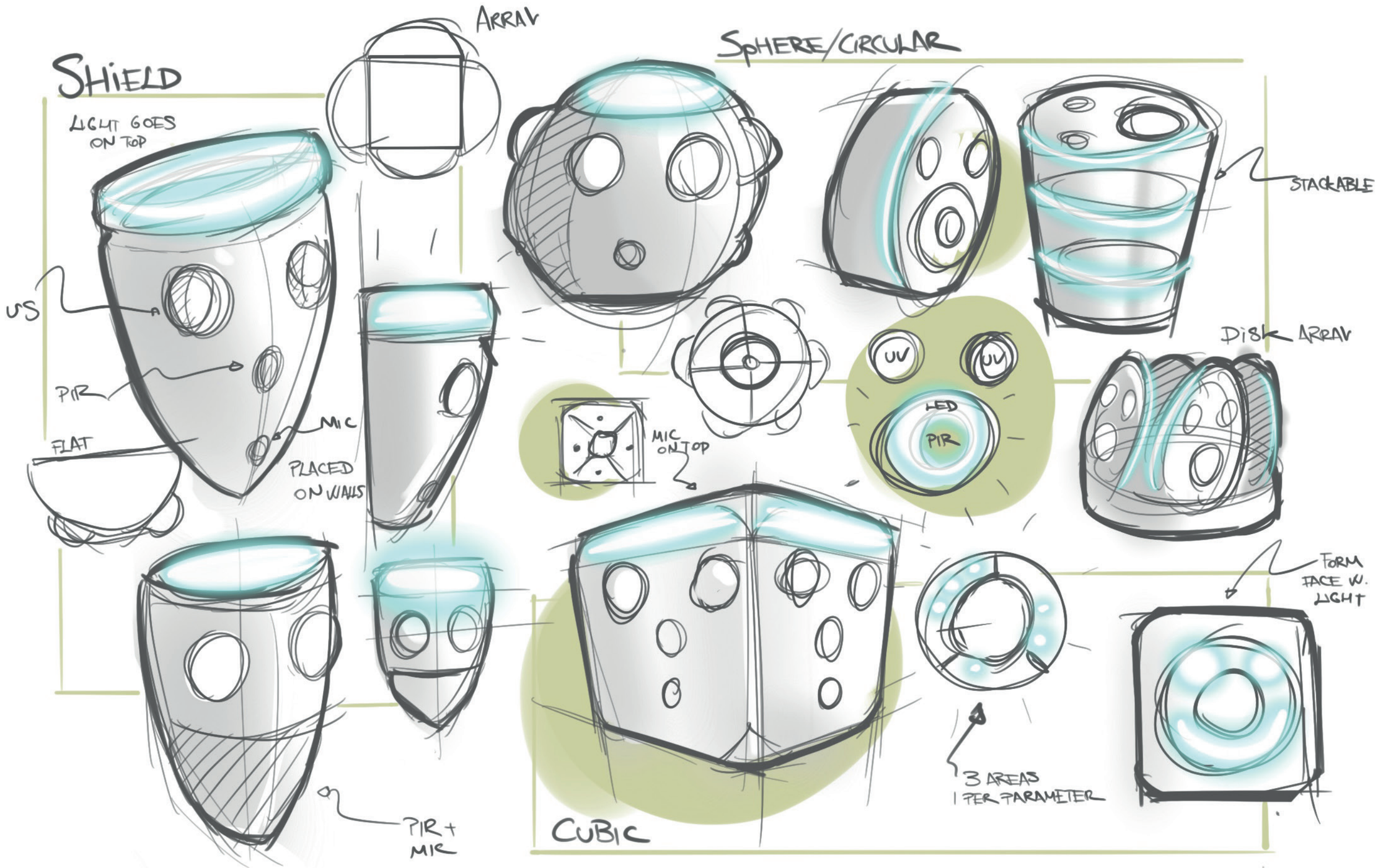
Concept of a vapour ring blowing power plant, Copenhagen by BIG



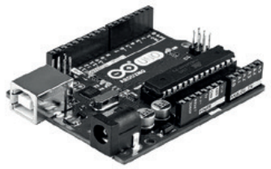
As displayed in the concept, the power plant spits vapour just to show that is working, it is a friendly way of interacting with the user.

We will use the same principle but with light, using an animated LED ring.

SKETCHING


SHIELD
LIGHT GOES ON TOP
US
PIR
MIC
FLAT
PLACED ON WALLS
ARRAY
PIR + MIR
SPHERE/CIRCULAR
STACKABLE
MIC ON TOP
UV
UV
LED
PIR
DISK ARRAY
FORM FACE W. LIGHT
3 AREAS 1 PER PARAMETER
CUBIC

ELECTRONICS AND ALGORITHMS



ARDUINO UNO V3

Is the main controller, (master) of the product its the one that calculates the outcome and send it to the app.

ANDUINO NANO

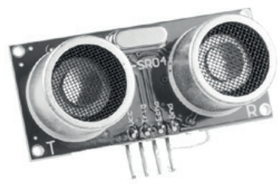
IS the brain inside each node (Slave), this part is in charge of collecting the data and sending it to the master.

BLUETOOTH HC5

Is the main way of communication the slave module will send the data to the master module, there will be one on each module and one in the master, 4 Slaves to 1 Master.

9V Battery

In charge of feeding power to the whole system.

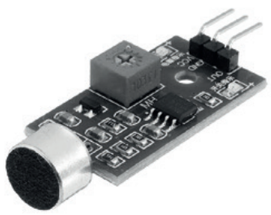


HC- SR4 (US)

In charge of detecting movement, it measures distance, so the fluctuation of this value means something is moving in front of it.

HC - SR501 (PIR)

In charge of detecting presence, with a 180° action radius will be able to tell if something is moving around it.



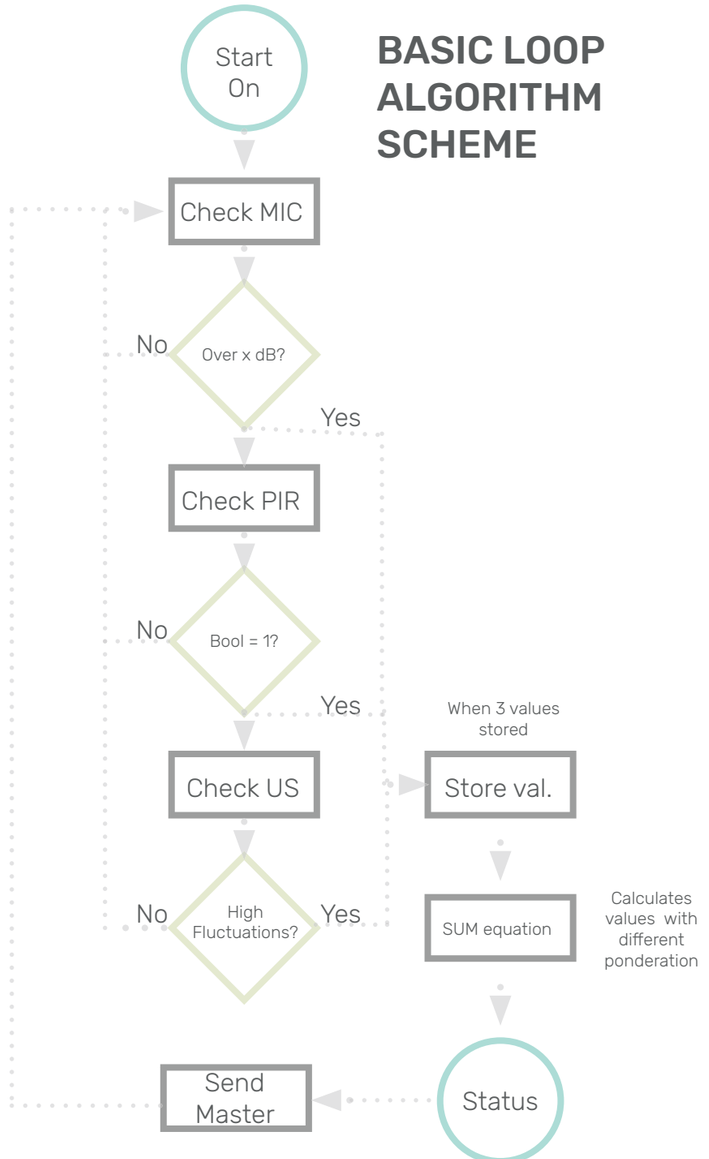
KY - 037 (MIC)

Will detect the noise levels and display them in form of dB

16 Neopixel ring

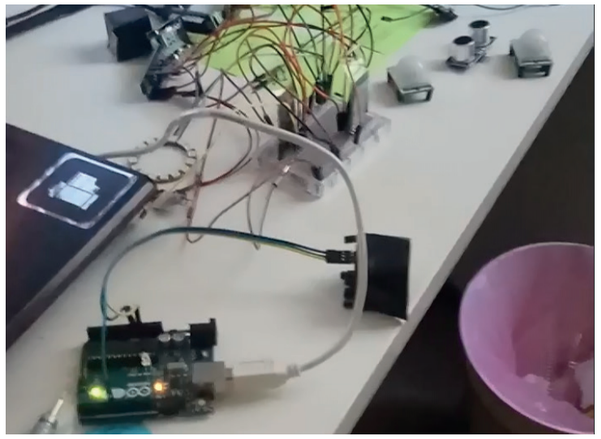
It can be animated, so it will be increasing the number lighten LEDs the busier is the place.

BASIC LOOP ALGORITHM SCHEME

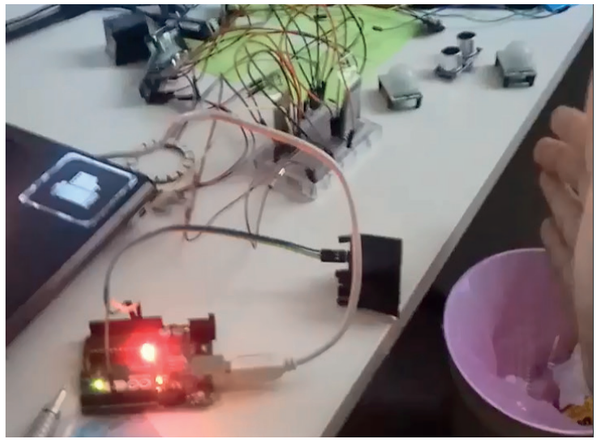


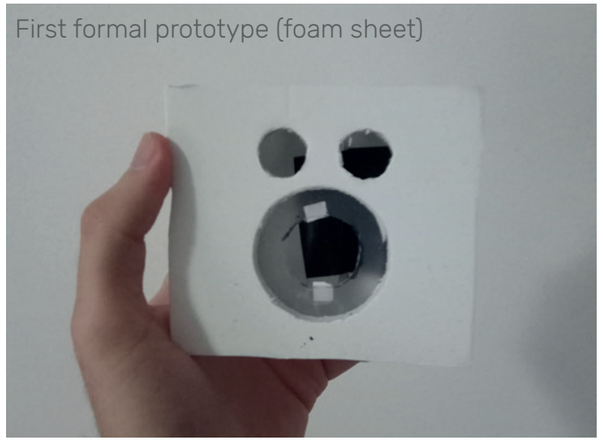
PROTOTYPING

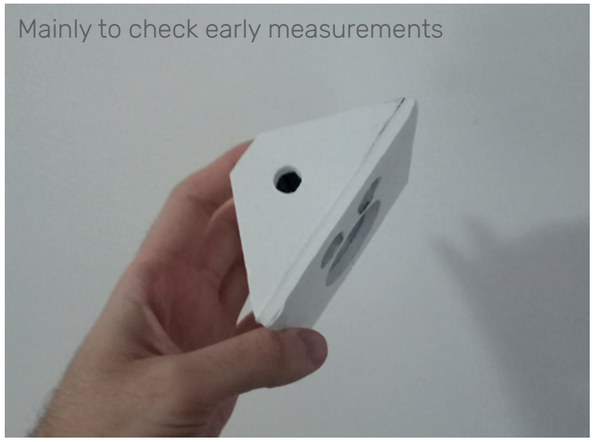
Early Arduino prototype.

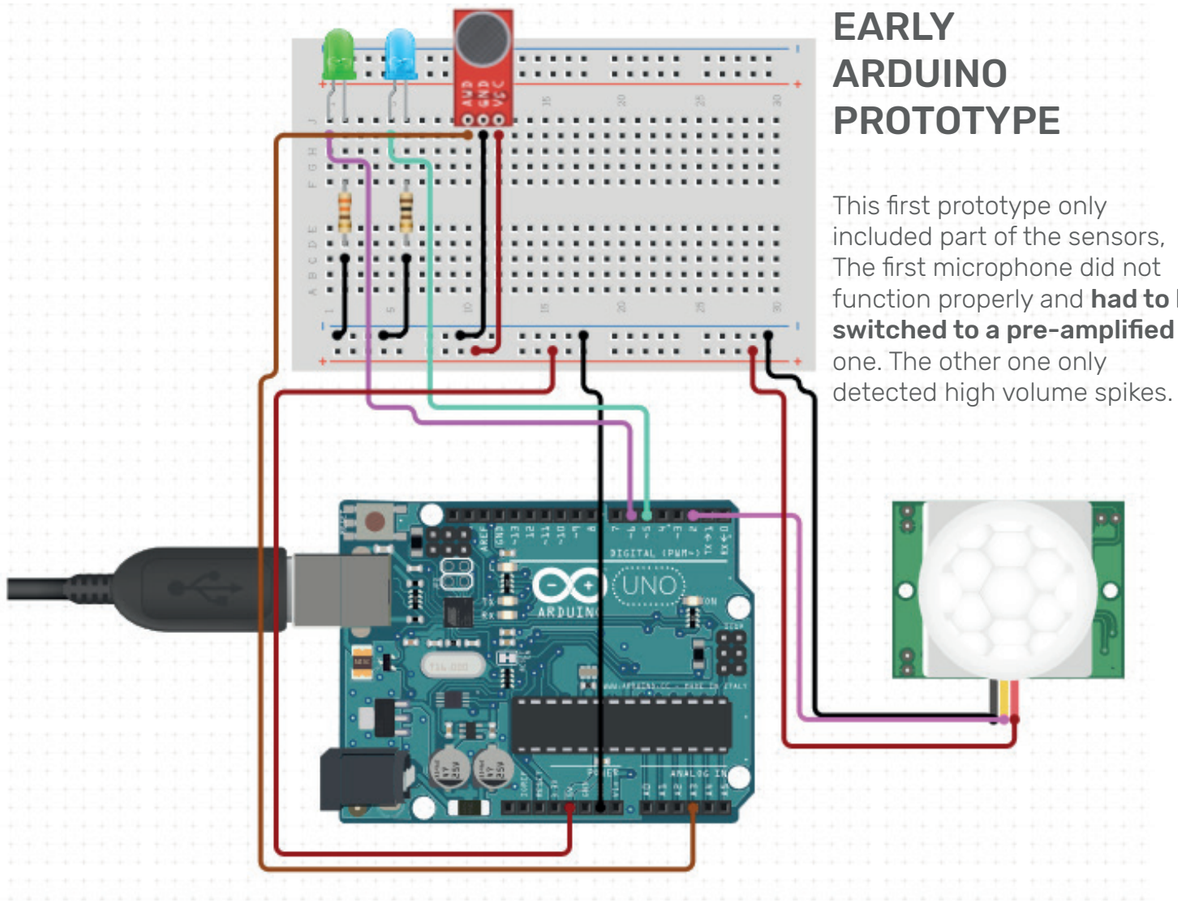


Presence and sound detection.





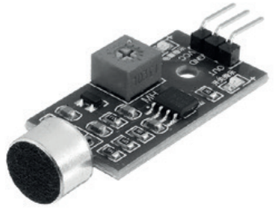




EARLY ARDUINO PROTOTYPE

This first prototype only included part of the sensors, The first microphone did not function properly and **had to be switched to a pre-amplified** one. The other one only detected high volume spikes.

KY-037 microphone



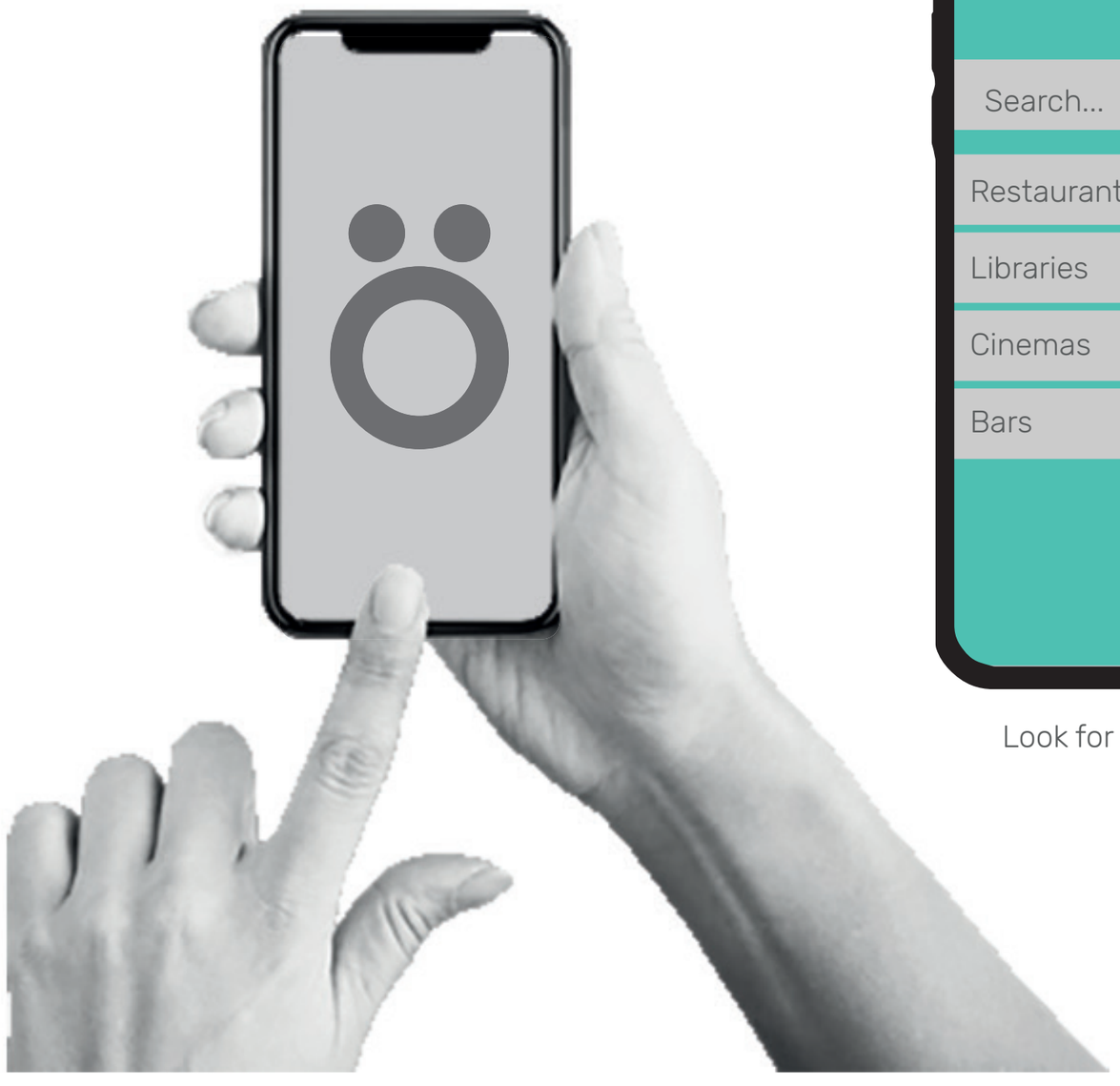
Detects sound spikes, not suitable for our application. Boolean values of 1 or 0.

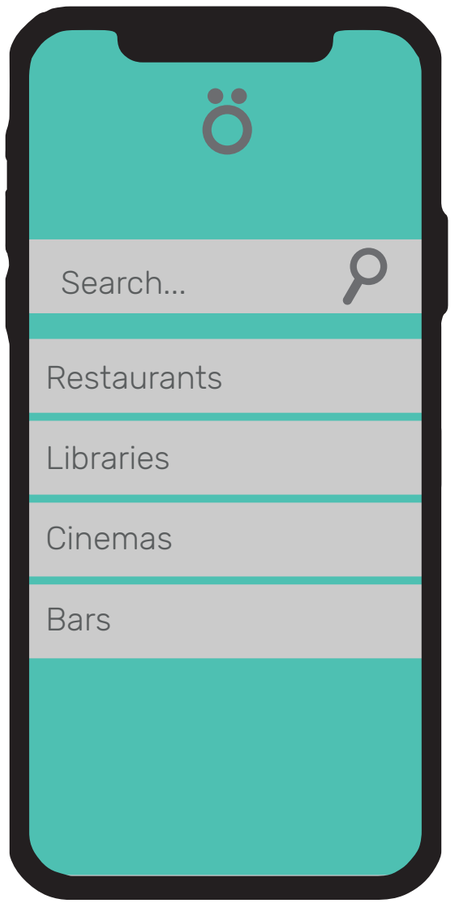
MAX9814 Pre-amplified microphone

Detects sound levels, can be converted to a wide range of dB and put into the equation.

THE APP

The application is the main medium where the user and product interact, will be used to display what the physical product collects from its environment and surroundings. This is a first approach with some basic wire-frames to develop on the detail phase.





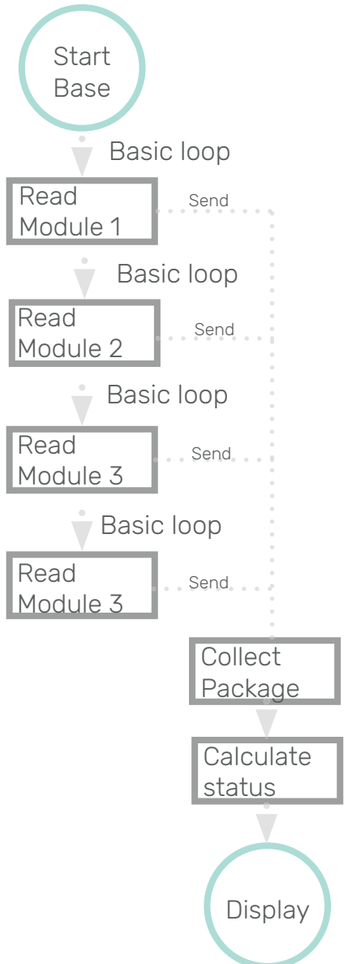
Look for a place

Browse the map,
Colours show density

Access to more detail

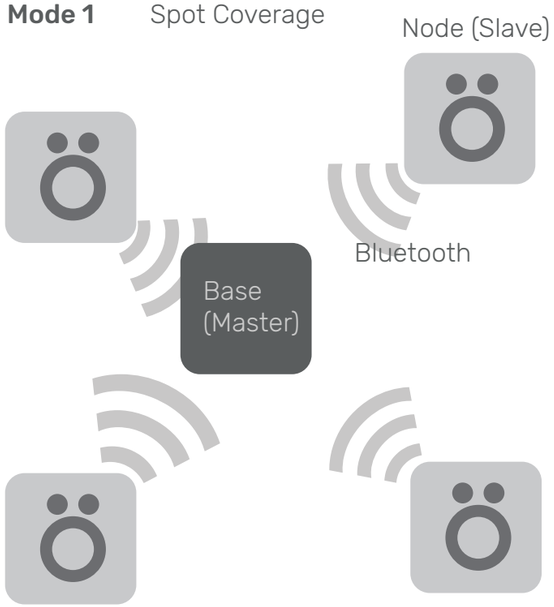
DEVELOPING THE MODEL

With a modular synthesis the algorithm changes a bit.

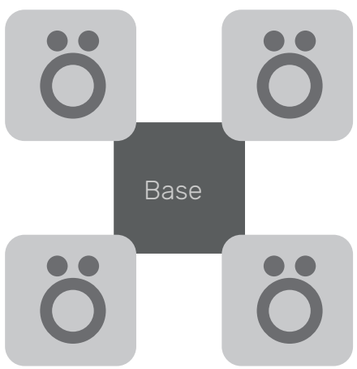


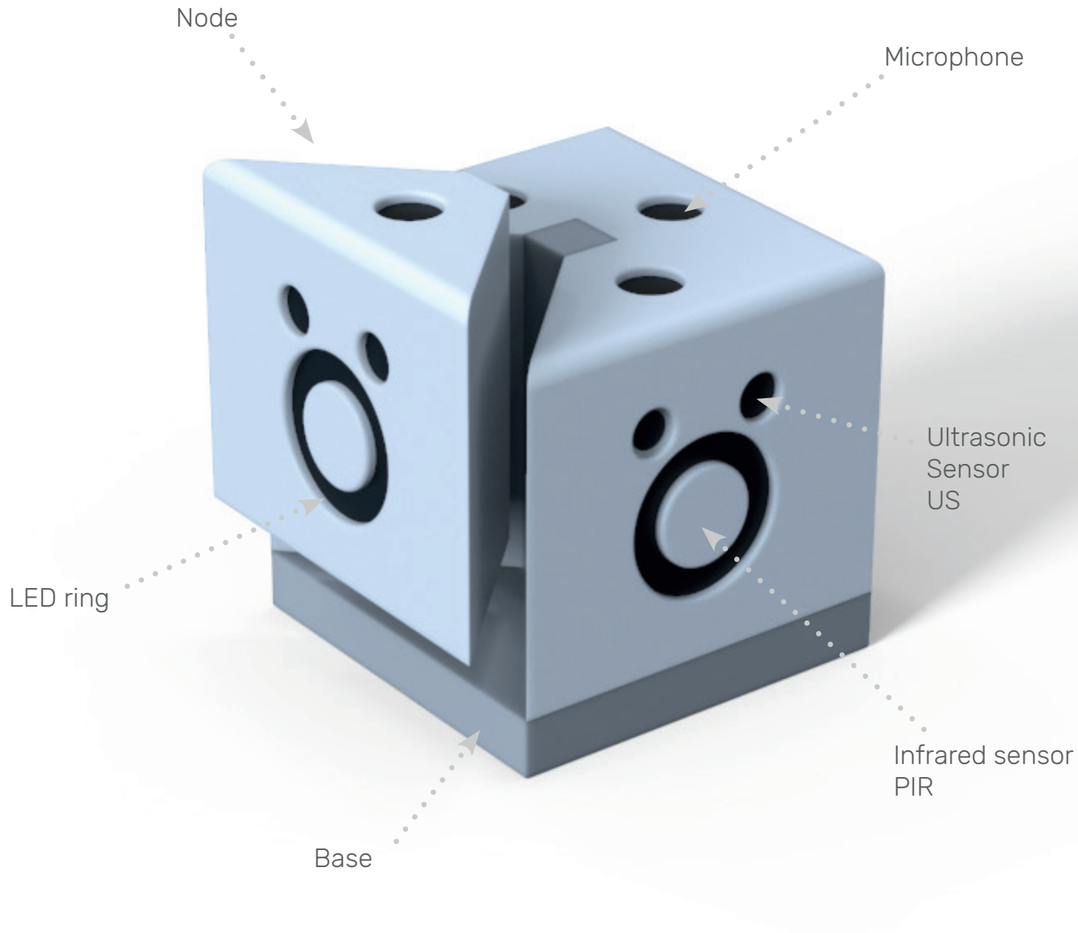
MODULAR PLAN

Mode 1 Spot Coverage



Mode 2 Surrounding coverage





DEVELOPING THE MODEL

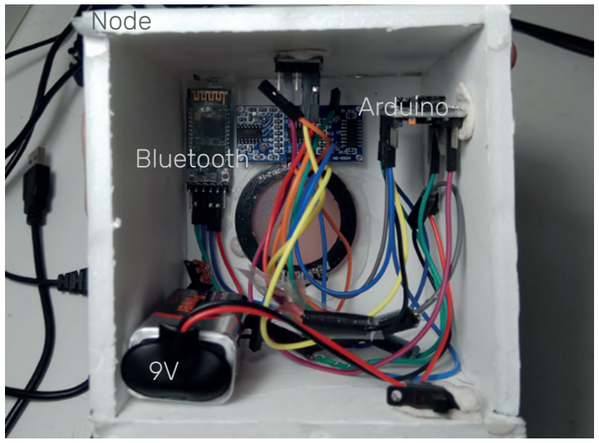
Due to some technical problems the model/prototype had to be constructed only with one module. The module had to be increased on size as I was not able to purchase smaller sensors and not able to manufacture a proper PCB.

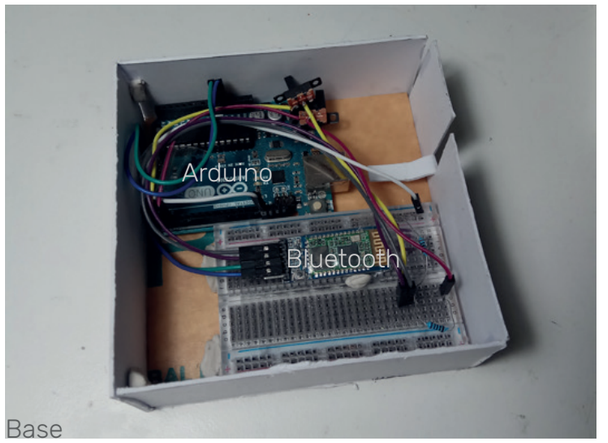
However the idea of the final product consist on the 4 modules working in harmony with the base, the requirement of more programming language skill, setting up a server for the app and achieving proper electronics is not comprehended in this project.

However, the main purpose of this prototype is try to see if in a basic performance can achieve its main purpose. The data was sent in small packages containing the main values of the product. The scheme allows us to follow a organised outcome giving different importance and weight to the different parameters.

The order of this values is represented in the algorithm the values should be mapped from 1 to 10 to indicate how high is a parameter comparing all of the in a similar scale, the cycles consist of reading of 4 seconds per module.

MOVEMENT (20 fluctuations in four sec means a 10) * 0.8 ponderation
PRESENCE (being on 1 TRUE for the whole cycle means a 10)* 0.5 ponderation
NOISE (To be determined in experimental lectures, be careful with residual noise) *0.2 ponderation
The value goes from 0 to 15 and would show how busy is a place.

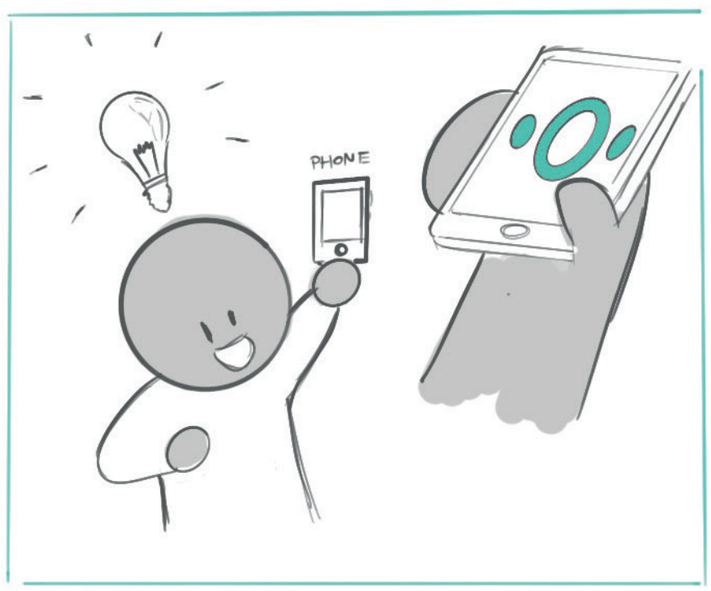


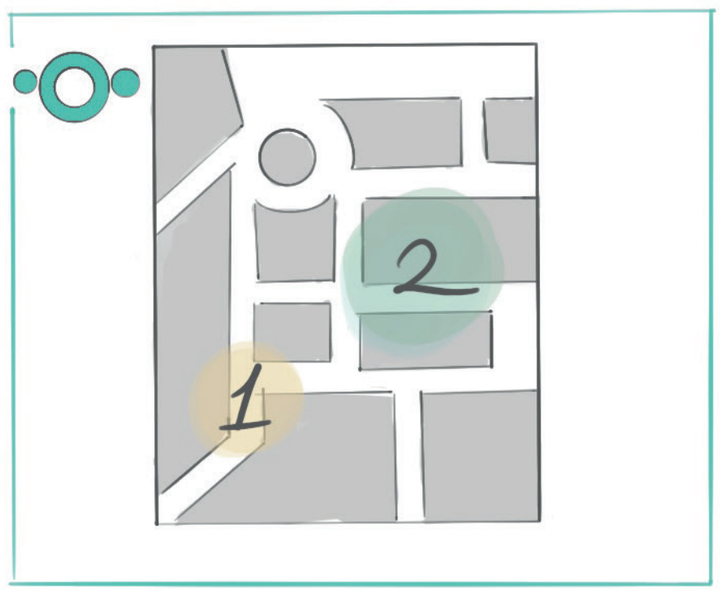


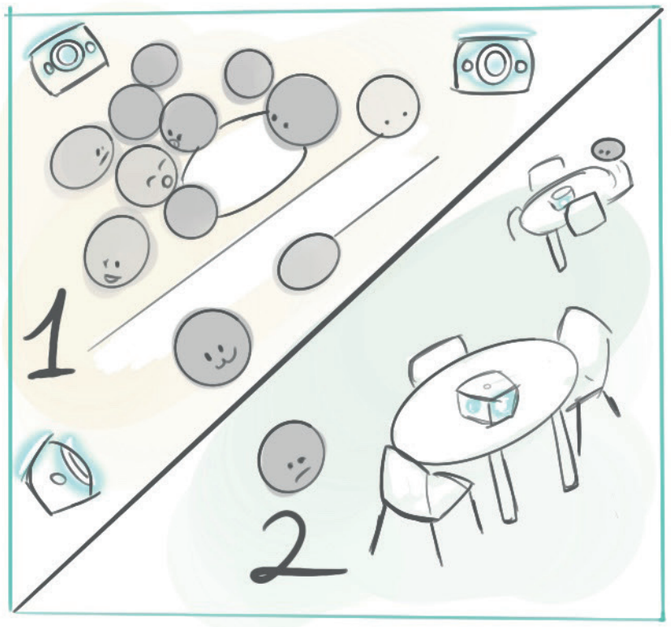
Base

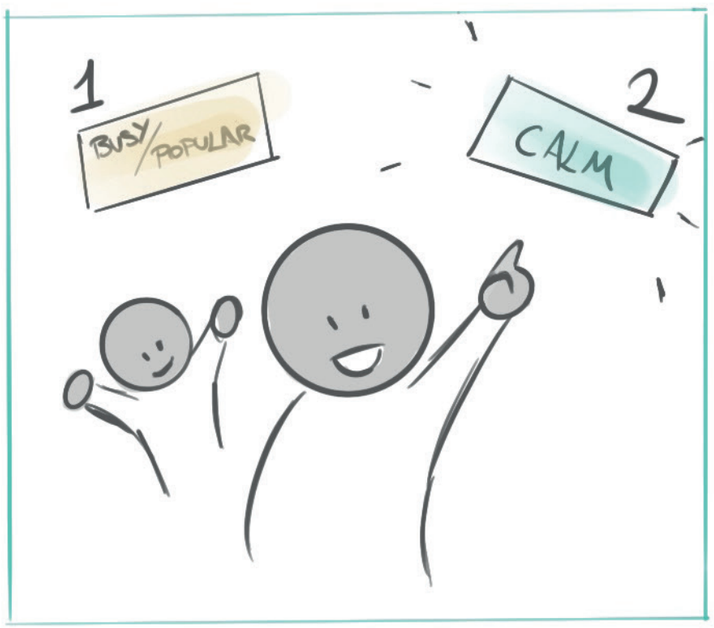
Front view

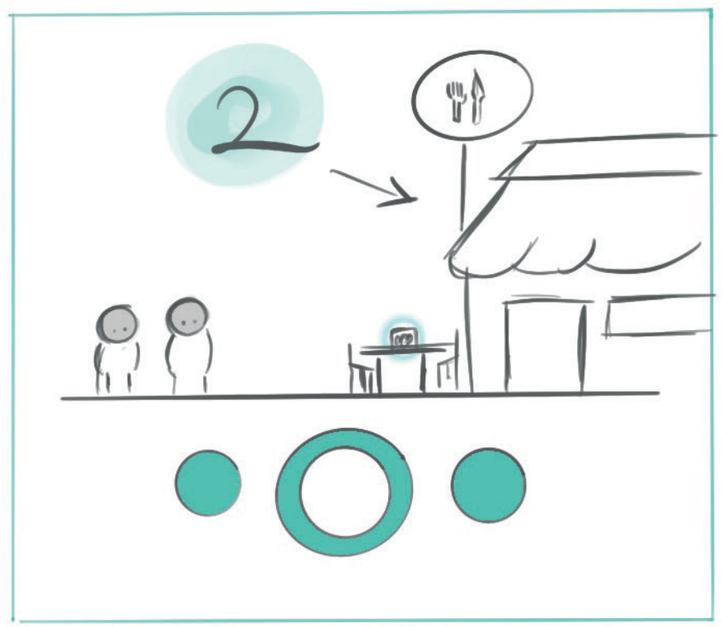
STORYBOARD











REFINEMENT

Defining the final idea

ASKING THE USERS

INTERVEWS Asking about the idea of the system

Small independent restaurant (near Tamworth Vilalge)

Free tables available always.
People don't expect it to be full, the owner thinks that it would be good for the customers rather than the business so they can cater to their needs. Customers have always a guaranteed table.

Medium chain restaurant Betty's Burgers (Darling harbour)

Place is always full.
Customers are willing to wait because of the quality and if they see there is a long queue they might think is a popular place. Might be indifferent for the business even harmful affecting their shift management.

Customers

Customers in general think that is a great idea, if they really like a place due to its quality they would not use it. However if they are deciding between same quality or the time is a constrain, they idea is great for them.

CONCLUSIONS

Restaurants seem indifferent about the idea, but **customers seem to be really interested with the concept** (mainly young people).

The application gain more weight and the **focus is reconsidered** due to people not minding long queues if the quality is good.

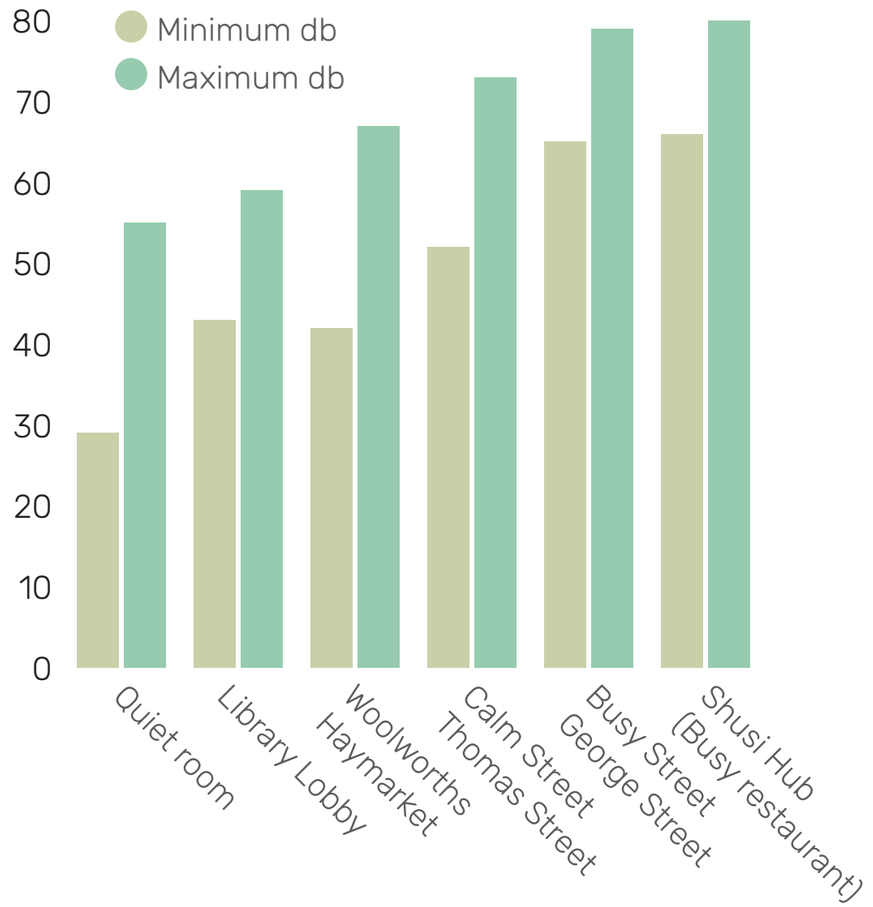
MEASURIG WHAT IS BUSY

As we stated before , we do not know yet the value in dB that define what a noisy/ busy place is. Thus, further empirical research was conducted to determine the vale that will consist in the algorithm and will give sense to that parameter.

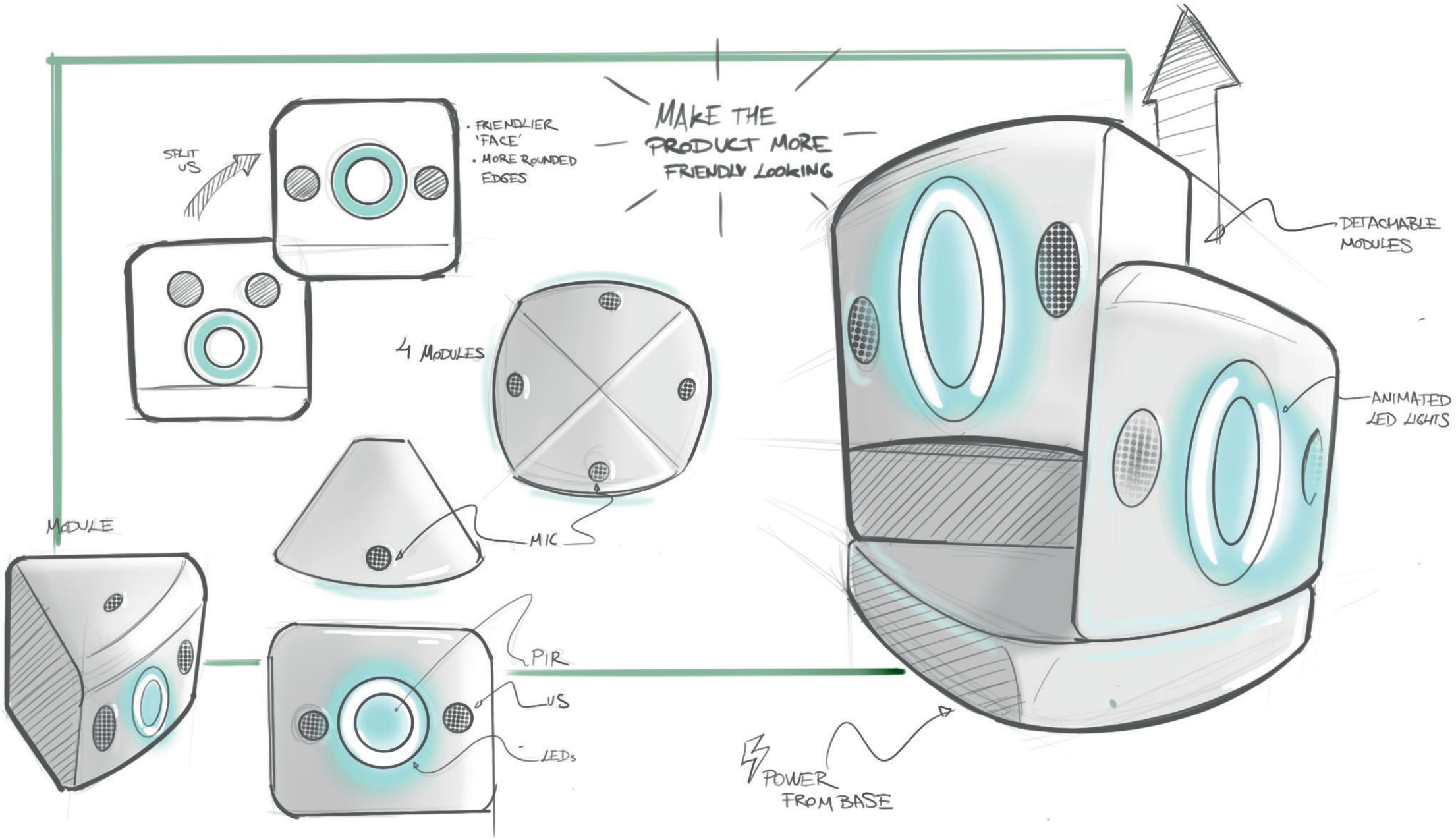
The experiment was carried out, both with the microphone prototype and secondly with a smart-phone app capable of measuring decibels during 1 minute. With both values, I traced a graph displaying the quietest value and the noisiest value and divided it by the different places I measured with the phone.

We can observe in the experiment that the values oscillate from 30dB (completely quiet) to almost 80dB rowdy restaurant. However, we will consider a more real threshold. For our algorithm **we will take from 50 to 75dB comprehending the loudest noise in an empty room to a really loud noise in a restaurant, giving us a more real approach to a indoors public space.**

Data gathering for sensor refinement



FINAL SKETCHES



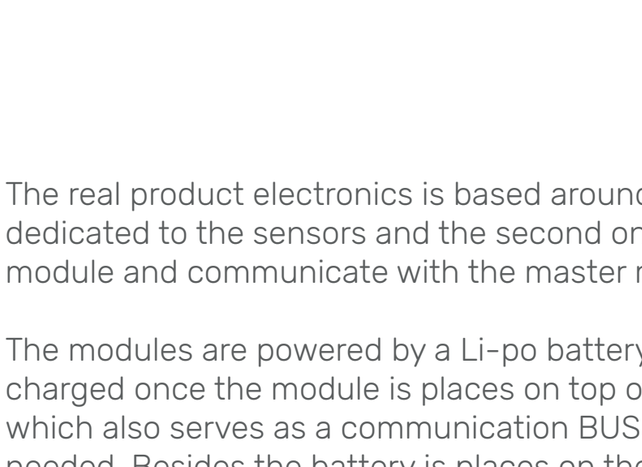
ELECTRONICS

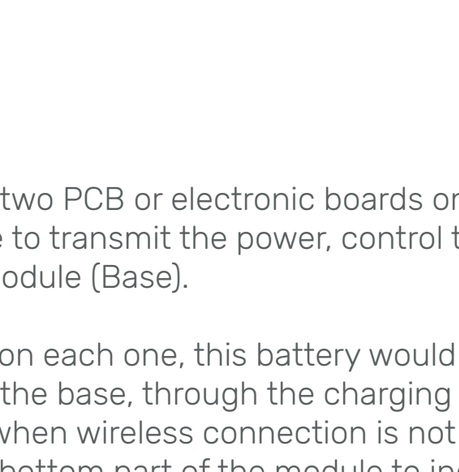
The real product electronics is based around two PCB or electronic boards one dedicated to the sensors and the second one to transmit the power, control the module and communicate with the master module (Base).

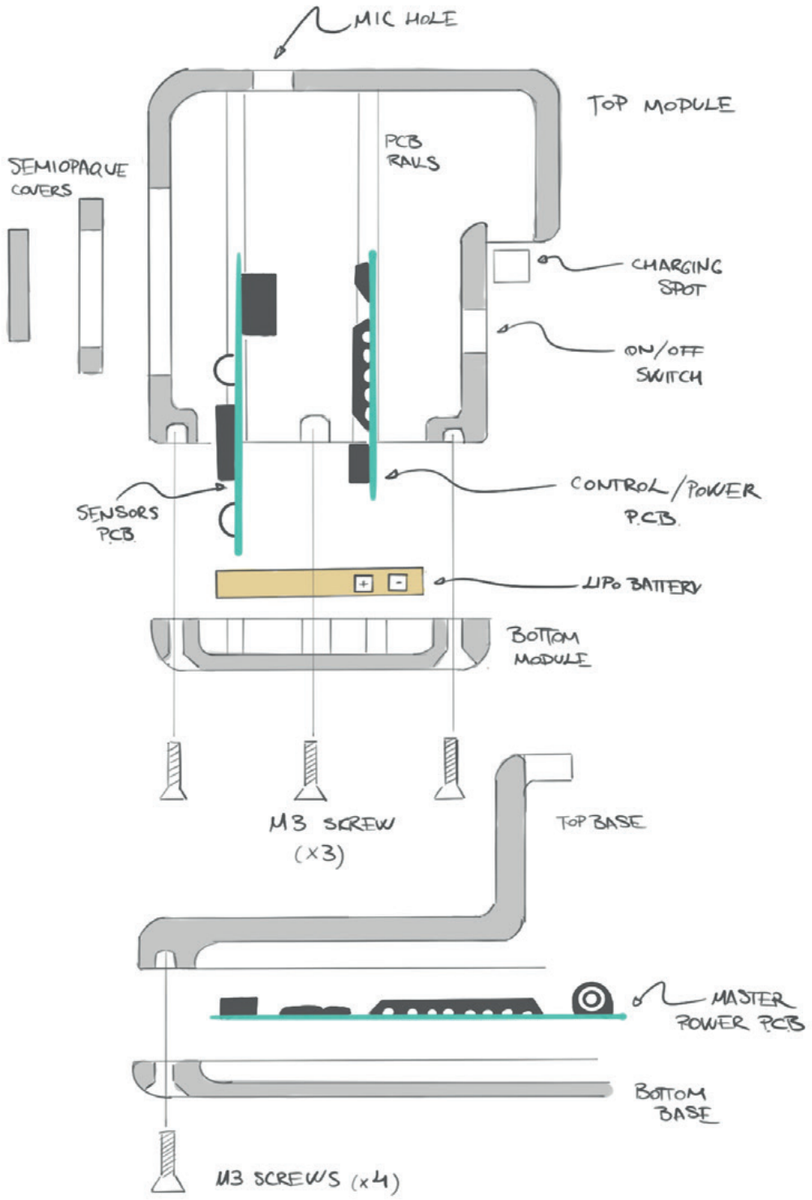
The modules are powered by a Li-po battery on each one, this battery would be charged once the module is places on top of the base, through the charging spot which also serves as a communication BUS when wireless connection is not needed. Besides the battery is places on the bottom part of the module to increase the stability of the structure.

The base, on the other hand consist of only one PCB board due to its increased size, the PCB is in charge of reading the modules and coming up with an outcome.

The assembly is based on M3 screws except the semi-opaque covers in front of the module that will be glued on place. The PCBs will slide in place fitting and the sides of the main body. This will allow an easier access and removal if needed.







MANUFATURING/MATERIALS

The product is inclined towards a more standard manufacturing approach, it will be mainly plastic and will be **injection moulded** to reduce costs already inflated by the electronics.

It will need to be a tough plastic, due to the constant exposure to people and public areas so the are the main choices to go with the material selection:

ABS

Will be the body and base plastic, is tough and relatively cheap. It can be injection moulded so there should not be any problem if the design does not contain overhangs or really complex geometries.

PMMA

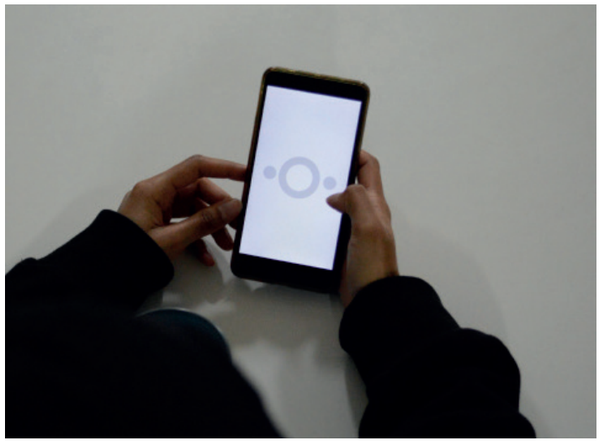
We choose this one for the semi-opaque covers, It will be two different opacities, light for the LEDs to shine through and darker for the PIR sensor getting rid of sensitivity problems.

MOCKUP APP

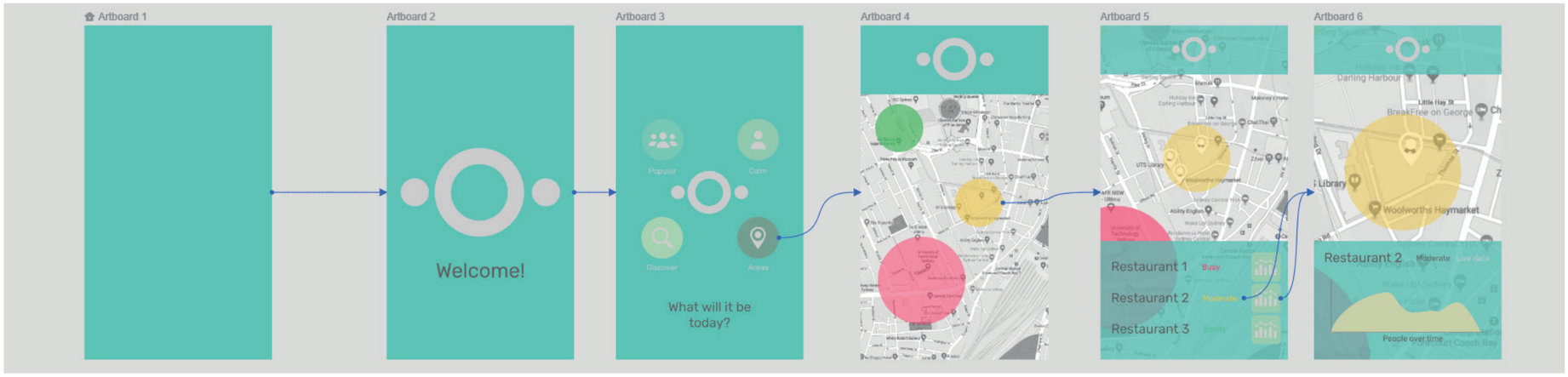
To further test the application I developed a simple mock-up on the software InVision to see whether it makes sense to the user. The application consisted on a simple search through a menu into an specific density on an area.

On the test people were asked to look for a medium density place in a map, **the study showed that the bubbles colors representing the density needed different colors to be better recognisable.**

The app will not be further developed, as it would be a bigger design project itself, but the test gave us the general idea of the utility of such part of the product.



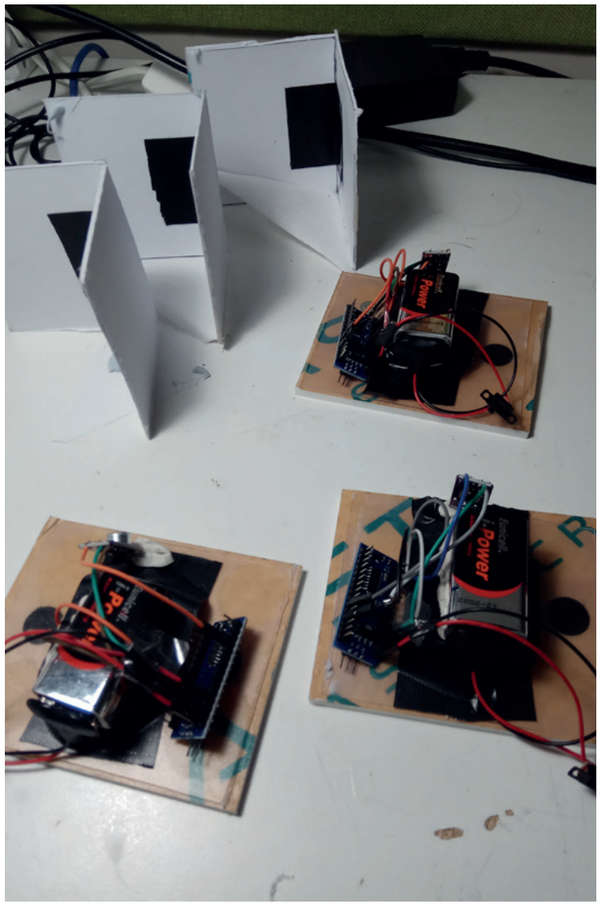
Colors on the app differ from the main color scheme for a better differentiation and recognition of area density.

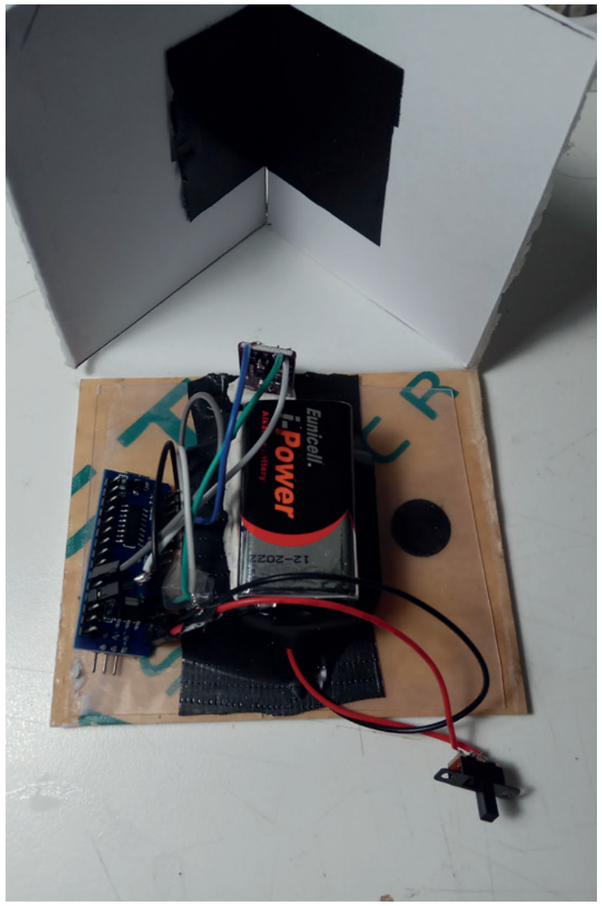


Welcome message into main menu, showing the principal actions.

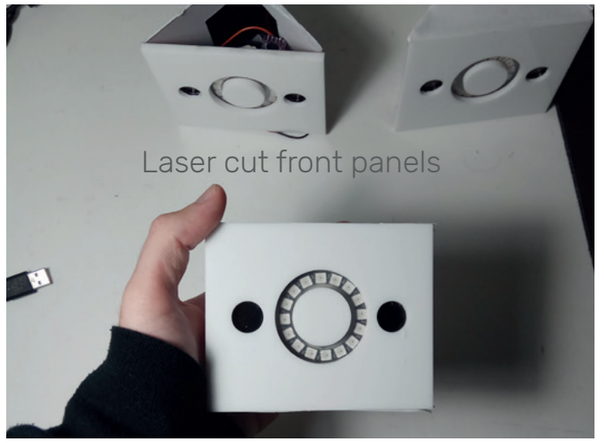
The user was asked into the mapped that showed different density values, they were asked to get into the medium density one and look for the time graph.

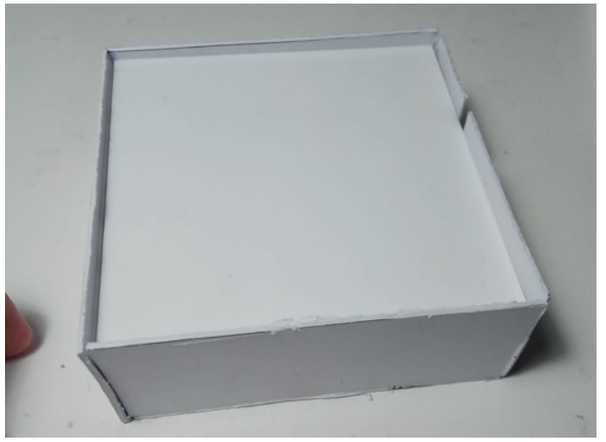
FORMAL PROTOTYPE

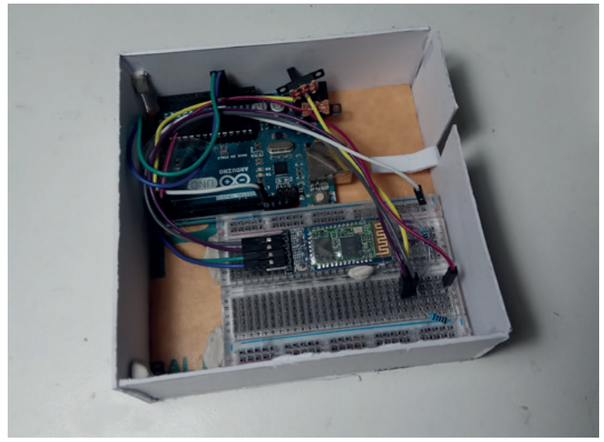




The formal prototype consisted on three more modules as a companion to the functional one. They all had light but not all the sensors, the microphone was added to them to interact with the lights in the real life testing.

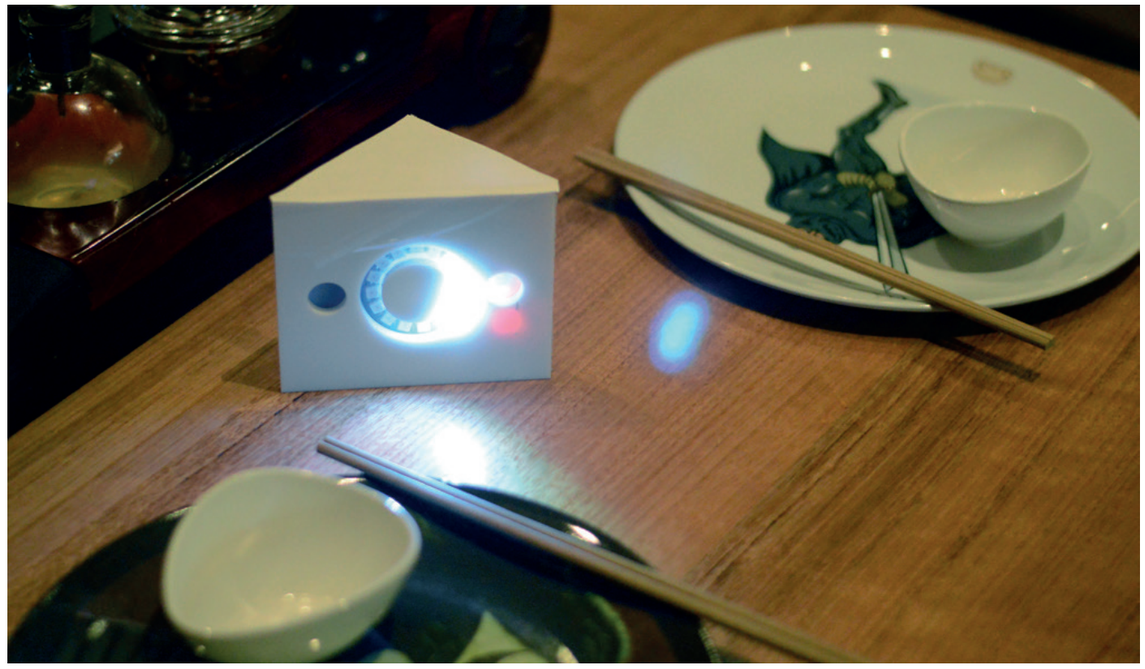


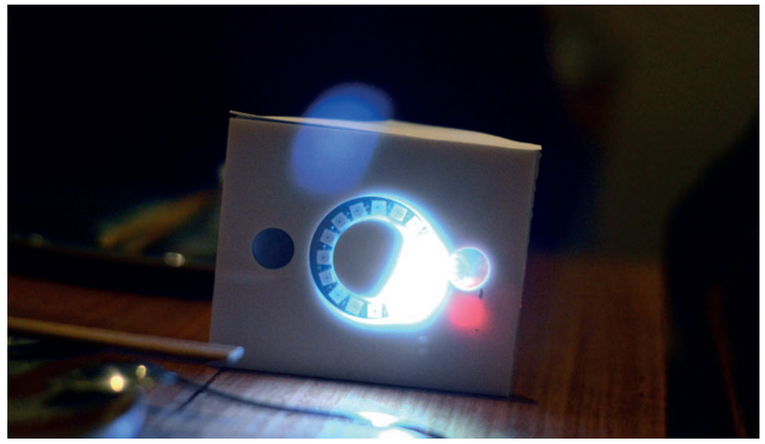


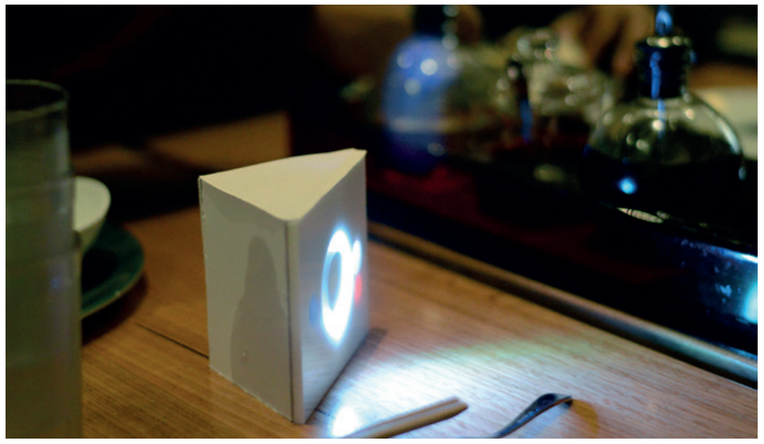


Base and functional model remained the same, just the code and some wiring were improved on them.

TESTING







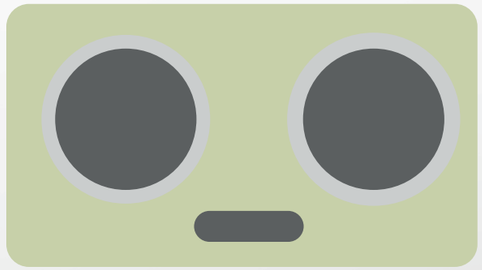
Pictures taken at
Harajuku gyoza (Darling harbour, Sydney)

The test was carried out in a public restaurant, and gave us feedback to improve the model on a later stage.

Outcome after experimentation

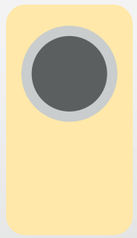
- Light is too strong, disturbance of the environment in dark places.
- People looked and pointed at it, the product is fairly visible due to the lighting.
- People don't feel uncomfortable because of the product, but might think the table is taken.
- The sensor is not the most accurate, due to it quality/price

PRESENTATION



Ultrasonic sensor

Measures changes in distances



Microphone

Measure noise levels

LED ring

Show the customer the data status

MEASUREMENT OF NOISE AND MOVEMENT TO DETERMINE HOW BUSY IS A PLACE

Infrared sensor

Measures presence

Central mode

Detachable nodes

CONCLUSIONS

After conducting the final tests and giving the final presentation to the tutors the project turned out to have some minor flaws, some of them easily addressable.

Though the product looks friendly it does not merge enough to be suitable for restaurant or public spaces. The shape is not visually disturbing but it can be improved, making it less noticeable to the average user.

The colour chosen for the lighting was a light blue, although it is an calming colour it does not affect the same way as far as LEDs are concerned. Blue is a colour with high energy in the light spectrum, so when exposed to long periods of time it can be exhausting to the human eye and could disturb the people around. The idea is to dim the colour to a more orangish look and making it feel more cosy.

There is another problem regarding tall objects. When programming the prototype chairs were not taken into consideration, making it a flaw in the code and resulting in false positives of movement. We can address this problem by pointing this sensor slightly upwards an angle high enough to not be disturbed by this objects but still catch the human figure in its range.

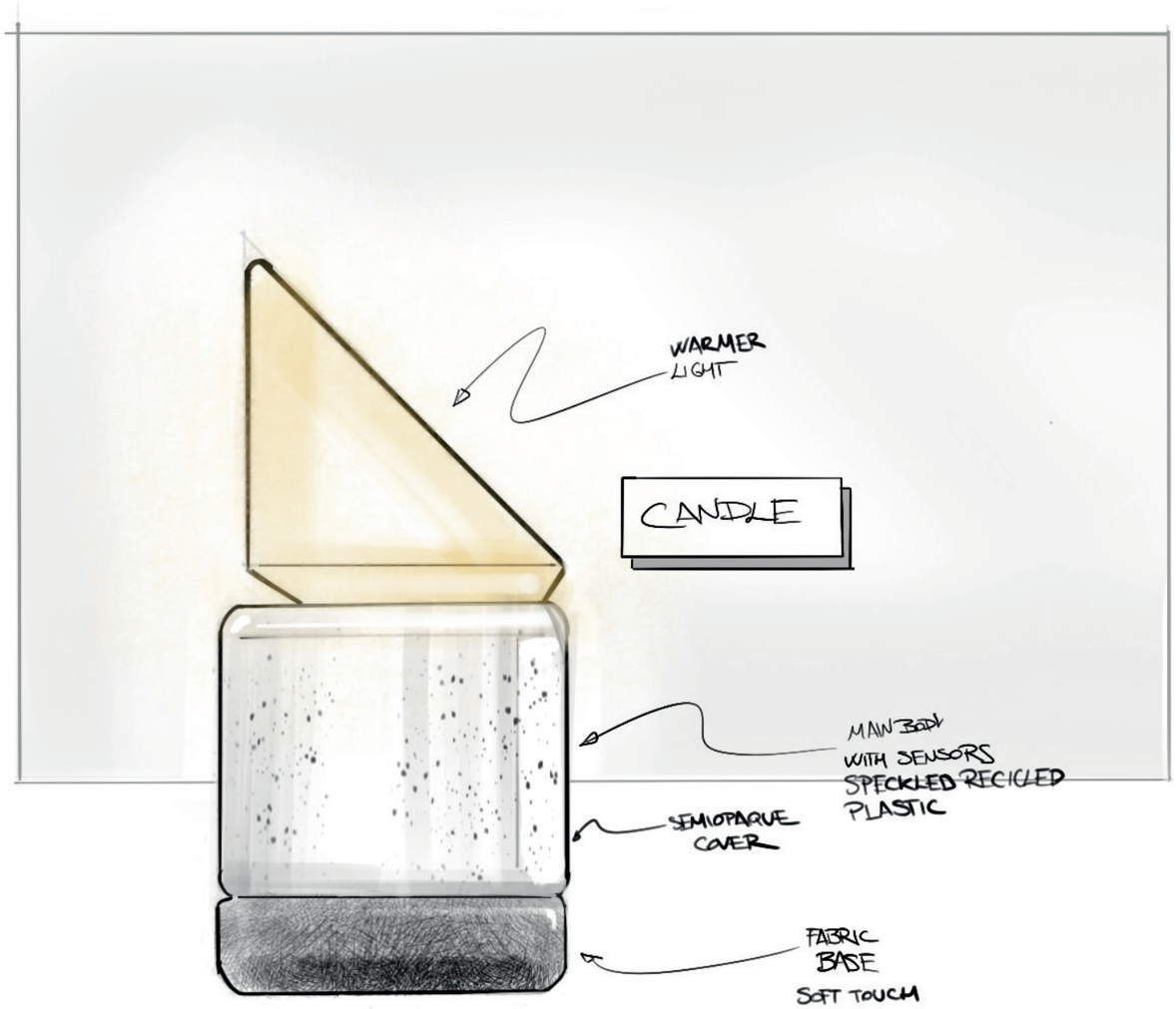
The materials chosen are not properly explored and might be good considering other more ‘human’ materials. This can be addressed by choosing recycled plastics or tending material such as fabrics or timber, more environmental friendly and easy to replace/repair.

Nevertheless, having some flaws does not mean that the project was a complete failure. It had a high acceptance amongst the tutors and the interviews people, the utility of the project relies on a well structured software and quality sensors, qualities unfortunately out of reach for an university student.

Moreover, the system accepts further improvements and capabilities putting it in a scope of bigger updates and possibilities.

Overall the project was satisfactory and enriching enough to learn about today’s society and the different points of view on the bigger problem of overpopulation. The electronic product approach is one of the different manners of addressing an increasing problem, that is impacting a huge amount of field in the modern era. Is in our hands as designers trying to ease people’s lives and making them more comfortable while addressing a bigger frame of problems, such as environmental issues, political, social, cultural, etc. There is always a place to begin when trying to solve a problem and it might not be the right solution, but may help by inspiring others into the solution of a valuable outcome.

FURTHER IMPROVEMENT (POST)



This is an idea after being evaluated, that addresses all the problems stated before. Again this was not shown in the final presentation, so this would be an extra for further exploration.

The friendliness is not based any more in the idea of pareidolia, now it is more related to a daily life object as it could be a sheer candle. The model is polygonal so it reassembles a modern aesthetic.

The materials have changed as well, it is now formed by speckeld recycled plastic, a trend in design that is helping the environment. Also the base is now grey cloth giving it a more human touch and dampening any hit that might suffer.

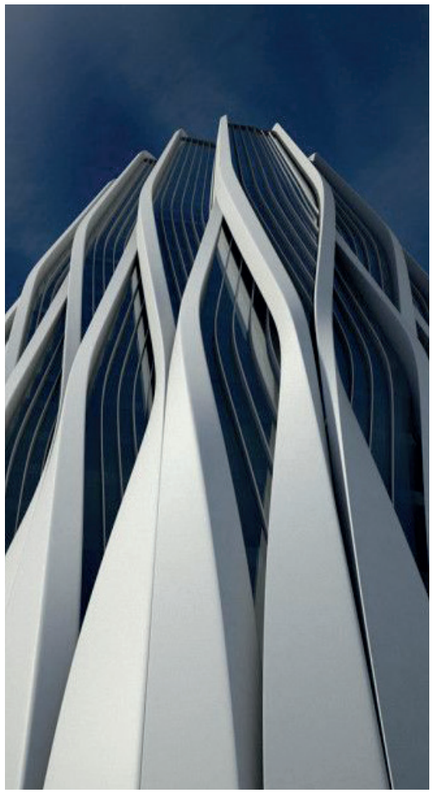
Light has changed from blue to orange, the idea of animating it is no longer in practice. Now the light is dimmer the less people there are around, an brighter and more flickerish the busier is a place, giving more light and ambience to the space.

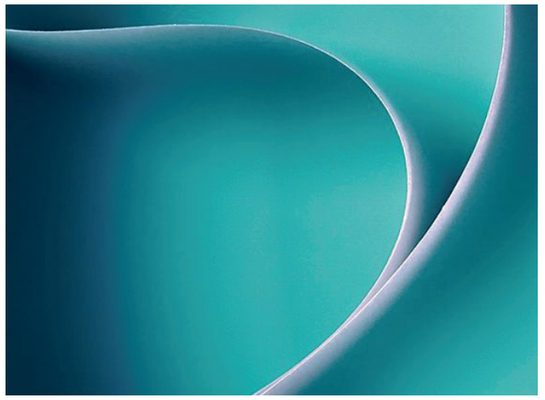
This whole idea relies one the relatable object making it easier to being accepted by the users that are not aware of its function. The product would remain the same modular structure and electronics.

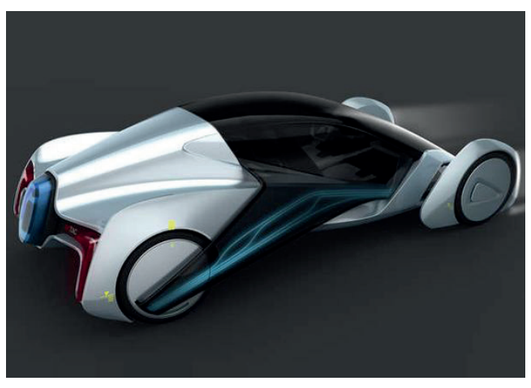
ATTACHMENTS

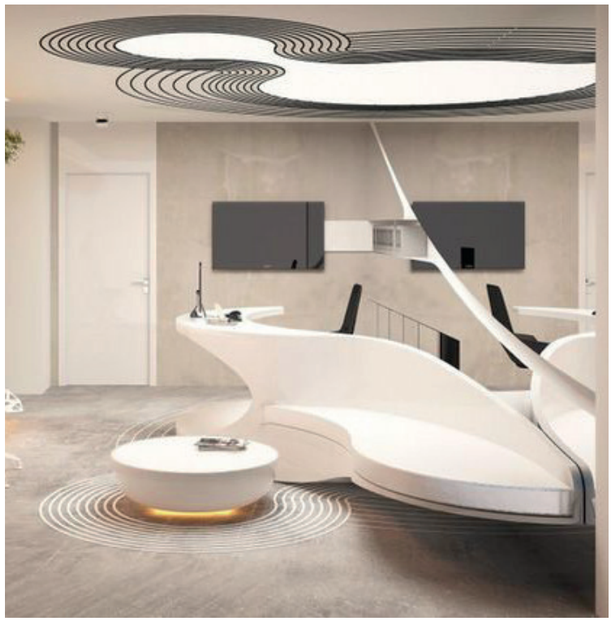
Extras not included in the process explanation

MOODBOARDS

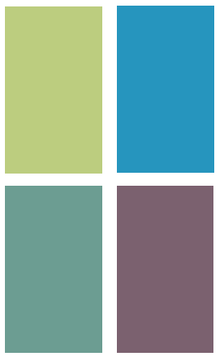


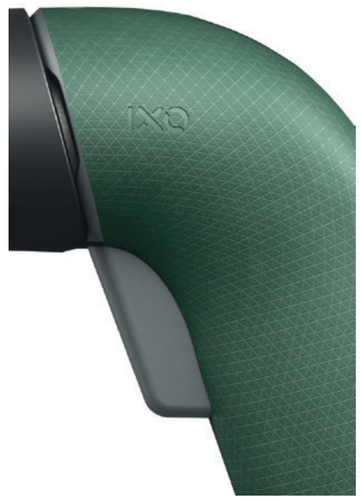






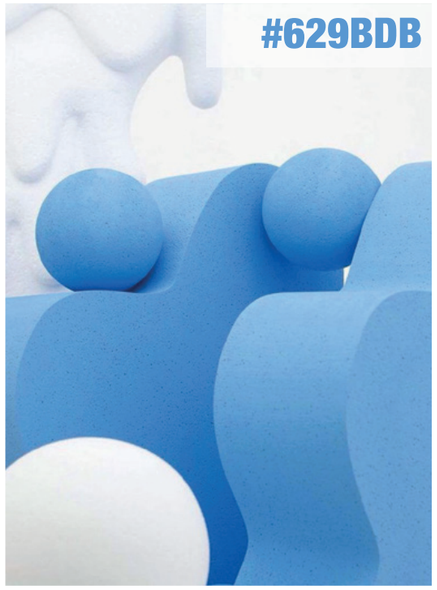

KEVIN.MURPHY
SMOOTH.AGAIN.RINSE
FULL.AGAIN
ANGEL.RINSE
PLUMPING.RINSE
LEAVE-IN.REPAIR





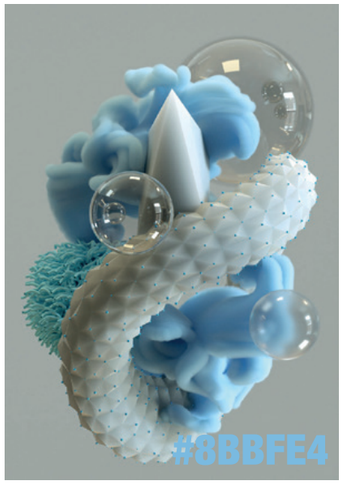
#15256

#807BAC



#629BDB

#36F6DD



#8BBFE4

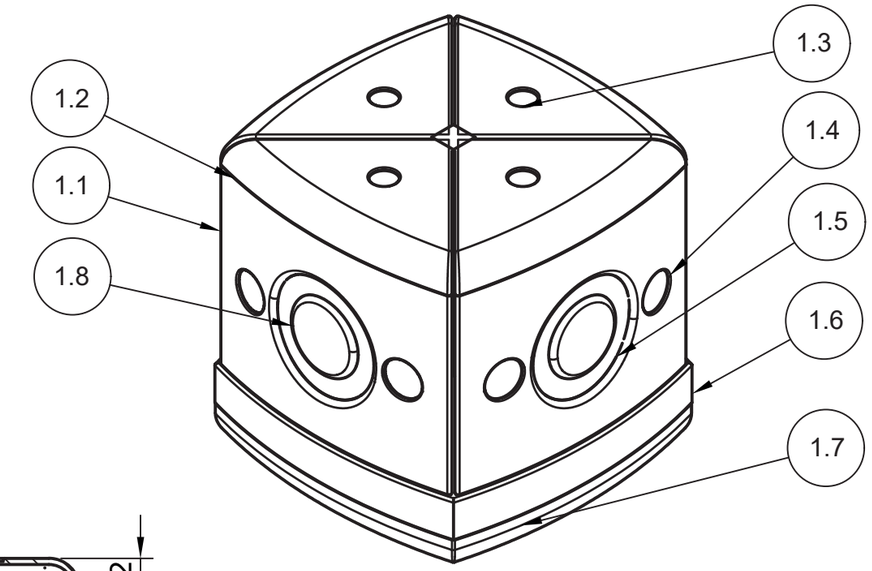
#1E9CD7

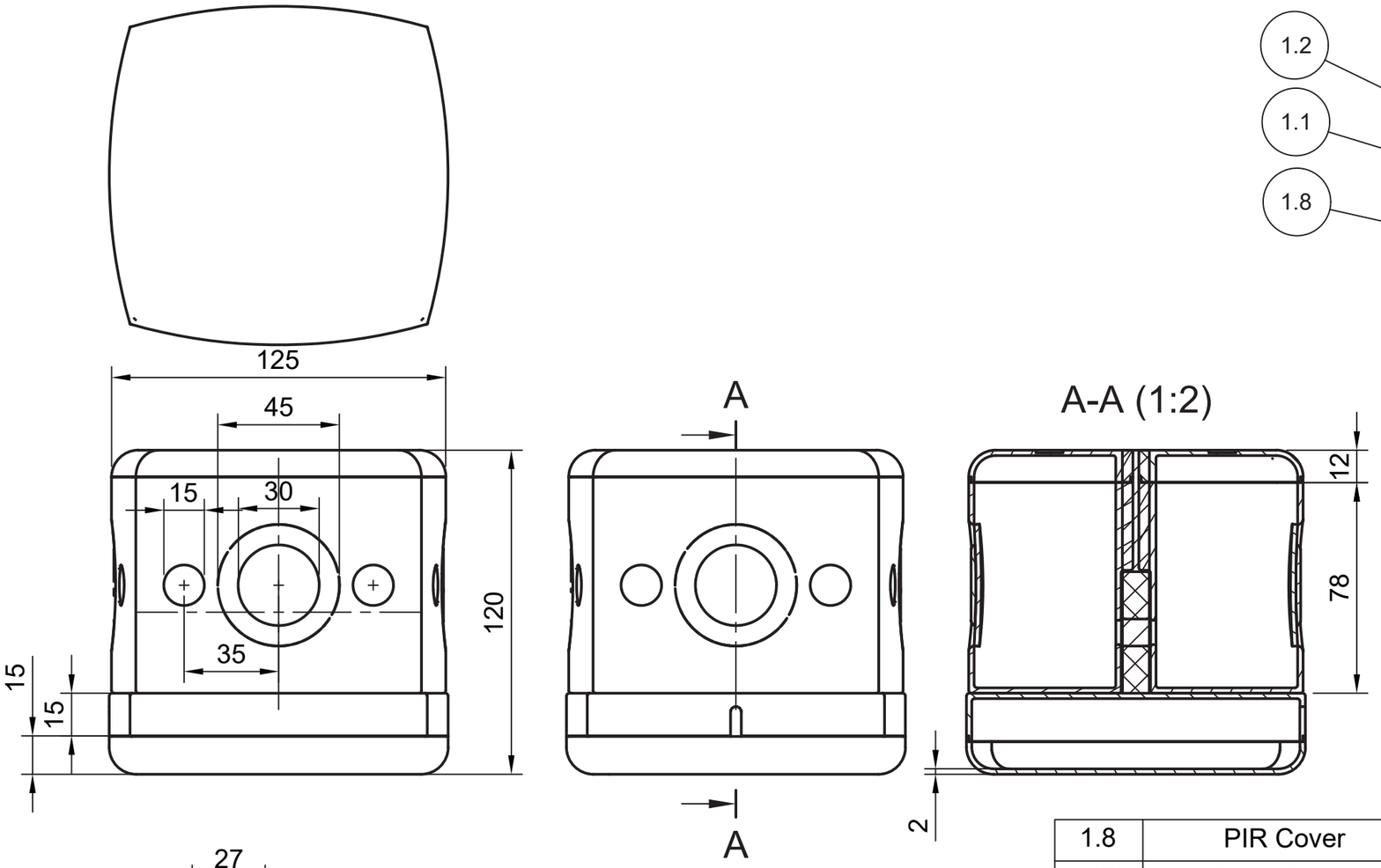
#363636

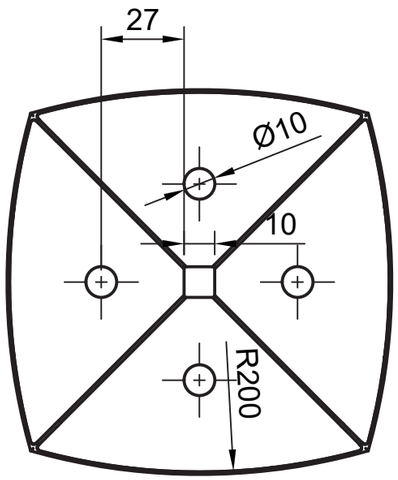
#7C848B

#333A49

#0092CF







Ref	Name	Qty.	Material
1.8	PIR Cover	4	Translucent PMMA
1.7	Base Bottom	1	RAL 9016 ABS Plastic
1.6	Base case	1	RAL 9016 ABS Plastic
1.5	LED Cover	4	Translucent PMMA
1.4	US Cover	8	Poliester Fabric mesh
1.3	Microphone Cover	4	Poliester Fabric mesh
1.2	Slave top	4	RAL 9016 ABS Plastic
1.1	Slave Case	4	RAL 9016 ABS Plastic

Dept.	Technical reference	Created by	Approved by
		Jesús Escudero Pérez	
		Document type	Document status
		Title: Product Main Module	DWG No.: 1.0
		Scale: 1:2	Date of issue:
		Sheet: 1/1	

Universidad Zaragoza 1542

CODING

MASTER MODULE

Interpreting the values.

```
#include <EasyTransfer.h>

char dbChar[10];
char distanceChar[10];


struct NODE_DATA_STRUCTURE
{
 float db ;
 float distance;
};

struct ACKNOWLEDGE
{
 boolean received = false;
};

NODE_DATA_STRUCTURE data;
ACKNOWLEDGE acknowledge;

EasyTransfer ETin, ETout;

void setup()
{
 Serial.begin(9600);
 ETin.begin(details(data), &Serial);
 ETout.begin(details(acknowledge), &Serial);
}
```

```
void loop()
{
 if(ETin.receiveData()){

   String dbString = String(data.db,1);
   dbString.toCharArray(dbChar,10);
   Serial.print(“noise =”); Serial.println(dbChar);

    String distancetString = String(data.distan-
ce,1);
   distancetString.toCharArray(distanceChar,10);
   Serial.print(“distance =”);Serial.println(distan-
ceChar);

   acknowledge.received = 1;
   ETout.sendData();

   if (int(distanceChar)< 30 || int(dbChar)>55)
  {
   Serial.println(“status = calm”);
  }
  else
  {
   Serial.println(“status = busy”);
  }
   }

 delay(200);
 acknowledge.received = 0;

}
```

PROCESSING LANGUAGE

Visual Representation.

```
import processing.serial.*;
import processing.serial.Serial;

static final int PORT_INDEX = 0, BAUDS = 9600;

int[] vals = {};


String val;

Serial arduinoUno;

void setup()
{
 size (800,800);
 arduinoUno = new Serial (this, “COM8”, 9600);
}

void draw()
{
 background(66,66,66);

 if ( arduinoUno.available() > 0)
 {  // If data is available,
 val = arduinoUno.readStringUntil(‘\n’);
 }

println(val); //pr}
```

Although it has been mentioned before this code is not shown in the memory, this was the code used to visualize the microphone input and display its values on a vertical axis.

SLAVE MOULE

Collecting and Sending values.

```
#include <Adafruit_NeoPixel.h>
#include <EasyTransfer.h>
#include “echo.h”

#define mic A0

#define PIN 3
int ledsMic[] = {1, 2, 3, 4, 5, 6, 7, 8};
int ledsUs[] = {9, 10, 11, 12, 13, 14, 15};
Adafruit_NeoPixel strip = Adafruit_NeoPixel(16,
PIN, NEO_GRB + NEO_KHZ800);


#define PIN_ECHO 6
#define PIN_TRIGGER 5


const uint8_t sampleWindow = 50;
uint16_t sample;

struct SEND_DATA_STRUCTURE
{
 float db ;
 float distance;
};

struct ACKNOWLEDGE
{
 boolean received = false;
};

int counter = 0;
SEND_DATA_STRUCTURE data;
ACKNOWLEDGE acknowledge;
EasyTransfer ETin, ETout;

Echo miEcho(PIN_ECHO,PIN_TRIGGER);

void setup()
{
 pinMode(mic, INPUT);
 Serial.begin(9600);
 ETout.begin(details(data), &Serial);
 ETin.begin(details(acknowledge), &Serial);
 strip.begin();
 strip.setBrightness(100);
 strip.show();
}

void loop()
{


 float cm= miEcho.getcm();
 delay(100);


 unsigned long startMillis= millis();
 float peakToPeak = 0;

 uint16_t signalMax = 0;
 uint16_t signalMin = 1024;


 while (millis() - startMillis < sampleWindow)
 {
  sample = analogRead(mic);

  if (sample < 1024)
  {
     if (sample > signalMax)
   {
     signalMax = sample;
   }
     if (sample < signalMin)
   {
     signalMin = sample;
   }
  }
}
 peakToPeak = signalMax- signalMin;
 float db = map(peakToPeak,20, 900, 50, 80);

 for(int i=15; i > 0; i--)
 {
  strip.setPixelColor(i, 0, 0, 0);
  strip.show();
  delay(10);
 }



float dbLED = map(db,50, 60, 0, 7);
 for(int i=0; i < dbLED; i++)
 {
  strip.setPixelColor(ledsMic[i], 103, 182, 255);
  strip.show();
  delay(100);
 }


 float usLED = map(cm, 60, 10, 0, 6);
 for(int i=0; i < usLED; i++)
 {
  strip.setPixelColor(ledsUs[i], 103, 182, 255);
  strip.show();
  delay(100);
}


if(ETin.receiveData())
{
 if(acknowledge.received == true)
 {
   digitalWrite(13,HIGH);
   delay(100);
   digitalWrite(13,LOW);
 }
}
 counter ++;
 if(counter == 8)//Send data once every 8 counts
 {
  data.db = db;
  data.distance = cm;
  ETout.sendData();
  counter = 0;
 }

 delay(250);
 acknowledge.received = false;

}
```

FORMAL MODEL

Visual Representation.

I include in this part the code used for the visual formal models displayed on the presentation. This was merely a visual interaction, the microphone gets a value and represents it in the LED ring.

```
#include <Adafruit_NeoPixel.h>
#define LED 3
#define mic A0


const uint8_t sampleWindow = 50;
uint16_t sample;

Adafruit_NeoPixel strip = Adafruit_NeoPixel(16,
LED, NEO_GRB + NEO_KHZ800);

void setup()
{
 pinMode(mic, INPUT);
 pinMode(LED, OUTPUT);
 strip.begin();
 strip.setBrightness(100);
 strip.show();
 Serial.begin(9600);
}

void loop()
{
 unsigned long startMillis= millis();
 float peakToPeak = 0;

 uint16_t signalMax = 0;
 uint16_t signalMin = 1024;


 while (millis() - startMillis < sampleWindow)
 {
  sample = analogRead(mic);

    if (sample < 1024)
    {
       if (sample > signalMax)
       {
          signalMax = sample;
       }
       if (sample < signalMin)
       {
          signalMin = sample;
       }
    }
}

peakToPeak = signalMax- signalMin;
float db = map(peakToPeak,20, 900, 50, 80);
 delay(200);

 int nleds = map(db,50, 80, 0, 15);
  Serial.println(nleds);

  for(int i=0; i < nleds; i++)
 {
 strip.setPixelColor(i, 103, 182, 255);
 strip.show();
 delay(10);
 }
   delay(1000);

   for(int i=nleds; i > 0; i--)
 {
 strip.setPixelColor(i, 0, 0, 0);
 strip.show();
 delay(10);
 }


}
```

RENDERS

REFERENCES

PRIVACY

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[3] *Chalup, S.K., Hong, K. and Ostwald, M.J., 2010. Simulating pareidolia of faces for architectural image analysis. brain, 26(91), p.100.*

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DATASHEETS AND CODING

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THANK YOU

For reading

Jesús Escudero Pérez 725174
jep.crafts@gmail.com