The Virtuscreen

Design of an AR experience for several people

Bachelor Thesis Industrial Design Engineering

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15-08-2016

UNIVERSITY OF TWENTE.

"Design is an adventure in which
new experiences unfold"

Preface

This bachelor thesis is my completion of the study Industrial Design Engineering at the University of Twente. The thesis has been performed at 100%FAT in Enschede for three months in the year of 2016. The aim of this thesis is to show my competence as an Industrial Design Engineer, by delivering a design to 100%FAT according to their requirements and wishes.

This opportunity of completing my bachelor would not have been possible without the cooperation of several people. I would like to thank the workers at 100%FAT for helping me when I needed support and I especially would like to thank Floris Schreuder, Bjorn Karselius and Lieven Maes for their help and advice while giving me the opportunity to work on this project at the company. I would also like to thank Arie Paul van den Beukel for guiding me through the route taken for the assignment.

It has been a pleasure for me working at 100%FAT. I have been able to express myself through working on what I like to do.

Enschede 27 Juli 2016

Jasper Westenbroek

Resume

During this report the focus was to design the VirtuScreen for 100%FAT. 100%FAT is a company realising ideas provided by others. They come up with concepts and realise them in order to satisfy their customers. Due to time constrains they are not able to work on their own ideas which they would want to see realised. One of these ideas is the VirtuScreen. The VirtuScreen is to be a successor to the VirtuScope, which already has been designed by 100%FAT.

The VirtuScope is a kind of binoculars with which the user is able to see Augmented Reality. The VirtuScope shows the user objects or images which are not currently there. This varies from dinosaurs walking around in museums to alternating reality in such a way the user thinks he or she is looking at the environment of a 100 years in the past. However the VirtuScope is not optimal. Lacking in both user friendliness and usability for several people at the same time, the VirtuScope loses its interest.

That is why the design question for this report is:
How can the VirtuScreen be designed in such a way that it is able to create an Augmented Reality experience which is interesting for several people, both in terms of physical design (aesthetics and ergonomics) as the experience itself? Where the concept of the VirtuScreen eventually is to be worked out into technical drawings for construction and assembly.

In order to answer this question, several sub questions were needed to be answered first. These sub questions are:
- What requirements and wishes exist for the VirtuScreen?
- What are the features which will be implemented in the VirtuScreen?
- How does the market look like and what aspects are important according to the ergonomics of the users?
- What concepts form an improvement according to the stated requirements, wishes, features and other aspects?
- How will the technical concept look like?

These questions were answered in several important steps. Starting off with doing research on the context, followed up by brainstorms and creating ideas for a solution. Eventually working with iterations of models in order to create a better understanding of the concept. The results from these processes eventually ended up in a design and technical drawings. In addition to this content a promotional video was created to help 100%FAT sell the concept of the VirtuScreen.

The research done during this project resulted in requirements and wishes of which the most important ones are (noting that some of these requirements also arose while working on the iteration models and design sketches):
- At least three people must have good eyesight on the screen.
- The product should arouse interest to possible users.
- The turning speed cannot be faster than 1 km/h.
- Long triggers for a good interaction.
- Screen size is to be around 45 inch.
- Height of screen placement is around 160cm / 150 cm measured from its midpoint.
- Distance between the screen and centre of the pole is to be around 36 cm.

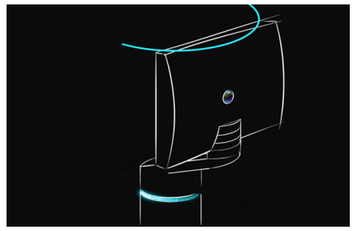


Image 0.1: Chosen concept idea

The researches and sketching also resulted in features which could be implemented in the VirtuScreen. Using a morphological scheme, these features were put together into four concept ideas. Eventually these were evaluated together with 100%FAT in order to choose a direction for the products design and use. During this meeting the “simple“ idea was chosen, which used a screen attached to a pole.

Coming close to a solution for the research question, research had to be done on the target group, especially on the ergonomics of this group. A list with measurements, using DINED, to which the VirtuScreen must suffice was made in order to later evaluate whether or not the product was able to deliver a desirable experience.

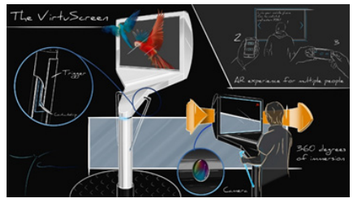


Image 0.2: The concept visual (Appendix A5)

Using drawings, collages, brainstorms and the iterations, design concepts were made enabling the designer and 100%FAT to choose the appearance of the VirtuScreen. As seen in Image 0.2, the product has many aspects. Long triggers; an additional stand for children; a breaking system; a window effect to create realism; a large landscape placed screen and the ability for secondary users to link their phones to the VirtuScreen. Altogether creating an experience for several people thanks to this linking ability and the wide screen for several people to look at.

The concept (both design and use) of the VirtuScreen was clear, which meant a 3D model could be developed in order to make technical drawings. This model took into account different important aspects of its production like: space management, cable management and construction. Thirty five technical drawings were made to show the assembly and production of the most important components. These technical drawings are to be found in Appendix A7.

Even though the questions were answered, it seemed a good idea to create a promotional video / presentation for 100%FAT to use when they want to present the VirtuScreen to a potential buyer. This video describes the unique selling points of the VirtuScreen in an interesting manner, which arouses interest when someone is thinking of buying one.

Concluding to what is stated before, it can be said that a VirtuScreen has been designed which meets the needs 100%FAT had for the VirtuScreen. The VirtuScreen as it is designed is able to create an interesting interaction (using Augmented Reality) with several people in different ways. The VirtuScreen has a lot of potential in becoming a fun and interesting product, creating new experiences for potential users.

However, some aspects still need to be looked at in the future. It is recommended for 100%FAT to look at:
- The implementation of the window effect (an effect which creates a more immersive feeling)
- The technical drawings in order to optimize them as much as possible
- The usability of the handles with long triggers
- The attachment of the top part to the turning mechanism including the braking system.

Table of contents

1. Introduction

100%FAT is a company where both ideas and concepts delivered by external companies are realised. Those Ideas differ from interactive products to installations that cater to your senses. Quickly responding to the newest innovations in open source software and rapid prototyping is what gives 100%FAT the ability to create innovative presentations and products (100%FAT (n.d.) [1]). Working on many projects they do not have the time to work on their own ideas, which is why this project was assigned to someone outside of the company.

The company itself is the owner of the VirtuScope (a project realised by themselves with the help of Thijs & Sneijder). The VirtuScope is a product that works like binoculars. Looking through it from one side, it shows the user what is happening on the other side. However the VirtuScope shows even more. Projecting virtual objects in reality, it gives an extra layer to what is seen. There are many possibilities according to the context, which could be walking dinosaurs in a museum or showing how the environment looked a 100 years ago in city centres. (100%FAT (n.d.) [2])

Image 1.1: Concept of the VirtuScope

Though the VirtuScope works fine it is not yet optimal, according to 100%FAT. It lacks in user-friendliness and it blocks other people off when someone is using it, which make the product uninteresting. Ideas to build a product similar to the VirtuScope exist, which are the ideas worked on in this project.

The successor of the VirtuScope is to be the VirtuScreen. The basics are initially the same as the VirtuScope, however it should be attractive to three different people giving each one of them an augmented reality experience. The VirtuScreen should be in line with the target group and locations. While it is able to turn 360 degrees, use a camera, have a flat screen and have enough space for remaining hardware components. In addition to these requirements it needs to be transportable without a lot of effort. Concluding to this, the product should be suitable to be built for one to ten orders per year.

During this project, the problem stated above is focussed on. The objective is to design a VirtuScreen able to deliver an Augmented Reality experience to three different people, both in terms of physical design (aesthetics and ergonomics) as the experience itself. Where the concept of the VirtuScreen eventually is to be worked out into technical drawings for construction and assembly.

This objective is to be attained through certain steps. First of all several analyses are done to fathom the context and target group for which the VirtuScreen is to be designed. Analyses of the market and characteristics are done to see what possible solutions already exist and what new possible solutions could be used to create new ideas. These analyses can be found in Chapter 2. This research eventually results in a table of requirements (Chapter 3) which holds the aspects required to be implemented in the product.

During and following from the previously stated processes, ideas are written/drawn down on paper. The Idea generation (Chapter 4) contains the solutions and ideas which are to solve the objective.

After doing the analyses and during the Idea generation a vague image of what the VirtuScreen is supposed to be, starts to arise. To clarify how the product is to be used and how augmented reality experiences should be implemented in the product, several iterations (models) are created. The iterations start of simple, eventually turning into a prototype which is to be used to test certain possibilities. These iterations can be found in Chapter 5.

Due to the Idea generation and the iterations, the idea (both ergonomic aspects and AR-implementation aspects) is clear. Conceptual visualisations are created to be consulted with the owners of 100%FAT. Together with 100%FAT a design is to be chosen, which eventually will be realised into a solidworks model. The concept generation in which this choice is made is to be found in Chapter 6.

Realising the product into a model of the assembly comes with a lot of complications. Problems like solidity, cable management, space management, materialisation and production are tackled. The solutions for these problems can be found in Chapter 7. Important aspects and components of the product are made into technical drawings. These drawings (Appendix A7) are important for 100%FAT, because they enable them to build the VirtuScreen.

In addition to the product realised in Chapters 1 through 7 some promotional material is created which can be found in Chapter 8. This material is created to help 100%FAT sell the VirtuScreen to potential buyers, pushing them over the edge when they are thinking about using the VirtuScreen.

2. Analyses

2.1 Market research

There are many products on the market already able to show augmented reality. This group of products consists of both physical objects and mobile applications. Some of the products are static while others can be used to look around in the surroundings. There are many differences between the Augmented / Virtual Reality products even though there are aspects which overlap.

Overlapping aspects:
- Usage of a screen
- Showing virtual objects
- Experience for one person except for the table seen in Image 2.1 and the Pepsi screen mentioned in the analysis (Appendix A1)
- Showing content specialized to the product except for the Pepsi screen mentioned in the analysis (Appendix A1)

Differences between products:
- Size
- Freedom of movement
- Freedom of choosing what to look at
- How to hold it
- Using it standing or sitting or walking

Pros of augmented reality products:
- New experiences
- Educative possibilities
- Fun when experienced with multiple people

Cons of augmented reality products:
- Slow when installed on mobile phones
- Installation on mobile phones
- Not fitting to certain locations

The points mentioned above show that there are many opportunities to create a product able to compete with others within the world of augmented reality. Aspects most augmented reality products do not embody are the specialized content for a certain location and the experience for multiple people. Only one product has these aspects which seemed to be a great success for advertising. The only fact that this screen was static instead of movable made the experience special for only one moment (enough to attract attention for an advertisement). However, a product which would be used for longer than a few seconds would need something extra. An interaction to keep the user occupied and curious could do the trick. Combining the mentioned aspects would deliver a product with unique selling points ready to compete with the others.

Image 2.1: Market analysis collage (Appendix A2)

2. Analyses

2.2 Target group analysis & ergonomics

Target Group

The target group for this project is the museum visitor and the project developer. These are the groups which use the product most often. However it is possible the product will be used in different locations than the museums and construction sites. The product could be placed at city centres and parks as well. Even though the location to use the product was narrowed to only indoors a future version of the product should be able to be used outside. This means the design of the product should focus on the future uses as well.

Which means many people need to be able to use the product. Since parents bring their children to museums it is necessary for the product to be usable by parent and child.

Project developers could place the screen on places where they want to show what is to come in the future. Imagine an architect who is designing a house and is able to show the house on location before it is even there. The architect will not be the person looking through the product, but the future owners and the residents in the area will want to know what the future looks like for their living area.

This means the product needs to be attractive to potential buyers while the primary users (the actual people using the product) need to have a great experience with it. One of the aspects to create an experience for everyone, is the fact that the size of the VirtuScreen should be suitable for the target group. The ergonomics of the target group is analysed below.

Ergonomics

In order to "design for all", the different sizes of the users are very important. Using DINED (a dynamic anthropometric database created by the Delft University (2004) [3]) measurements of both adults and children were analysed. Since it is almost impossible to design for every user it is chosen to design for at least 95% of the society. Using the models seen in Images 2.2 and 2.3 and the formula: P95 = Xgem ± Z95 x SD where the value for Z95 is 1.64, the measurements were found. Several measurements (like eye height and shoulder height) are important for the design of the VirtuScreen. Due to the fact users will use the product while standing. In addition to these measurements the arm length is very important as well since both children and adults need to be able to turn the product.

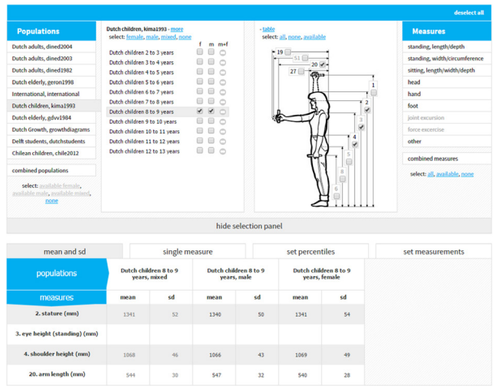


Image 2.2: Ergonomic measurements of children

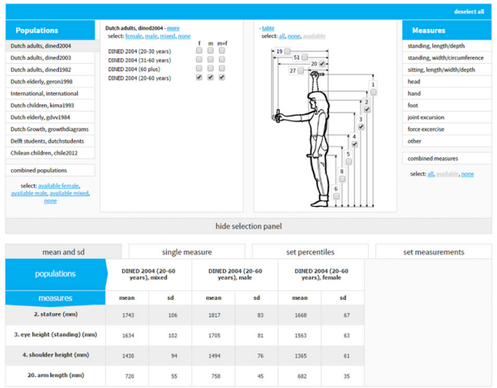


Image 2.3: Ergonomic measurements of adults

Using these models the information below became available for use during the design process:

- 95% of 8 year olds is taller than 1255mm.
- 95% of the adults (20 to 60 year old) is smaller than 1917mm.
- Shoulder height: 992mm – 1585mm.
- Arm length: 494mm – 811mm.
- Eye height: not known – 1802mm.

Since the size of the human head does not grow much, it is assumable that the distance between the top of the head and the eyes is almost the same as adults, which is: 115mm. This results in an eye height of 1140mm – 1802mm.

During the design process these measurements (seen in Table 2.1) were kept in mind in order to evaluate ideas and concepts whether or not usage would be possible for the target group. In Chapter 7 the measurements were used to evaluate the final product.

	95% of children is more than	**95 Adults is less than**
height	1255mm	1917mm
Shoulder height	992mm	1585mm
Arm length	494mm	811mm
Eye height	1140mm	1802mm

Table 2.1: Calculated ergonomic measurements of adults and children

2. Analyses

2.3 Analysis of characteristics

Brainstorming and collages

Brainstorming about the VirtuScreen is one of the first things done during the process. Not much was clear yet about how the VirtuScreen was going to work. Only the idea of showing augmented reality to people at certain areas. The word web shown in Image 2.4 is the result of the brainstorm, where both new ideas and insides were mentioned.

Image 2.4: The first brainstorm for ideas

Even though not much input came from the brainstorm, several good aspects which were not thought of before were mentioned. To expand upon the arguments from the brainstorm some collages were made. Collages focussed on location, aspects, use, and gamification were made to achieve this purpose.

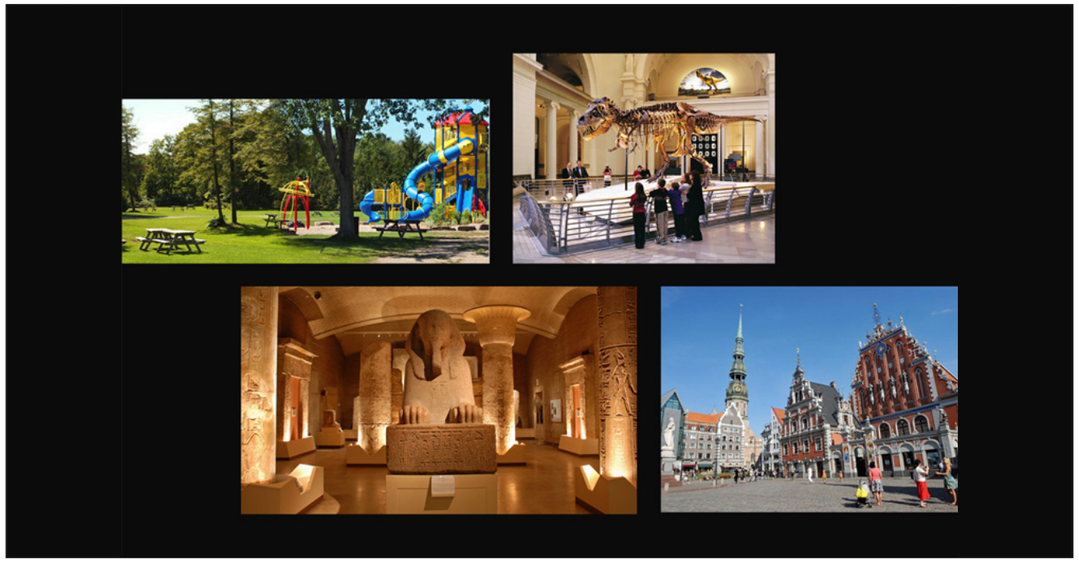


Image 2.5: Collage of possible locations (Appendix A2)

The collage seen in Image 2.5 shows several locations were the VirtuScreen could be placed. Each location looks completely different were the functions of the VirtuScreen differ as well. Which means the design should be simple, with a style fitting in any context. Chapter 4 will elaborate further on what direction the design has taken.

Image 2.6: Moodboard for possibilities (Appendix A2)

The collage seen in Image 2.6 is a mood board which scratches the surface of possibilities for the VirtuScreen, beginning to think about the characteristics of the interaction. At this point it was not yet decided that the VirtuScreen would only be built for inside locations. The ability to withstand weather conditions was scrapped from the requirements after noticing how expensive the product would be because of the certification of waterproofness. Furthermore the idea of a rimless TV arose which was thought to create a smoother transition. This idea was later on debunked during the test with iteration 2 (Chapter 5).

2. Analyses

Image 2.7: Collage for use, based on playground equipment (Appendix A2)

The collage seen in Image 2.7 shows a numeration of products (playground equipment). These products are to be understood by both children and elderly. The simple constructions are safe and easy to use. Such a design approach could benefit the understanding of the VirtuScreen's use. Handles and other aspects mediate to the user how the product is to be used. According to Steven Dorrestijn (n.d.), products like these mediate before the eye. They could be categorized as guiding products. Meaning that the products give the users suggestions about possible ways of using it. Creating an interaction like this in the VirtuScreen makes it an understandable product even though the technology is complex.

Image 2.8: Collage for gaming possibilities (Appendix A2)

During the brainstorm session mentioned before aspects like gamification were hinted at. There are many possibilities of integrating some sort of game in the VirtuScreen. These days a lot of companies are working on virtual / augmented reality games. The fact it is becoming very popular adds another unique selling point to the VirtuScreen. Especially if it could be played together with other people. Image 2.8 shows existing augmented reality games which could be an example for an integrated game for the VirtuScreen.

Image 2.9: Collage for design aspects (Braun) (Appendix A2)

Adding to the list of collages a collage (Image 2.9) of the possible appearance was made. A consultation during a meeting about the design with the owners of 100%FAT concluded in the following visual design aspects:

- Sleek
- High-tech
- Functional
- Braun design
- Apple design

The pictures show the simple and sleek style 100%FAT desires to see in the VirtuScreen. During the idea generation (Chapter 4) and Concept generation (Chapter 6) this style was kept in mind to create 100%FAT's VirtuScreen

2. Analyses

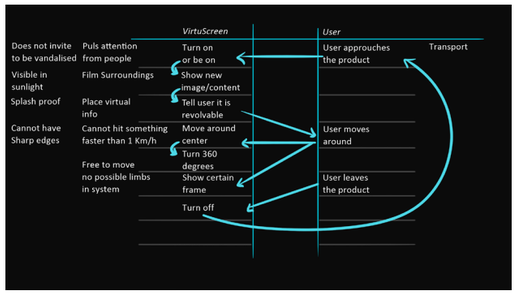


Image 2.10: Function allocation 1, the VirtuScreen moves out of its own (product does most of the actions)

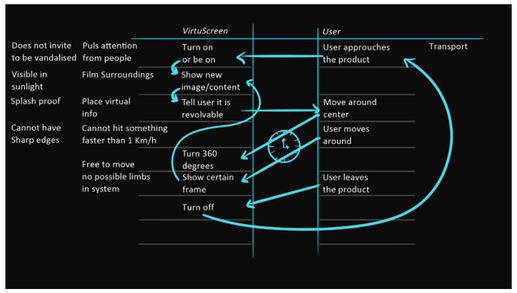


Image 2.11: Function allocation 2, the VirtuScreen turns on and of by itself

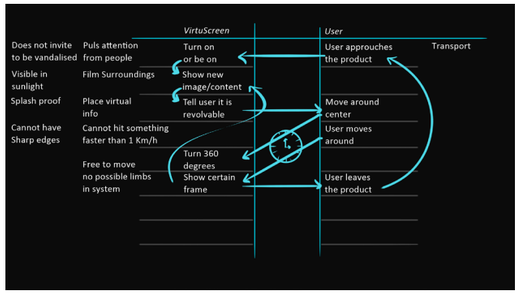


Image 2.12: Function allocation 3, the VirtuScreen is always on and constantly nudges users

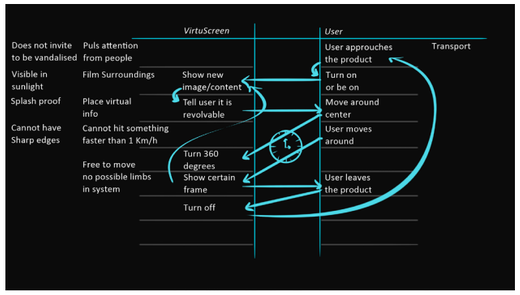


Image 2.13: Function allocation 4, the VirtuScreen were it is mostly controlled by the user.

Function allocation

The possibilities within the functionality of the VirtuScreen has become a bit more clear by now thanks to the research done and thanks to a function analysis. This analysis resulted into several function allocations. The technique of using function allocations creates ideas or iterations of how the product works or is to be used. While some functions might be better for the product to have, other might better be performed by humans. That is why a creating several diagrams can create both new ideas and improved ideas. The function allocations with the analysed functions can be found in Images 2.10 to 2.13.

Scenarios

In order to get a better understanding regarding the problems that could occur using the VirtuScreen, as many scenario's as possible were defined by sketching out the possibilities. The scenarios are both possibilities of problems which need to be prevented and problems that the product should solve when in use. In a later stadium (testing the iterations in Chapter 5) most of these scenarios were tested to see how it would play out in reality and how certain problems could be resolved.

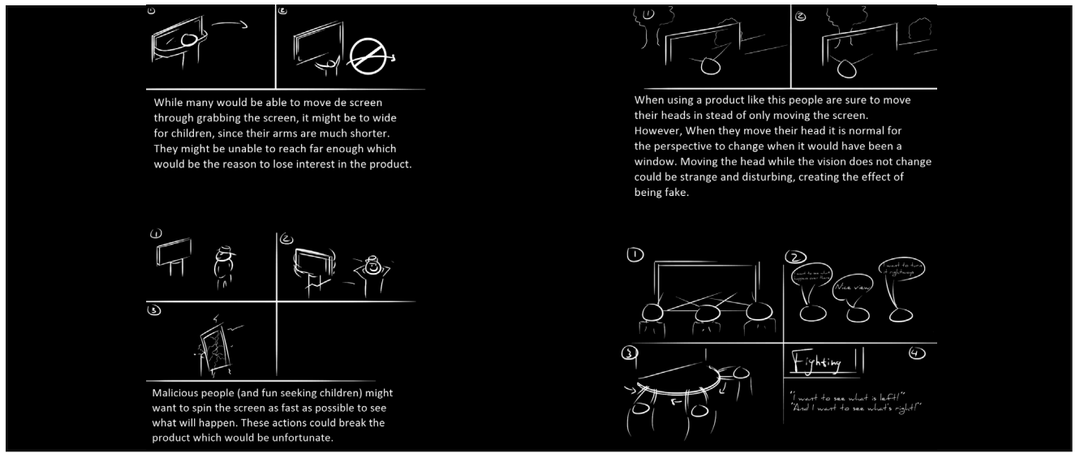


Image 2.14: First batch of scenarios

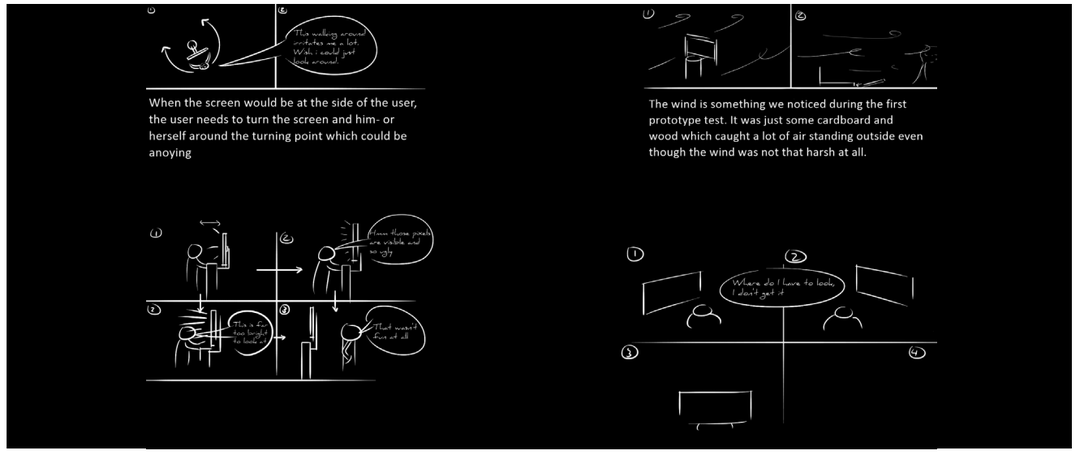


Image 2.15: Second batch of scenarios

3. Table of requirements

The requirements for the VirtuScreen were mostly decided by 100%FAT, but in order to have a better understanding of the product that had to be designed, more requirements were needed. Based on the environment and users some more were added. The requirements can be found in the list below, divided into three groups: Requirements of use, requirements of design, requirements of components and construction and requirements which were received during to the tests which can be found in Chapter 5. In addition to these requirements there were some wishes to be kept in mind during the design process.

Requirements

Use:

- It should be able to turn around 360 degrees.
- At least three people must have good eyesight on the screen.
- The screen must at least be visible in a room with a lot of light.
- The VirtuScreen needs to be easy to understand without the use of a manual or introduction.
- Only three actions must be enough to interact with the product.
- The turning speed cannot be faster than 1km/h.

Design:

- It may not contain sharp edges.
- Body parts cannot be able to get stuck.
- It cannot contain holes big enough for a child to be able to stick his finger in it.
- The product should arouse interest to possible users.
- The product does not invite users to vandalise it.

Components and construction:

- Uses a screen or if possible a projection.
- It uses a camera in order to perceive the environment.
- The product needs to be able to be taken apart in order to transport it.
- The product must be suitable to be built for 1 to 10 orders per year.
- Space for hardware:
  - GPU: 235mm x 130 mm x 40 mm
  - Power: 200mm x 150mm x 95mm
  - Motherboard: 230mm x 175mm x 45mm
  - Wi-Fi extender: 120mm x 60mm x 15 mm + antenna 200mm perpendicular to surface 120 mm x 60mm
  - Arduino: 40mm x 60mm x 30mm
  - Camera x 2: 30mm x 27mm x 174mm (ZED-CAM)
  - Turning mechanism including break mechanism and sensors

Requirements received due to the testing of iterations (Chapter 5):

- Height of hand placement on handle around 110 cm above the ground.
- Distance between screen and centre point is around 36 cm.
- Screen size is to be around 45 inch.
- Distance between handles and centre point is around 14 cm behind it.
- Use of window effect where movements of the users head affect the frame seen on screen.
- The midpoint of the screen lies below 180 cm above the screen (around 160 / 150).
- The width of the side of the screen does not have to be as small as possible.
- High quality material is needed for a good experience see requirements of camera and screen in previous parts of the list.
- The foot of the stand needs to be larger than the one of the VirtuScope. Larger than a radius of 40 cm.
- Handles need to be placed vertically.
- Long triggers for a good interaction.

Wishes

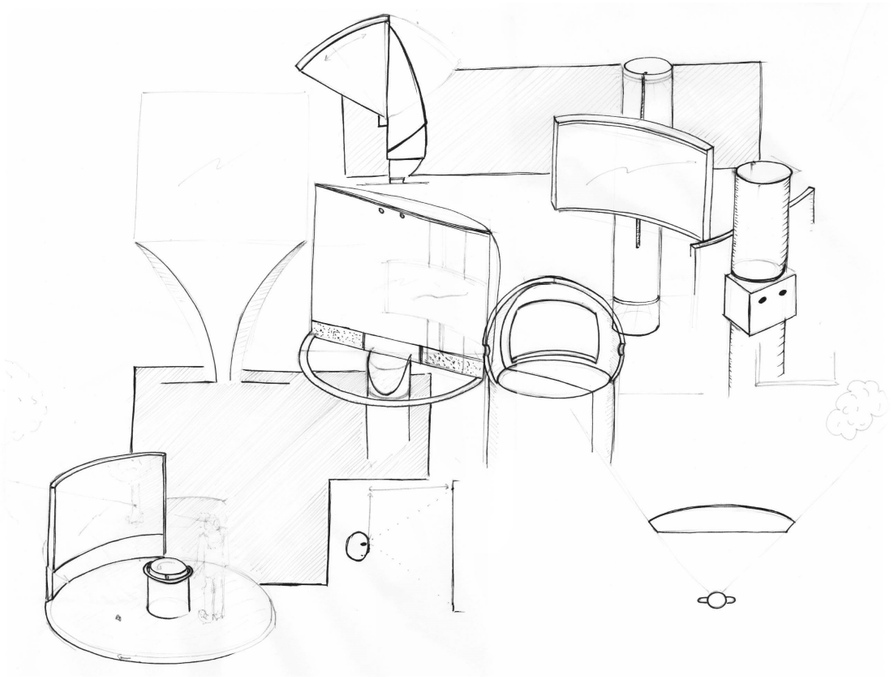
- Makes use of audio including space for audio card and speakers.
- Transportation should be as cheap as possible.
- Transition with reality as smooth as possible.
- Changes field of sight when user moves around in front of the screen in order to have a perfect transition.
- Is able to withstand rain (splash proof).

4. Iteration process 1: Ideas

4.1 Idea generation

With the information provided by the collages and analyses, ideas started to unfold. At this point the table of requirements was not yet completed, which means the drawings seen in Images 4.1 to 4.3 show the results of the early idea generation. These drawing focus on possible uses and experiences. These ideas did not yet include ergonomic aspects due to the fact it was not yet clear what direction was to be taken with the VirtuScreen. All drawings can also be found together in Appendix A4 and A5.

Image 4.1: Sketches of use and shape 1



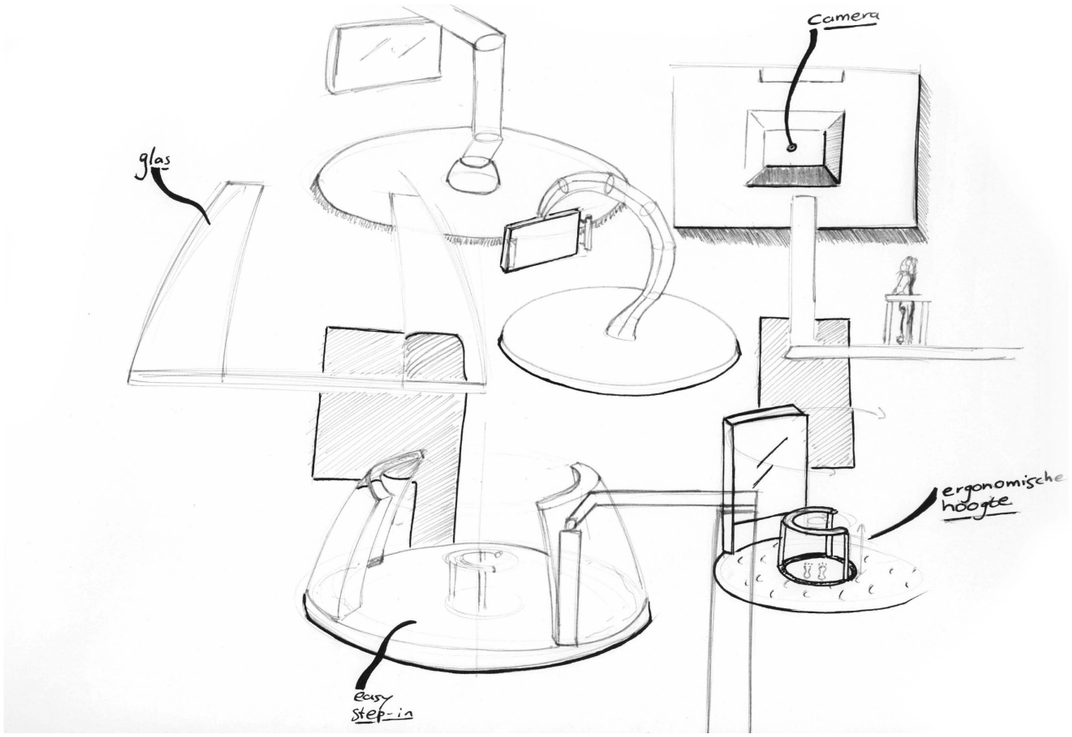


Image 4.2: Sketches of use and shape 2

4. Iteration process 1: Ideas

Using these drawings a Morphological scheme was created. The scheme shown in Image 4.3 and 4.4 shows how this was done. Using ideas and aspects from the drawings, function allocation, scenario analysis and requirements a list of aspects divided into categories was created. This list clarifies the possibilities and made it easy for both the designer and 100%FAT to choose several interesting directions.

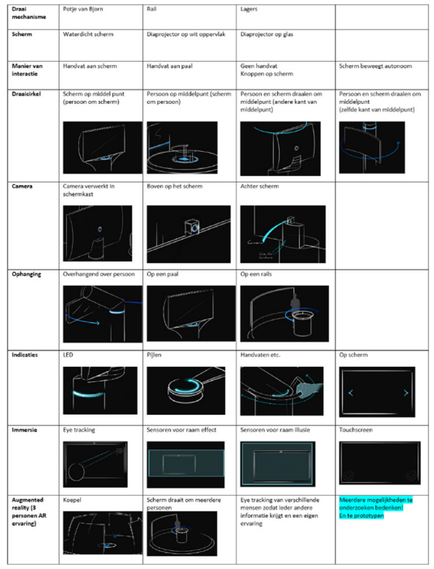


Image 4.3: Morphological scheme (Appendix A3)

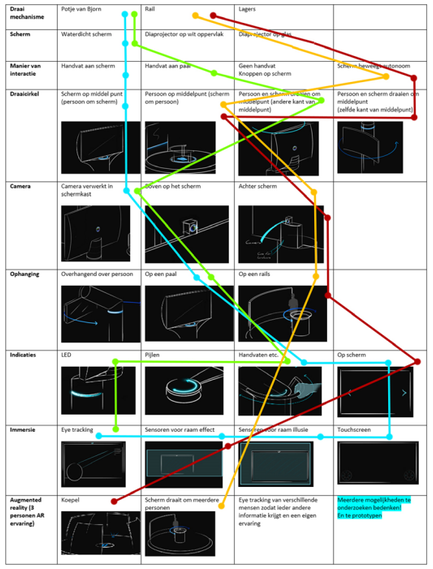


Image 4.4: Morphological scheme with concept idea lines (Appendix A3)

By using the morphological scheme during a meeting with the owners of 100%FAT, several concept ideas were created to discuss what direction to follow during the rest of the project. An enlarged version of the morphological scheme with concept ideas implemented which is seen in Image 4.4 can be found in Appendix A3. The lines seen in the picture represent the different conceptual ideas which are elleborated on in the upcoming section.

- Concept idea 1 - blue line
- Concept idea 2 - green line
- Concept idea 3 - yellow line
- Concept idea 4 - red line

The concept ideas were created by both the designer and 100%FAT according to their preferences and imagination. Trying to find both the best and most innovative ideas.

4.2 Conceptual ideas & choice

Concept idea 1

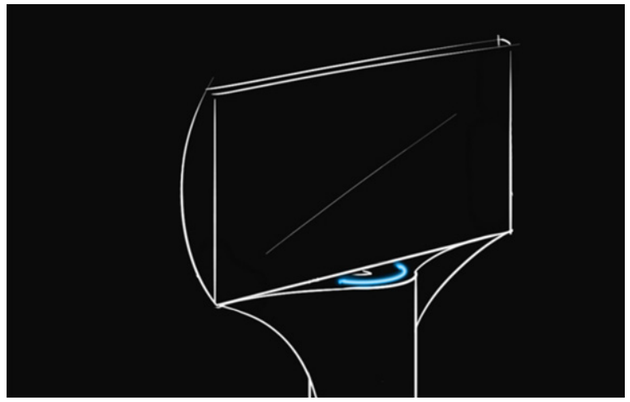


Image 4.5: Basic idea of concept idea 1

Concept 1 is the easiest and most forward solution to the problem. It is a screen planted on top of a pole which is able to turn 360 degrees. Using a waterproof screen the product can be placed outside without having problems with the rain. Inside the pole a mechanism is installed which enables the product to turn around freely without destroying the cable work on the inside of the mechanism. The camera is placed behind the screen and is nicely imbedded in the structure which gives it a clean finish. Handles attached to the screen enable the user to turn the screen in any direction wanted. This way showing the user the screen can be turned in any direction. Added to this indication, arrows are shown on screen which show there is more to see at the sides.

In order to create immersion, several aspects are implemented in the software. This will be realised through eye tracking, a touchscreen and sensors which follow the movements of the user to change the perspective they are looking at (window effect).

Good aspects:

- Easy construction
- Not that expensive
- Simple design
- Control on all movements
- 360 degrees visibility

Bad aspects:

- Not inviting
- Misses an experience for three until now
- Walking around the centre instead of standing in it

4. Iteration process 1: Ideas

Concept idea 2

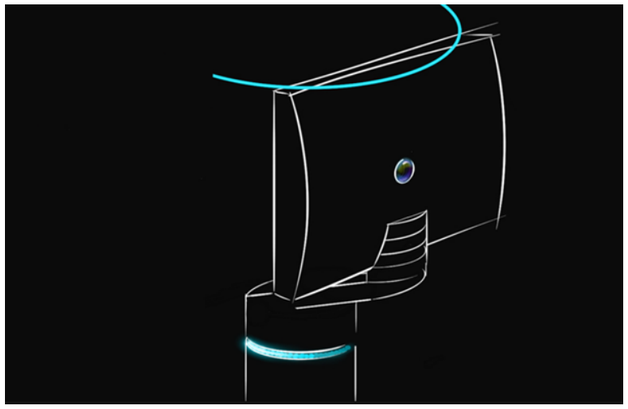


Image 4.6: Basic idea of concept idea 2

Concept 2 is not much different from the first concept. However, the placement of the screen is different. It is placed away from the centre which should create a different experience looking around. Also the user does not grab handles attached to the screen since these are attached to the pole. These handles look like handles from playground equipment and they will invite bystanders to grab them. This will make the user notice the screen is able to turn 360 degrees. This recognition will also be created thanks to LED strips implemented in the pole. These LED's will be animated to move around the centre to trigger users to turn the screen. It also attracts the attention of bystanders who are not interested immediately.

In addition to these aesthetics, immersion is created through eye tracking, which will focus on the eyes of three different people who are looking at the screen. The screen will show certain images or certain information when a person is looking at a certain point of the screen. This creates three different interaction at once.

Good aspects:
- Simple design
- Cool indications
- Clear indication of use
- Not that expansive
- Able to look around 360 degrees
- Control on every movement

Bad aspects:
- Not clear whether or not it creates an experience for three people
- Construction might be troublesome

Concept idea 3

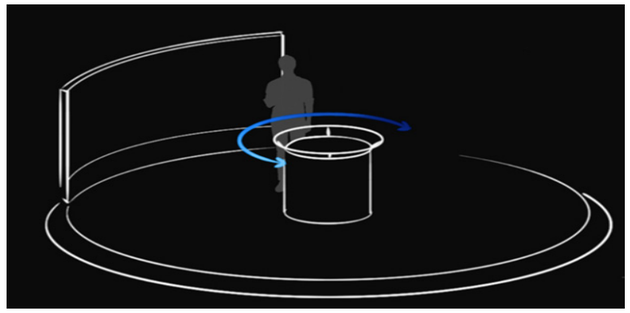


Image 4.7: Basic idea of concept idea 3

Concept 3 differs a lot from the others. Instead of placing the screen at the centre point, it focusses on placing the user at the centre. Three screens are installed on a rail which is positioned around the walking area as seen in Image 4.7. When the user walks around one of the screens will follow him to the location he or she is walking to. Behind the screen a camera is installed to show what is behind the screen with the extra layer of virtual reality to create the special experience (as if the user is walking around in the virtual area).

The immersion is created through the interaction explained above. This immersion for three people is realised through using three screens which all follow someone else.

Good aspects:
- Experience for three
- Walking around in augmented reality

Bad aspects:
- Takes a lot of space
- Very expensive
- Difficult to produce
- Screens can be in front of each other

4. Iteration process 1: Ideas

Concept idea 4

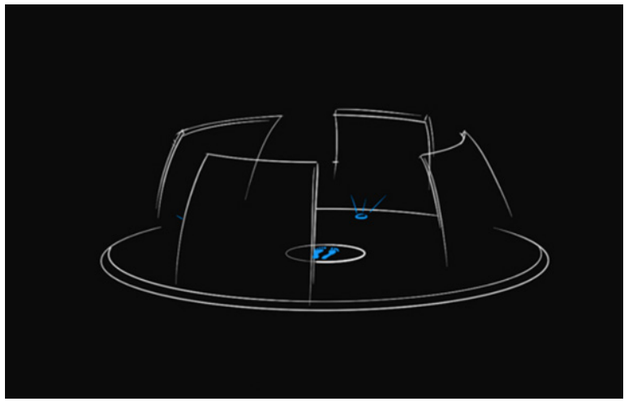


Image 4.8: Basic idea of concept idea 4

Concept 4 deviates from the use of a screen. Instead of a screen it uses projectors which show the virtual reality on glass structures placed around the users as seen in Image 4.8. This means a camera is not needed to film what happens behind the glass, since the user can already see it. Walking around will create an interaction similar to the interaction in concept three. The glass "plates" will move around the users which will eventually enable the users to see different scenes unfold around them. Through using LED's and arrows on the glass the people inside will be told to walk around when certain events occur on the other side.

Just like concept 3 the experience for three people is created through the autonomic movements of the screens. But also the signs of the events which occure on screen create an experience people probably have not had before.

Good aspects:
- Experience for three
- High tech appearance

Bad aspects:
- Takes a lot of space
- Use of glass only works in dark areas

The concept idea chosen to iterate on

Conceptual ideas 1 and 2 are chosen for continuation in this project, due to feasibility, costs and space. During a meeting with the owners of 100%FAT, the concepts were created using a morphological scheme and later discussed. During the discussion the conclusion arose that these concepts have the biggest chance of success concerning the budget of 100%FAT. They also resonate the most with what the owners of 100%FAT had in mind for the VirtuScreen. Chapter 5 contains the iterations using models to analyse how certain aspects should be implemented or used.

A direction for the VirtuScreen became clear and it was possible to start working on visualisations for its design while it was also possible to start working on iterations (Chapter 5) for its use. Sketches based on the chosen concept idea are seen in Images 4.9 to 4.11.

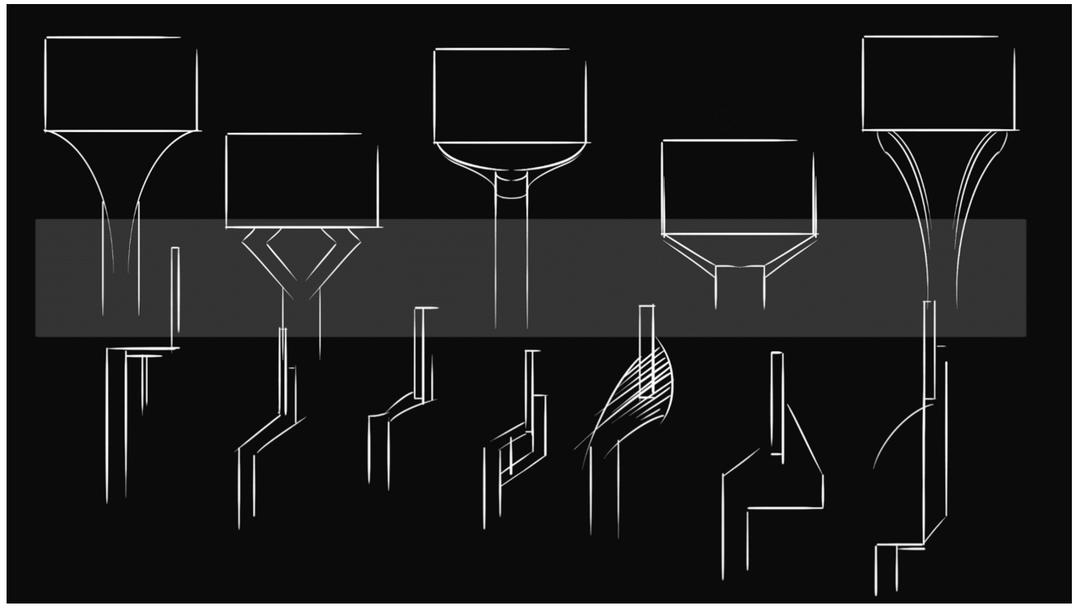


Image 4.9: Design study 1 based on chosen concept idea

4. Iteration process 1: Ideas

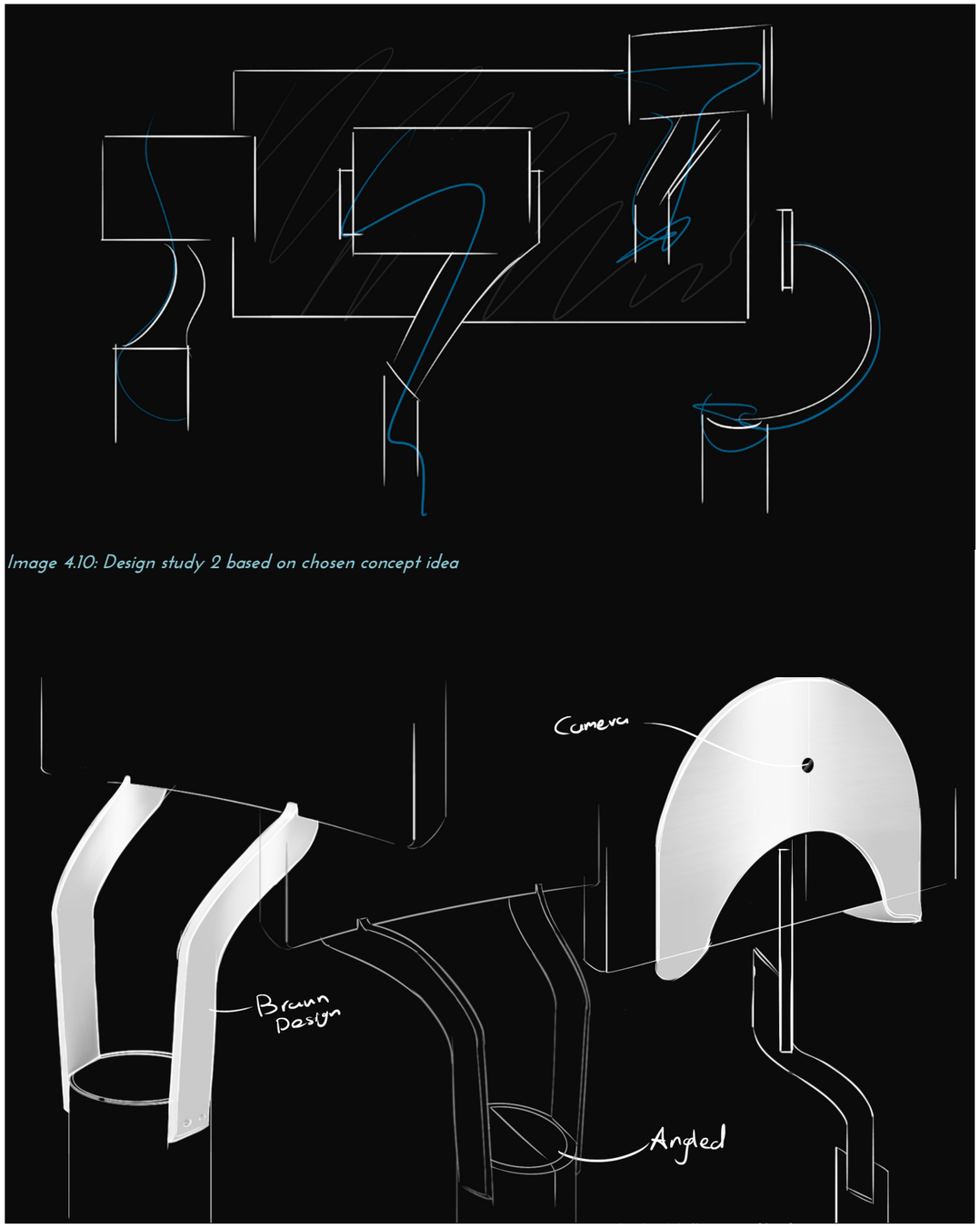


Image 4.10: Design study 2 based on chosen concept idea

Image 4.11: Design study 3 based on chosen concept idea and the Braun design collage seen in Chapter 2

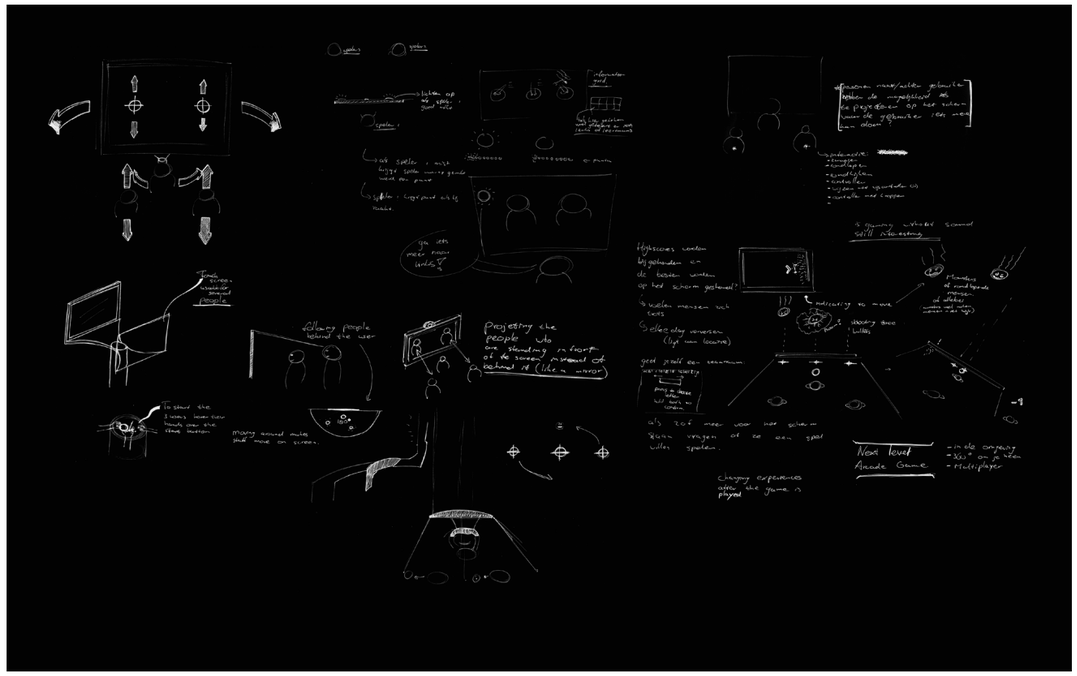


Image 4.12: Sketches on an augmented reality experience for three

Preliminary to a brainstorm on an augmented reality experience for three, several ideas were already thought of. These ideas are to be seen in Image 4.12. These ideas focussed on ways of an implementation of aspects which would enhance the augmented reality experience in such a way that three people would have benefit of it. These ideas differed from placing the second hand users behind the screen to in front of it, where they needed to move in order for the first hand player to hit his targets. During a brainstorm these ideas were discussed and used to come up with new and better ideas for the product:

- Eye tracking to show info at certain spots were users are looking
- Linking mobile phones to the screen in order to work together and achieve objectives
- AR-mirror in front of the screen
- AR-mirror behind the screen projecting bystanders behind the screen instead of on front of it
- Selfie generator placing yourself behind the screen wherever you want
- User sending bystanders to locations to earn points
- Using movements of bystanders to move cursors on screen
- Using movements of bystanders to move the crosshair during a game
- Playing a game against bystanders shooting them like duck hunt
- Using three VirtuScreens on a line playing something like tower defence

4. Iteration process 1: Ideas

Concluding from the brainstorm the functionality of linking mobile phones to the VirtuScreen was to be implemented in the concept. This Function would enable bystanders to link their phones and get the experience through them. It was chosen to implement this aspect due to the fact that augmented reality on mobile phones is becoming very popular. In addition to this reason, the thought of implementing something similar to https://www.airconsole.com/ seemed to be fitting to what kind of product the VirtuScreen should become. This functionality is further elaborated on in Chapter 6.

Further expanding on the drawings previously shown, more detailed visuals were drawn to show both materialisation, ambience, design and realism. These drawing were created while working on the iterations which enabled the implementation of ergonomics in the drawings. Using pictures of a user in front of the screen, a stance could be drawn to show how the VirtuScreen was to be handled. The picture used to create these drawings can be found in Image 4.13. While the drawings can be found in Image 4.14 and 4.15.

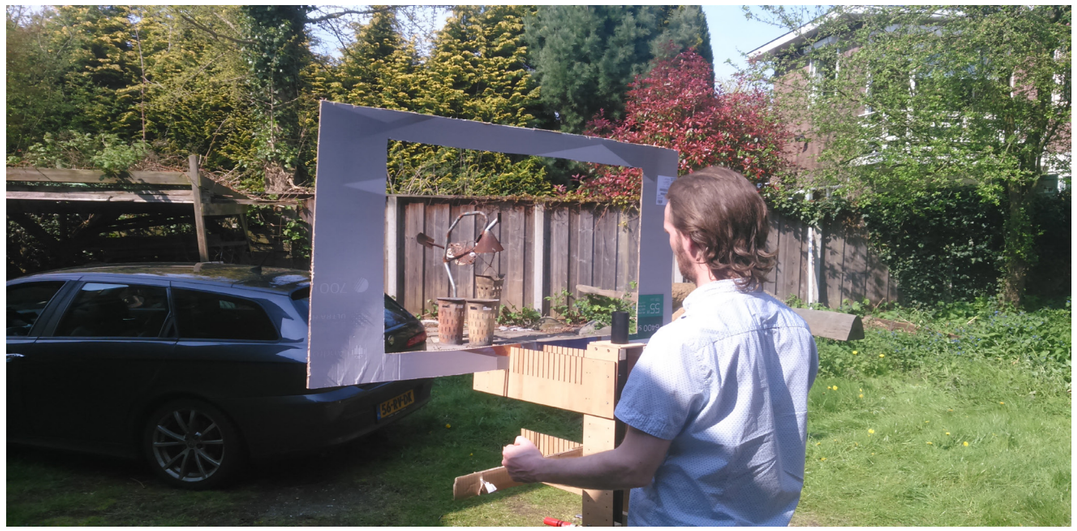


Image 4.13: Picture of the first model (Chapter 5), used to create more realistic drawings

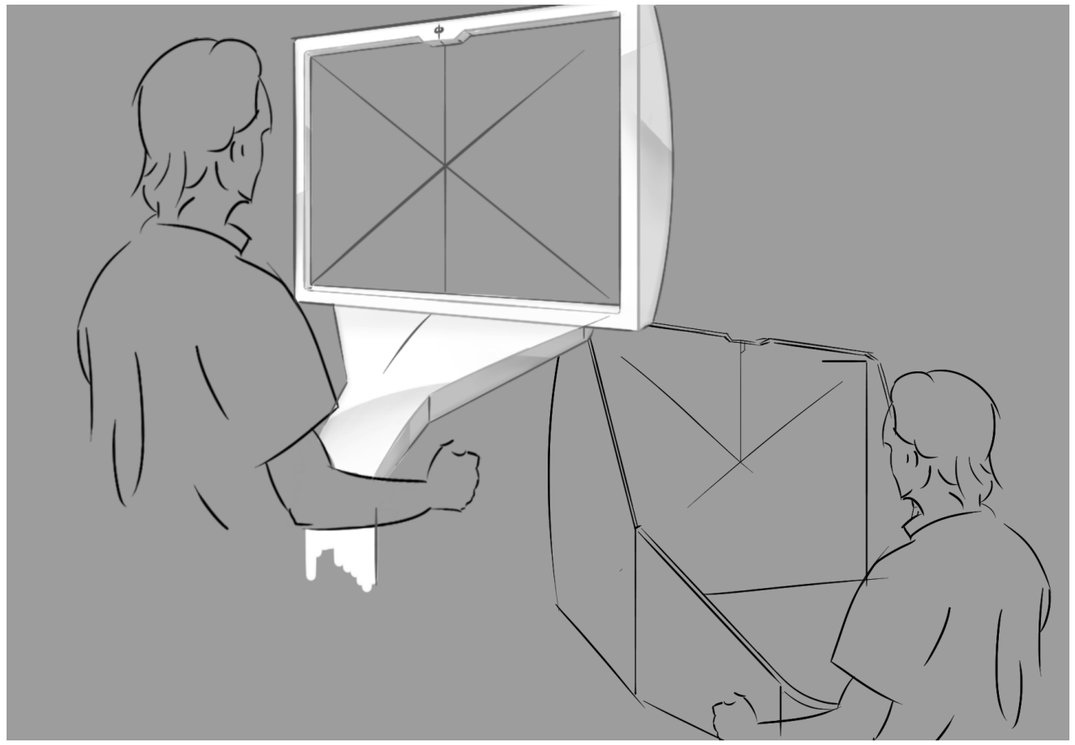


Image 4.14: Drawings based on gathered knowledge 1

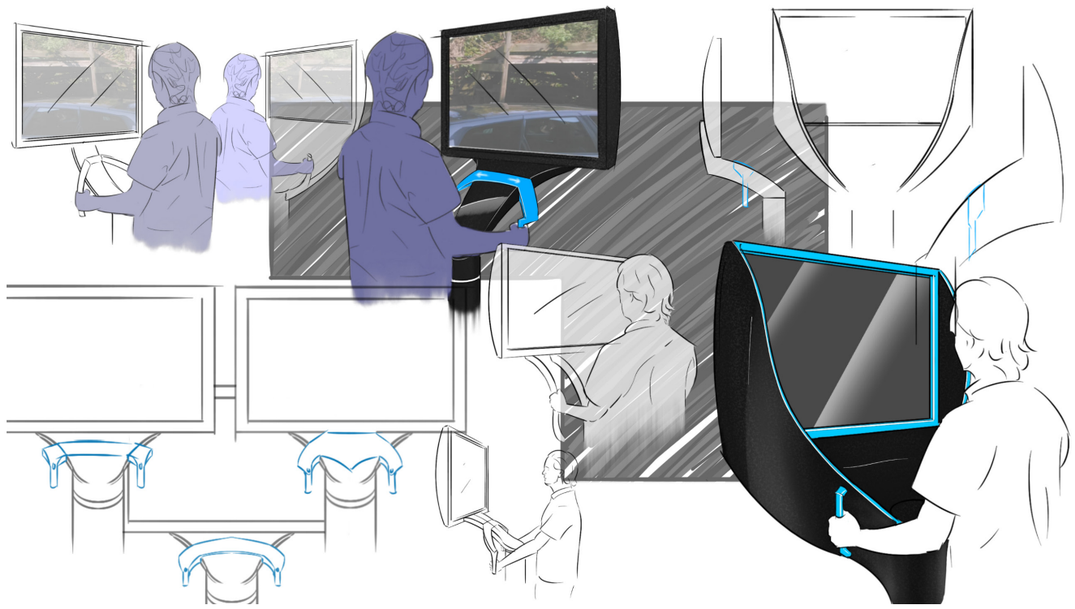


Image 4.15: Drawings based on gathered knowledge 2

5. Iteration process 2: Models

After the meeting on what concept to choose, which was mentioned in Chapter 4, an image of what the VirtuScreen was supposed to become became clear. However tests needed to be done to see how the shape of the interaction should be. The process of testing is divided in three steps or so called iteration models. The first iteration model being a version with which the ergonomics and possible movements can be tested. This model is a largely simplified version of the product, able to accommodate to various measurements.

The second iteration model focussed a bit more on hardware and the use of a screen. A small test followed to see how the use of a screen had an effect on the experience. Eventually using the information of iteration models one and two a third model could be built. This version could be described as a prototype of the VirtuScreen with which it is possible to look around in an environment. This prototype was used to test the interaction between the product and user when looking around.

Iteration model 1

As stated before, the first iteration model was built to test the ergonomics, possible movements and measurements. In order to create a model for the test, several steps were taken. These steps can be found below:

- Look for usable objects
  - Camera stand owned by 100%FAT suffices to create the prototype
  - Wood for laser cutting
  - Cardboard for “screens”
  - Screws and ‘nuts and bolts’
- Think of construction and dimensions
  - Sketching possible solutions and calculate measurements (Image 5.1)

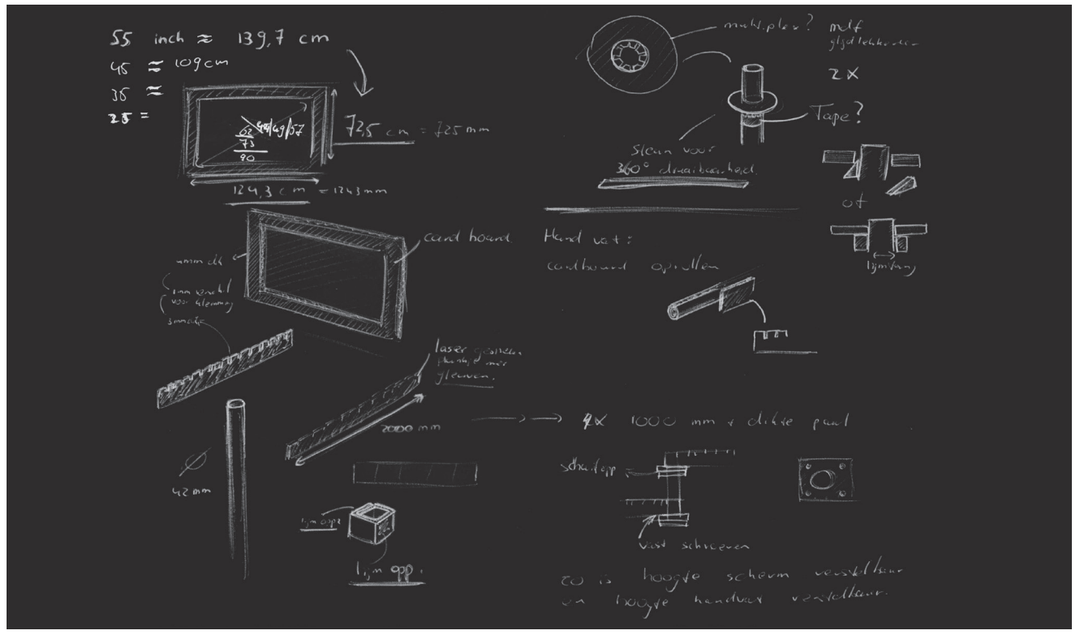


Image 5.1: Sketches for construction of the first prototype

- Work out prototype in solidworks to create DXF-files for the laser-cutter (Image 5.2)
  - Several components for a simple assembly
- Cut the parts needed for the prototype with the laser cutter at the University of Twente

5. Iteration process 2: Models

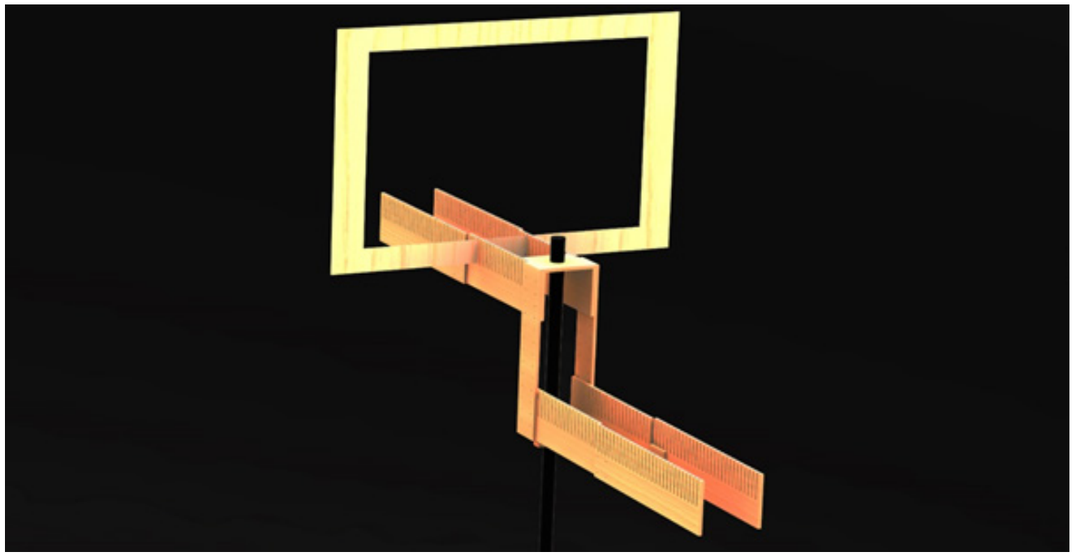


Image 5.2: SolidWorks model of first prototype

- Build the prototype (Image 5.3)
  Noticed flaws in wood so had to use some extra material to finish prototype.
  Place prototype outside to start testing.

Image 5.3: Picture of first prototype showing the most comfortable measurements

Test:
Once the model was ready the test could be executed. Using the test schema found in appendix A3 several questions were answered. Even though eventually not all questions could be answered, a lot of information arose. This information further filled the list of requirements seen in Chapter 3.
The points seen below are the aspects which were to be tested together with how this was done and what answer arose.

Handle height
- How: Adapt the model between 80 cm above the ground and 150 cm above the ground.
- Answer: Around 110 cm above the ground the comfortable height fort the average test subject was met.

Turning point/distance screen – distance between screen and centre point
- How: Change the distance slowly from - 100cm to 100cm.
- Answer: Around 36 cm behind the centre of the pole. This due to the fact the user stands in the middle when using it when the screen is placed here. This is preferred in comparison to walking around the screen.

Screen size
- How: Use screen sizes: 25inch – 35inch – 45inch – 55inch.
- Answer: ≈ 45 inch is a comfortable size big enough to see enough

Centre point / distance handles
- How: Change the distance between - 100 cm and 100 cm.
- Answer: Around 14 cm behind the centre point instead of in front of it. This creates a comfortable way of turning the screen where the user is standing at the centre point. The user does not have to walk around it which creates a more natural way of moving. The distance between the eyes and the screen is now around 40 cm which will be tested in iteration 2 to check whether or not this is comfortable.

Does the size of the screen have a significant effect on what frame is seen when the user moves his head (window effect).
- How: Move the head around.
- Answer: The size of the screen does indeed have an effect on what is seen when the user moves his head. However it is not needed to perfectly clone this effect, which means only creating the feeling by moving the frame a tiny bit should be enough.

Height of the screen
- How: The centre of the screen is to be expected around 180 cm. Adapt the model according to preferences.
- Answer: The centre point is located lower than expected. When watching the screen most people would like their eye height to be aligned with 2/3 of the screen (measured from the bottom). This means the centre is located around 160 cm instead of 180.

5. Iteration process 2: Models

Exasperation of the thickness of the screens edge
- How: Look around through the frame and make remarks on how much it is in the way.
- Answer: This prototype is not good enough to test this aspect. A screen is needed to see whether or not the edge is irritating. That is why this will be tested with iteration 2

Further conclusions found during the test are:

- Screen should be placed horizontally, because it would be beneficial for three people watching the screen.
- Focus on design for an indoor product, due to the fact the product would need a slightly different design to withstand wind and rain.
- There is space for a plateau on which children can stand to be able to interact with the VirtuScreen
- A feeling is triggered which wants the user to revolve the screen around the X-axis. This would enable the user to look up and down with the screen. Further testing is needed to see whether or not this aspect is to be implemented.

Iteration model 2

There were several questions which still needed to be answered after the test with iteration model 1. Since these questions mostly had to do with a screen, the second iteration had a screen implemented. This iteration made it possible to test several hardware aspects and a few ergonomic aspects which could not be tested with the first model.

Just like iteration model 1 an idea of how the model was going to look like was clear. However, some preparations were necessary. The steps of this preparation can be found below:

- Look for usable objects
  - Camera
    - Microsoft LifeCam
  - TV-Screen
    - LG 42WL10
  - Cables
    - (HDMI/Power/VGA/USB/etc.)
- Make a list of needed components
  - The usable objects above
  - Software for camera
- Download and install software needed to control and use camera
  - Microsoft LifeCam:
    - Install LifeCam Studio from
    - https://www.microsoft.com/hardware/nl-nl/p/lifecam-studio#support
- Build the prototype so it is ready for testing and evaluation of concept. (Images 5.4 and 5.5)

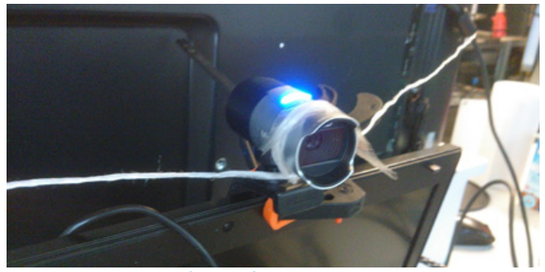


Image 5.4: Picture of second prototype

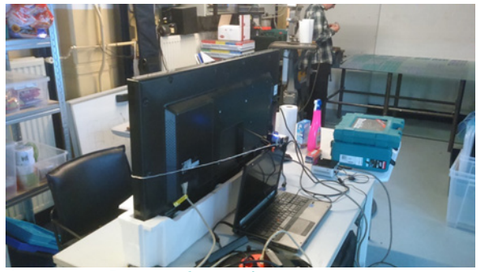


Image 5.5: Picture of second prototype

Test:

The aspects mentioned on the next page were tested in order to see what effect a screen and camera would have on the to be designed product. The schema found in Appendix A3 shows how this was done. This test resulted in to the answers which can be found below each aspect on the next page.

5. Iteration process 2: Models

Is the distance between head and screen measured in iteration 1 comfortable or tiring?
- Question: 40 cm seemed comfortable during the test of iteration 1, but is this also true when the user look on an actual screen?
- Answer: Looking at the screen is not tiring at all. Looking at it longer than an hour is not troublesome.

Is the transition between screen and reality realistic / sensible?
- Question: Is the experience damaged when the screen has a wide edge blocking the transition between screen and reality?
- Answer: Looking at the sides of the screen does not create awkward transitions when used normally. However, when the camera's angle is to big objects will be seen both on the screen as behind it, which damages the immersive experience.

Movement of head effect.
- Question: Move the head and camera behind the screen simultaneously in order to check how this effect behaves. Is this effect desirable?
- Answer: Looking around with a moving frame when moving the head is fun and intuitive. However, the question arises whether or not this is still 360 degrees.

Resolution and use of camera.
- Question: Is the material used good enough or should better materials be bought for the final product?
- Answer: A fast camera is desired in the final product, since a delay is present when the camera is being moved.

Further conclusions found during the test are:

- Since the focus of the eyes is on the screen instead of being on both the screen and what is behind it, there is no clean transition possible. When focussing on the screen the objects behind it are hazy. This way even the edges are not noticed.
- When the screen is not moving and the user hears something happening behind the screen, the natural reaction of the user is to look at the screen.
- However when the user is not looking at the screen and he or she notices something walking past the sides, he or she is inclined to look past the screen instead of at it to see what just walked behind it.
- Movement of the frame should only be applied when the user moves significantly. Small movements would create a stutter in the shown image if it were too sensitive. That is why this effect should be implemented in a smooth manner.

Iteration model 3

Even though most ergonomic aspects and the use of a screen was clear, the use of a screen on a pole still needed to be tested. Questions about its interactions while looking around with a screen still resided. That is why a more total version of the VirtuScreen was built for this iteration. This model could be seen as a prototype, where components are firmly attached in such a way it is able to represent the final product. The steps taken to create this prototype are:

- Look for usable objects
  - Camera
    - Microsoft LifeCam
    - ZED-cam will be useful in a later stadium
  - TV-Screen LG 42WL10
  - Pole used to prototype the VirtuScope
  - Nuts and bolts
  - Cables (HDMI/Power/VGA/USB/etc.)
- Make a list of needed components
  - The usable objects above
  - Software for camera
  - Solidworks parts
  - TV VESA mount
- Think of construction and dimensions
  - Sketching possible solutions and calculate measurements (Image 5.6)

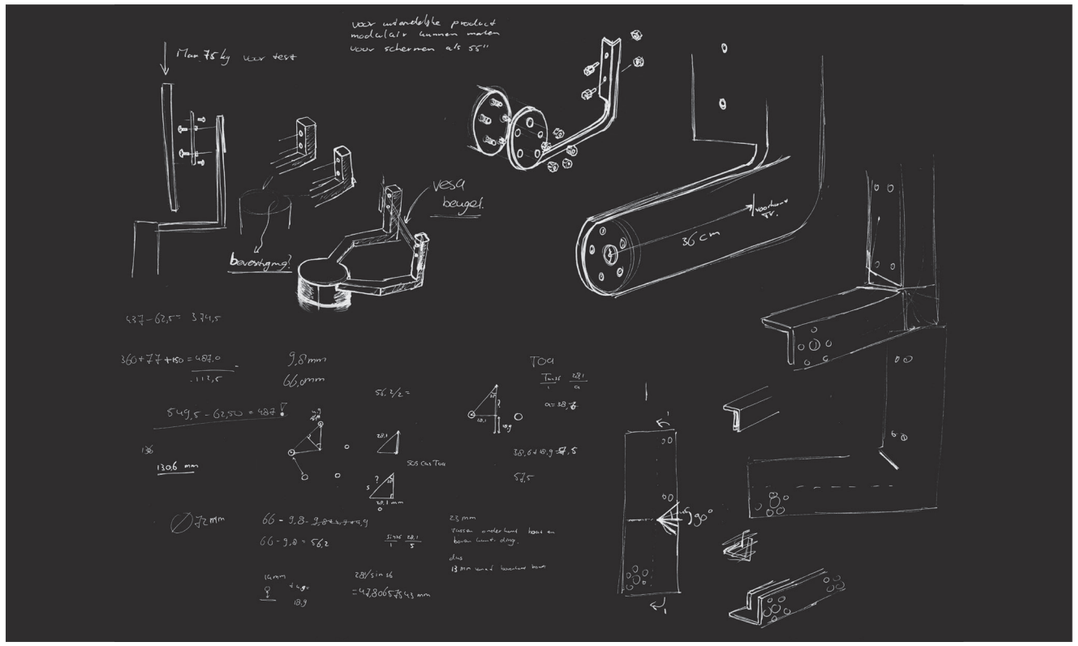


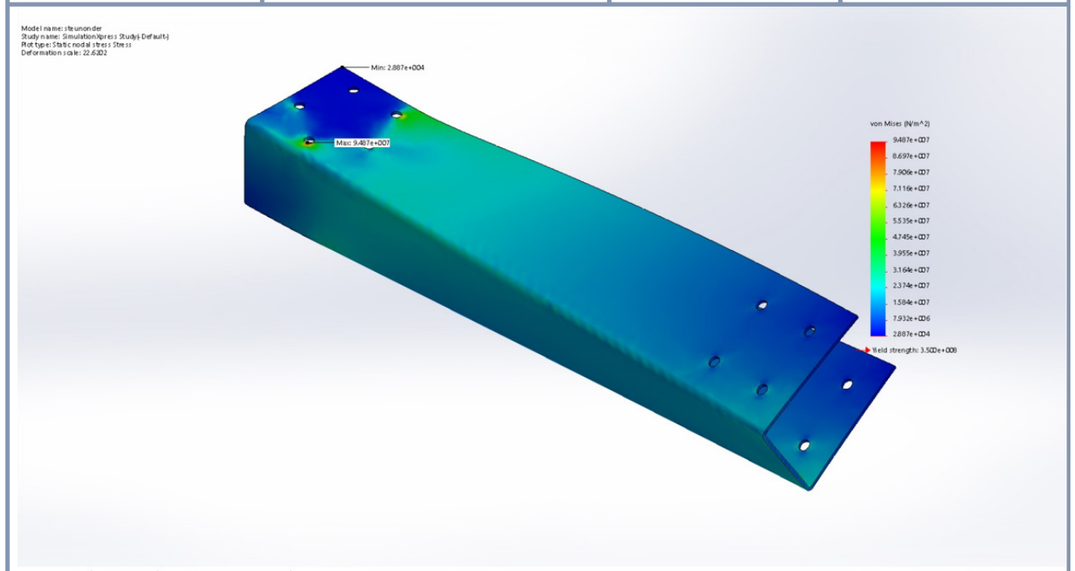
Image 5.6: Drawings of construction for third prototype

5. Iteration process 2: Models

- Work out prototype in solidworks to create DXF-files for the cutting factory and create technical drawings for the folding company
  Several components for a simple assembly Image 5.7
  Do simulations to check the strengths and weaknesses of the system Iamge 5.8

Image 5.7: Assembly model of parts which are to be produced

Name	Type	Min	Max
Stress	VON: von Mises Stress	28866.6 N/m^2 Node: 10169	9.4872e+007 N/m^2 Node: 178



steunonder-SimulationXpress Study-Stress-Stress

Image 5.8: Simulation analysis of stress in component which should be strong enough

- Order the VESA mount so it arrives in time
  source: https://www.tvbeugels.nl/02tvb-tvbeugel/

Asked the company for measurements of holes so the SolidWorks models could be adjusted to these measurements:

"Beste Jasper,

Helaas heb ik alleen een instructie blaadje, daar staan helaas geen maten bij. Maar de wand plaat is 70cm breen en 11 cm hoog
De sleuven zitten 5 cm boven elkaar hart tot hart
En zijn 3,6 cm breed en zitten 2,7 cm uit elkaar horizontaal.

Is dit wat u wilt weten?
Wat wilt u verder graag weten?

Met vriendelijke groet,

Rianne Stoppels
Tvbeugels.nl"

-Rianne Stoppels 2016 info@tvbeugels.nl-

- Download and install software needed to control and use camera
  Microsoft LifeCam:
  - Install LifeCam Studio from
    https://www.microsoft.com/hardware/nl-nl/p/lifecam-studio#support

  ZED-cam:
  - Download the latest ZED SDK for stereolabs.com/developers
  - On Windows, install VC 2013 redistributable package, available on:
    https://www.microsoft.com/en-us/download/details.aspx?id=40784
  - Install CUDA 6.5 or 7.0 from NVIDIA
  - Run the ZED SDK installer to install the ZED driver, tools and samples

5. Iteration process 2: Models

- Cut the parts needed for the prototype at Richter Staalservice B.V.

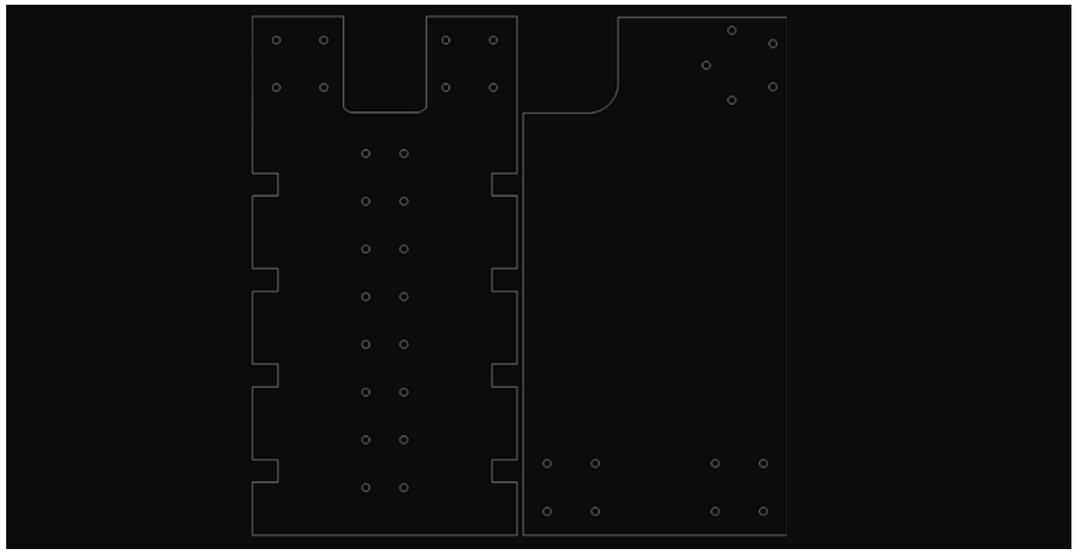


Image 5.9: DXF of parts ready for the lasercutter

- Fold the needed parts at HCT Staalbouw B.V.

  Had contact to know whether or not it was possible to fold the parts, so DXF-files could be send to Richter Staalservice B.V.

  The 126 mm is too long to fit in the machine, however after having a conversation with the workers, we came to a solution for this problem. Which meant no changes had to be made to the measurements.

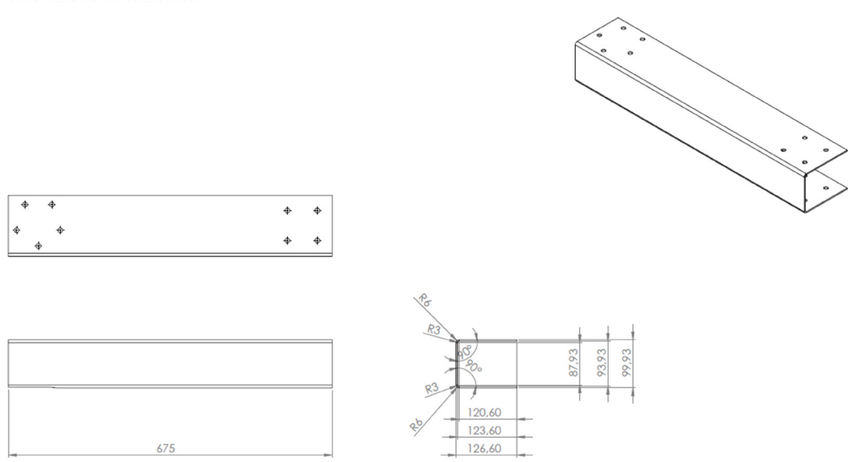


Image 5.10: Technical drawings used to verify the possibility of the bends

- Build the prototype so it is ready for testing and evaluation of concept.

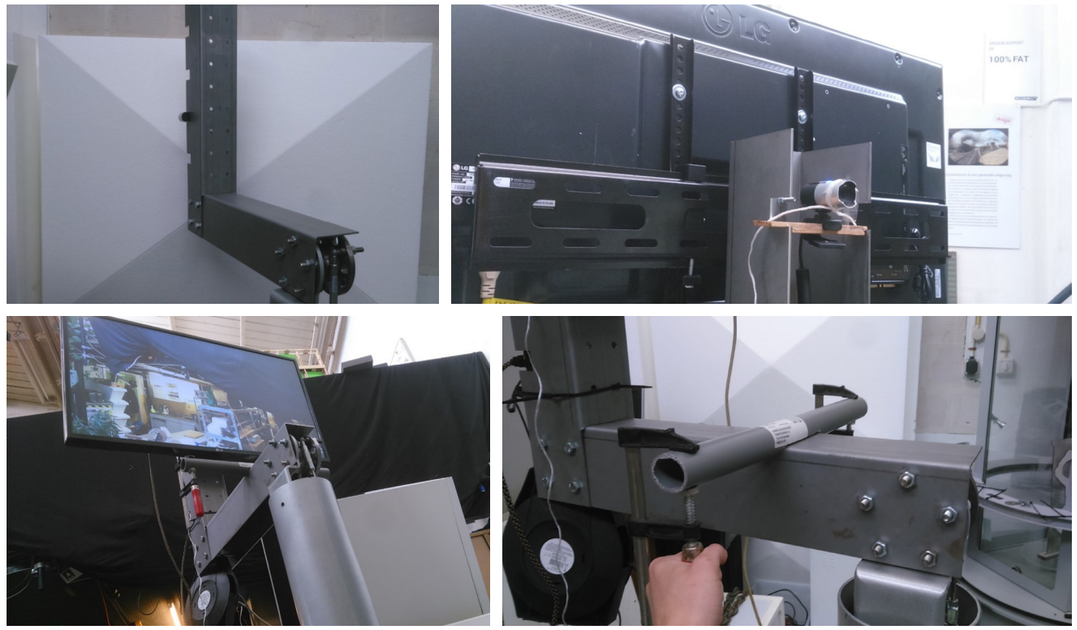


Image 5.11: Pictures of the third prototype assembled

Test:

Just like iteration 1 and 2 a test was done to answer the emerged questions. Even though the prototype did not include an augmented reality experience it was good enough to test the remaining questions seen below. The test schema can be found in Appendix A3.

Is the distance between head and screen comfortable when turning the screen?

- Answer: No complications arose when using the prototype. However, once again it is ensured that the camera which will be used in the eventual product must have good quality. The camera used in the prototype is slow and is very much distorted when moved. This distortion is also present when the VirtuScreen is wobbling. This is to be dissolved when the construction of the final product is more firm in both the X, Y and Z direction.

How much effort does it take to translocate the VirtuScreen?

- Answer: The product is heavy, but with a few people it is very much possible to move it. This should definitely be possible when the product is more firm and able to be detached into several head components.

5. Iteration process 2: Models

How big must the foot be to withhold it from falling over?

- Answer: The used foot is strong enough, however when someone would push the VirtuScreen and try to knock it over it will not be enough. That is why it is recommended to use a bigger foot than the one used for the VirtuScope. Besides that, it is recommended to attach the foot to the floor which ensures the screen from falling over.

Is the triggered feeling of wanting to revolve around the X-axis still present when looking through a real screen?

- Answer: The feeling to revolve around the X-axis is not that present when looking through a real screen. There is still a small presence of the feeling, however it is not enough for the product to have a functionality like this implemented into it. In addition, the cardboard version gave a different experience overall when looking around.

Do the handles need to be located horizontally or vertically?

- Answer: Handles a preferred to be placed vertically and grabbed on different heights. Different people with different lengths of arms would have different comfortable stances which means long handles are to be attached to the VirtuScreen.
- Founding: The desirable distance between the two handles is around 42 cm.
- Founding: Furthermore the VirtuScreen invites the user to shoot when looking around. This manner of interaction could have many possibilities for both one as several users. To enable this interaction, triggers are needed. These are to be placed on the back side of the handles, because the feeling to shoot is being incited at the fingers of the user.

How much effort does it take to move the screen around?

- Answer: It does not take much effort, which means some sort of braking system should be implemented to prevent people from turning it too fast and endangering others.

Would the eventual design including an AR experience have the desired effect for three people?

- Answer: Right now the screen is already interesting for three people to look at. When AR is implemented in a way several people could interact with it, it would definitely provide the desired effect.

Is a simple camera at the front side of the screen enough to measure movements of users?

- Answer: Yes a camera at the front will be able to measure this aspect. This means the window effect mentioned in the previous test will be implementable with the use of a camera, even though 100%FAT is not fond of this aspect due to the time it would cost implementing it. Further information about the window effect can be found in Chapter 6.

Further conclusions found during the test are:

Several aspects were noticed during the test. One of these aspects is the fact that the camera which films the surroundings is to be placed as closely to the screen as is possible. In comparison to iteration 2 the camera was placed with a bit more distance between the screen and camera. This proved to have a negative effect on the experience. The final product should have a better camera which is not placed too far from the screen. The viewing angle of the camera is also important since the space between camera and screen could be a bit more when a camera with a large angle is used. This is necessary due to the fact the image seen on screen should not be seen around the screen, because it is less immersive. In addition, the camera should have a higher framerate than 30 frames per second. If lower, the screen creates dizziness which is not desirable. 60 frames per second would create the best effect, however this should not degrade the quality of the image, since it is important to see a High Definition image.

An additional rubber rim around the edges is advisable, because when the screen would hit someone else's head this could strike the head really hard. This problem could also be resolved through realising some sort of friction which would prevent the screen from moving too fast. This braking functionality would also resolve the problem of the screen turning to the lowest point.

The radius of the surface on which children can stand should be around 20 cm. It should not be too big, since adults need to be able to move around it, and it should also not be too small, since it should not be too hard for children to stand on it.

Finally, the interaction with the VirtuScreen is fun and has many possibilities, which makes it a unique product.

6. Iteration process 3: Concepts

Concepts

As seen in Chapter 4, sketches were made according to the chosen approach. These sketches eventually resulted into three design concepts (as was desired by 100%FAT). While the use of the concept initially is the same, their appearances differ a lot.

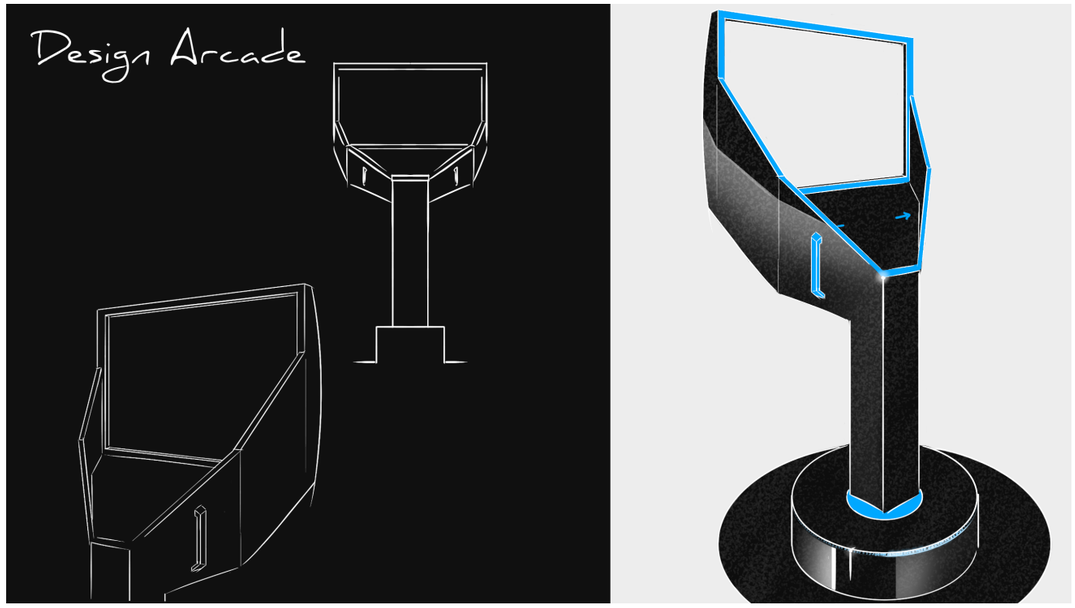


Image 6.1: Design based on an arcade cabinet

Image 6.2: Arcade cabinet
Source: http://makezine.com/2014/10/04/10-diy-arcade-projects-that-youll-want-to-make/

The first of three designs, as seen in Image 6.1 is based on an arcade cabinet (seen in Image 6.2). The bulky design represents the massive cabinets which were used to hold the gaming hardware. Since the possibility exists of integrating games, this design shows the user these possibilities beforehand. From a distance many users might recognize it as an arcade cabinet, which could arouse interest among them.

The second design, seen in Image 6.3, is a clean and sleek version based on 100%FAT's desired design directions. As discussed in Chapter 2 the VirtuScreen was to be a simple and sleek product. The products seen in Image 6.4 have smooth colours and shapes with details nicely implemented in such a way the user immediately understands how the products work.

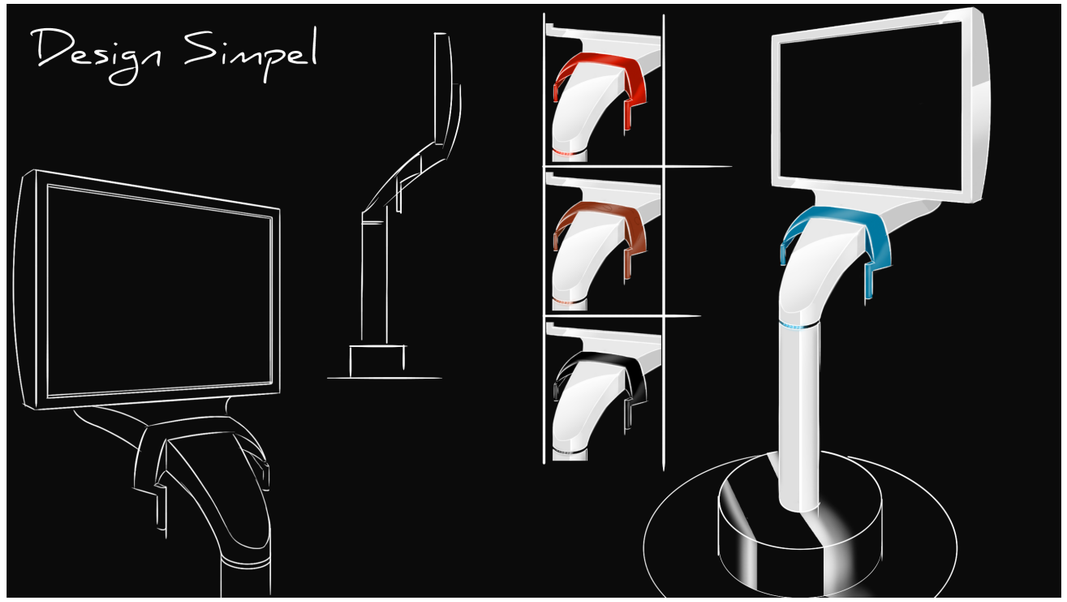


Image 6.3: Design based on the simple aspects within Braun design

Image 6.4: Collage on Braun design

6. Iteration process 3: Concepts

Image 6.5: A Braun product

The last design is based on a specific design approach. The product shown in Image 6.5 shows the appearance Braun products have, which clearly comes back in the design shown in Image 6.6. This design focusses both on being high-tech and minimalistic. The user only sees the construction, handles, camera and television which show the basic use of the VirtuScreen.

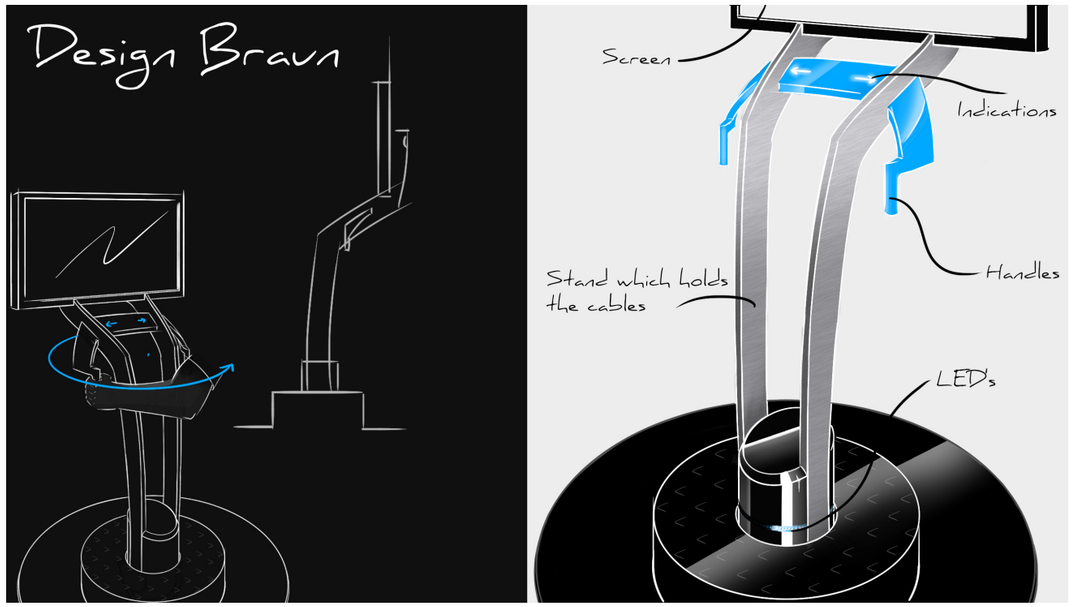


Image 6.6: Design purely based on the product seen in image 6.5

Concept choice

A meeting was necessary to decide what visual design direction the VirtuScreen would take. The produced concepts seen in the previous paragraph were discussed. The concepts were presented and discussed in order to make a choice. However, a specific choice could not be made. The representatives of 100%FAT liked several aspects from each design, especially the designs: design simpel and design arcade. That is why the choice was made to combine some of the aspects. Choosing “design simpel” as base design were certain aspects were to be implemented. These aspects are the roughness and the bulkiness from “design arcade”. “Design simpel” was to curvy and smooth according to the representatives. The production would be too expensive and complicated. This reason supported their choice to design a combination and confirmed what direction was to be taken. Image 6.7 shown in the following paragraph shows the final concept.

Final concept

The Final concept as seen in Image 6.7 has several important aspects for its use. As stated in the concept choice paragraph, a combination of design aspects was desired. Image 6.7 shows the result of this combination, while the significant aspects of the VirtuScreen’s final concept are elaborated on below it.

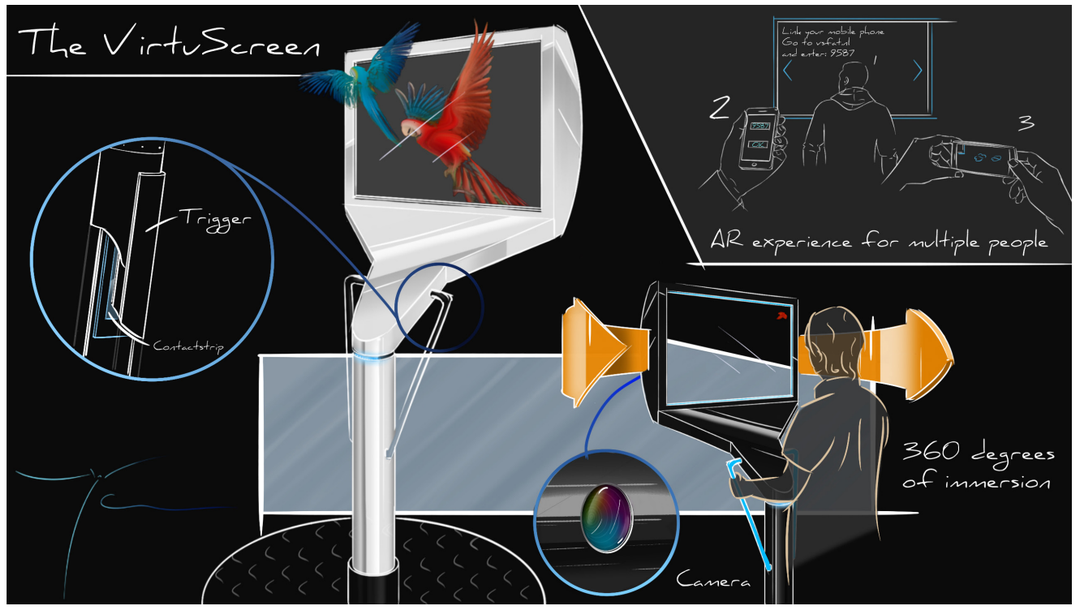


Image 6.7: Final concept based on a combination of important aspects

- Long triggers and additional stand

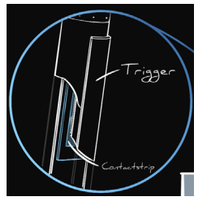


Image 6.8: Trigger design

The triggers are long so many different users can interact with the product. Every person has a different height where he or she likes to grab the handle, which is not a problem for the VirtuScreen with handles like these.
It also mediates to the users what they can do with the VirtuScreen and what the possibilities of its use are.

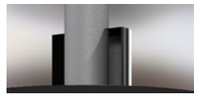


Image 6.9: Additional stand

In addition to the handles a stand is implemented in the design. The stand is a like a stepping stone for children to get up higher, enabling them to interact with the VirtuScreen as well.

6. Iteration process 3: Concepts

- Window effect

Image 6.10: Window effect

The window effect is an effect created by using an extra camera at the front side of the screen. This camera follows the movements and "mirrors" these movements. When the user moves his head to the right, his or her view should change according to the position of the head. The vision moves to the left when the user moves to the right. Concluded from the test with iteration two only the effect is enough. It is not necessary to recreate the effect a full 100 percent. This effect is realized by using a frame. When looking through the screen a part of what the camera films is shown on screen. This part is called the frame. When the user moves to the right the frame moves to the left showing the left part of what the camera is filming.

- AR for three through mobile linking

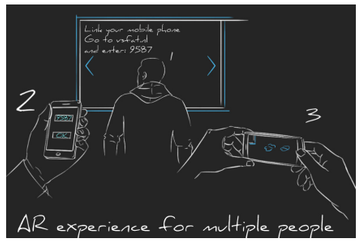


Image 6.11: Mobile phone linking

Just like airconsole.com where people are able to play together via linking their mobile phones, the VirtuScreen is able to link to the mobile phones of other people. When others cannot use the product because it is already in use, it is possible for them to get the same experience on their phones. Going to a website would enable them to fill in a code which is presented on the VirtuScreen. Filling it in connects them via the internet giving them the freedom to look around on their phones. This connection ensures many possibilities for the VirtuScreen, since it is possible to design several applications for this aspect. Together with the primary user they are able to achieve goals together or battle each other depending on the game.

- Framerate 30 fps or higher

Image 6.12: The ZED-CAM
Source: http://myzharbot.robot-home.it/blog/wp-content/uploads/2015/05/6K_ZED3.jpg

As concluded from the test with the third model mentioned in Chapter 5 a camera with an fps of 30 or higher is needed to create an experience without tiring the user. This means the camera chosen for the VirtuScreen is crucial for its success. At the moment the ZED-CAM will be used which does have the specifications required for this product.

- Full HD

Image 6.13: LG 42WL10 TV screen
Source: http://www.lg.com/nz/business-monitors/lg-42WL10

The screen used in the prototype was a full HD screen, which combined with a high quality camera is able to look really good. Also noticed during the tests is the importance of high quality. When there is a lack of quality the experience becomes boring. That is why a full HD screen is to be used in the final product.

- Braking technology in turning construction + 360 degrees of viewing freedom

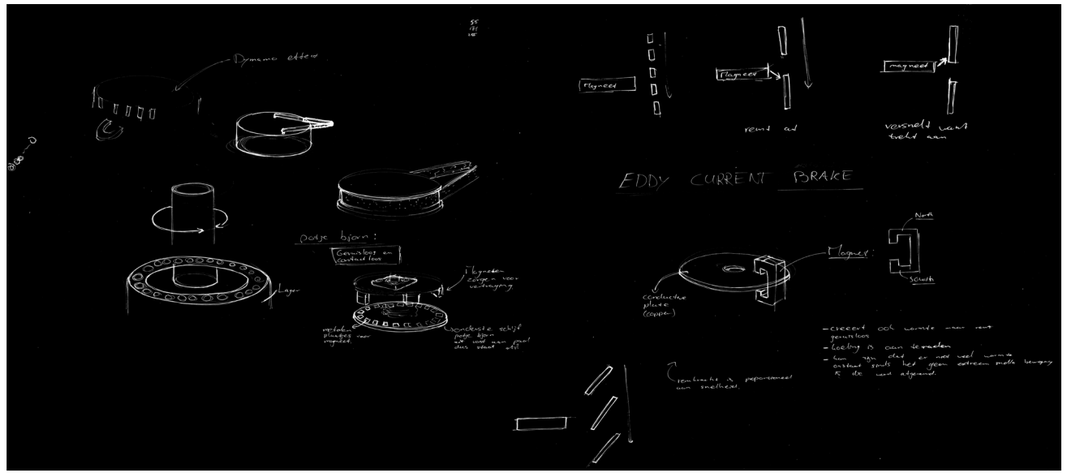


Image 6.14: Sketches of a braking system

Another aspect of the final concept is the use of Eddy current brakes to prevent users from turning the screen to fast. An Eddy current brake is a brake without creating resistance through friction. This means the brake is able to slow the movements without noise. A disk of copper and a magnet are used to achieve the braking activity.

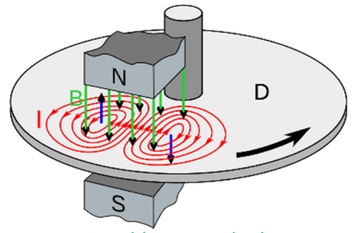


Image 6.15: Eddy current braking
Source: https://en.wikipedia.org/wiki/Eddy_current_brake

The magnet is positioned around the disk creating forces opposite of the direction it is turning. This way braking the movements (Wikipedia (2016) [10]). When using an electric magnet the strength of the braking force can be decided, this way 100%FAT is able to determine how much resistance is necessary for a desirable effect without having to use too much force.

- Specialised to location

One of the aspects already mentioned in the market analysis and which is implemented in the VirtuScreen is the specialisation to a certain location. If a potential buyer wants the VirtuScreen to be located at a certain spot, an exhibition for example, the team of 100%FAT is able to adjust the software to the specific location. This way a different experience is presented at different locations. Which is an experience desired by the VirtuScreens buyer.

7. Realisation

Solidworks model

Image 7.1: Exploded view of the complete assembly (Appendix A6)

The assembly of the product consists of many components making it a complex product. The model seen in Image 7.1 shows an exploded view of almost all the parts excluding nuts and bolts.

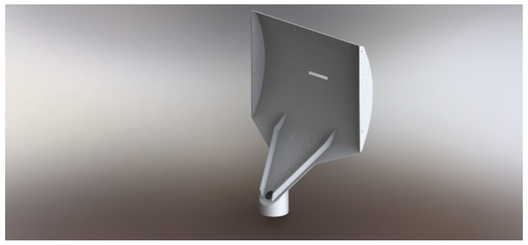


Image 7.2: Constructional backside

Probably the most important component of the VirtuScreen is the backside / constructional base. This component is connected to the pole and caries all the components. That is why this part has ribs welded to its body. These ribs exist to absorb the forces trying to bend the part. Besides the fact it carries the forces both external and internal, it is also the component to which most other parts are connected. Meaning that space is of great significance for its shape. This is also the reason why the ribs are directed outwards instead of directed straight.

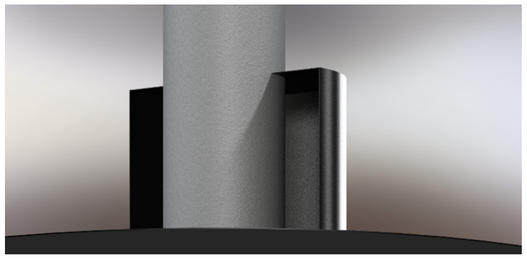


Image 7.3: Stepping stone / additional stand

Not seen in the exploded view but an important component for the VirtuScreen is the stepping stone for children. This part is located on the floor, high enough for children to be able to see the screen and slim enough for adults to walk around.

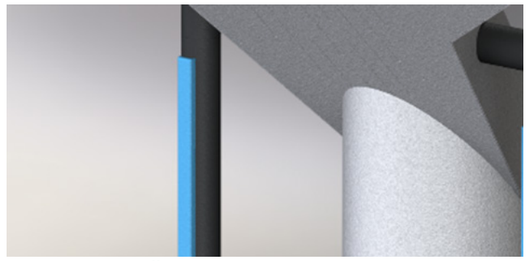


Image 7.4: Handle

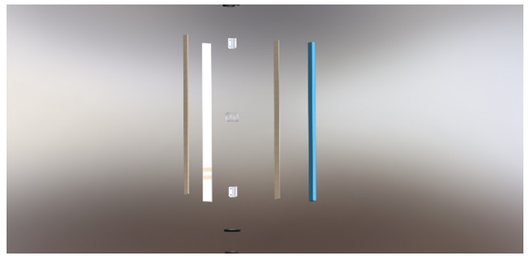


Image 7.5: Exploded view of handle

The triggers are located inside the tubes which act as the handles of the VirtuScreen. As said before they are long and notable for potential users. They are located on the sides of the VirtuScreens body and connected to the construction on the inside. This ensures that the forces created by the user's movements are not directed on the housing, which is not as strong.

The triggers consist of several components. The button, three boards, two joints, some connecting points, a spring and the components needed to measure the input (touch-sensor / contact point). Together they ensure that the interaction with the VirtuScreen goes smoothly for everyone.

The connection of the television to the construction is complex due to the space present in the back side of the product. The television also needs to be attached at its backside where the camera is supposed to be placed as well. That is why the connection directs to the bottom of the constructional base and is also the part to which the camera is attached. This direction is also important for the assembly of the product, since the assembler needs to be able to reach the attachment points. However one of the cons of this assembly would be the fact that it is not strong enough to withstand forces coming from the sides when the VirtuScreen is being turned. That is why the television fits precisely between two rubber strips which are also attached to the constructional base. However these are attached to the inside of constructional bases sides, meaning the television has no space to move around in the directions which could break the construction.

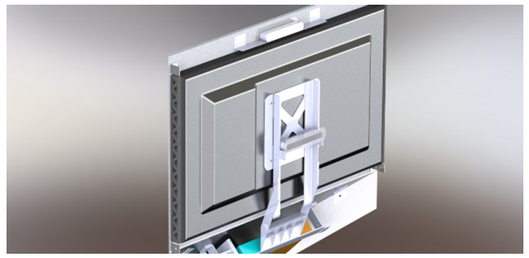


Image 7.6: Screen attachment seen from the back (Appendix A6)

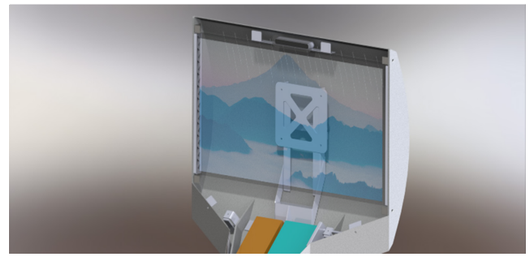


Image 7.7: Screen attachment seen from the front

7. Realisation

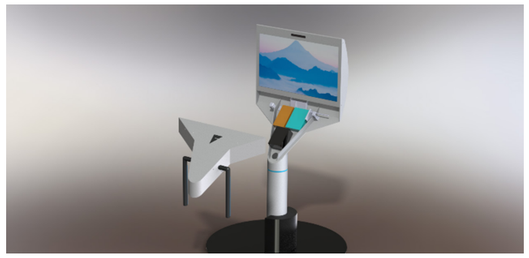


Image 7.8: Cap that covers the hardware (Appendix A6)

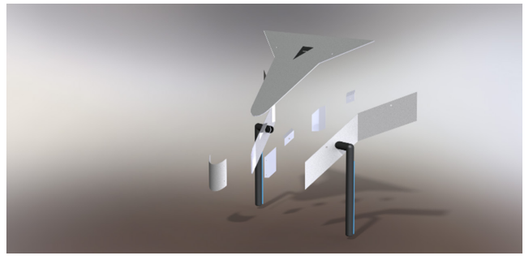


Image 7.9: Exploded view of the cap

In order to enable 100%FAT to reach the hardware a cap was designed able to be taken of when needed. This cap consists of several parts which are attached to each other. When removing the cap, 2 bolts need to be unscrewed. This allows the repairer to slide of the cap and reach the inner components.

Cable management

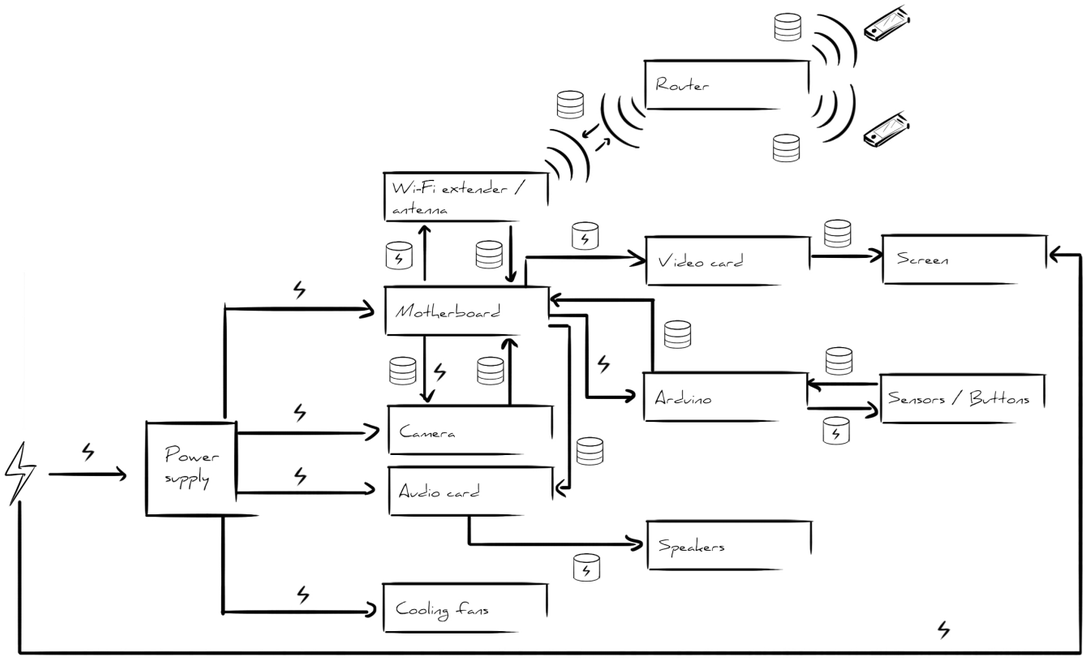


Image 7.10: Management of cables between hardware components

= Data = Data + electricity = Electricity

The product contains many different parts of hardware. These parts are connected with each other through cables which are able to deliver power, information or both. Image 7.10 shows all hardware components including the sorts of connections that lay between them. This diagram also shows what sequence is favourable when placing the components inside the body of the VirtuScreen. This is very important due to the fact that when an error occurs maintenance should be able to be done fairly easy.

Since the first component (the power supply) has many connections with other components while itself gets power from the net, the placement of it should be as early as possible. Placing the power supply first still creates many opportunities for placements of other components. While the screen and camera have their own spots other components need to be placed cleverly. In order to prevent cables to go back and forth, the unit that should come after the power supply should be the motherboard. The motherboard is connected to most of the components within the product, this due to the fact all information is processed by it. The complete placement of all the components is discussed in the following paragraph.

7. Realisation

Space management

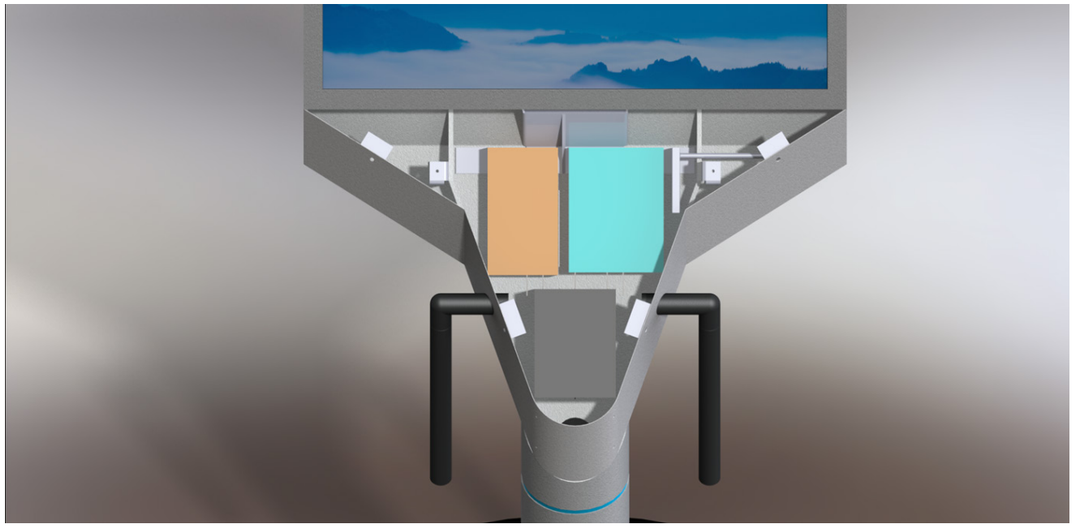


Image 7.11: Placement of components within the VirtuScreen (SolidWorks model)

As said in the cable management section the placement of components according to the cable sequence is very important. However the product only has a certain amount of space available which could push certain components to locations which are not as favourable. Due to the fact that the motherboard, video card and the power supply are big objects, options to place them are scarce. Combining this with the fact the power supply should be placed as early as possible means that there is only one “good” way to place them. As seen in Image 7.11 three large blocks are placed in the centre of the body. The grey block embodies the power supply while the orange block embodies the video card and the blue one the motherboard. Leaving some space at the sides for remaining hardware components. Luckily parts like the cameras, screen and sensors need their own space somewhere else which means the remaining space can be used for the small Arduino, small audio card, Wi-Fi extender and if needed: speakers.

Materialisation / Production

Due to time constrains the choice was made to elaborate on the important components of the VirtuScreen. These components are worked out into technical drawings (using the drawing rules written down by Krone and Lutters-Weustink (2013) [5]) almost ready to be sent to producers. However it is recommended to talk with these producers about the possibilities at that company, since some production techniques might not be possible for them. The components chosen to work out are the handles including the triggers and internal parts, the constructional back side of the VirtuScreen and the screens attachment components. These components are the most important parts of the VirtuScreen since they are the most difficult to produce and bear the most important roles in both the construction and interaction. All thirty-five full size drawings can be found in Appendix A7.

Constructional backside of the VirtuScreen

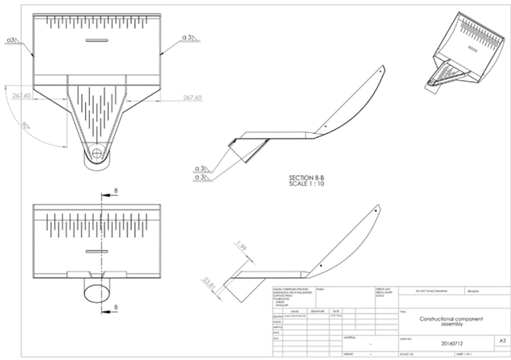


Image 7.12: Constructional backside assembly

The constructional backside is the most important component of the product. This part (Image 7.12) caries all the weight and needs to be firm enough in order to make it possible for users to turn the VirtuScreen without wobbling. That is why this component also is the heaviest one. The strength it embodies comes from the fact it is made from steel, and

The constructional backside consists of a bended plate which has been laser cut and a few components welded to it, strengthening the construction.

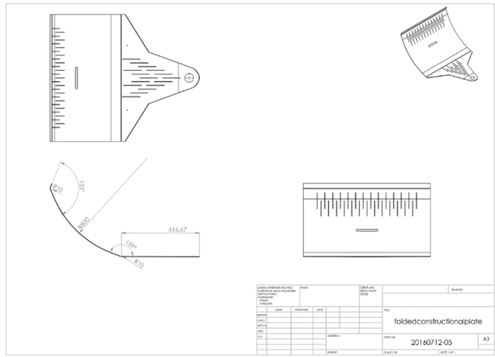


Image 7.13: Constructional backside bended plate

The bended plate seen in Image 7.13 has several important aspects. The holes which will be laser cut out of them, are needed for air ventilation, cable management and camera use. These holes are placed conveniently, not detaining the assembly of the product.

7. Realisation

Images 7.14 to 7.16 show the parts needed to construct the assembly. The tube seen in Image 7.14 embodies the connection between the pole and the constructional backside. This component is connected with the sliding contact built by 100%FAT, allowing the top of the VirtuScreen to turn 360 degrees.

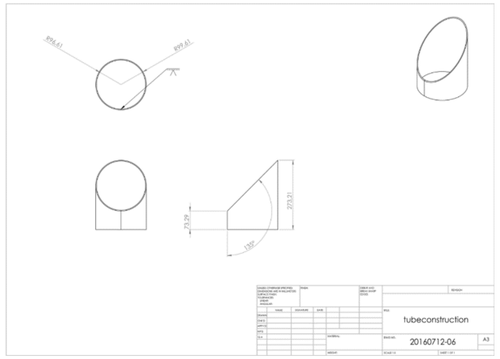


Image 7.14: Constructional backsides attachment to pole

The drawings shown in Images 7.15 and 7.16 are of the parts which strengthen the whole. They are welded to the plate in order to create a strong construction. they are placed conveniently, not being located in the way of the hardware.

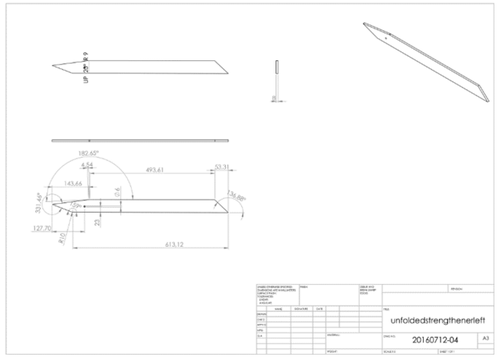


Image 7.15: Constructional backsides horizontal strengthener

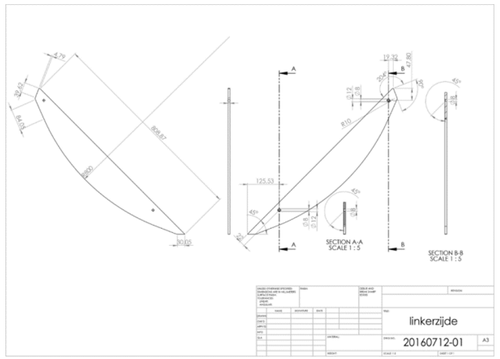


Image 7.16: Constructional backsides vertical strengthener

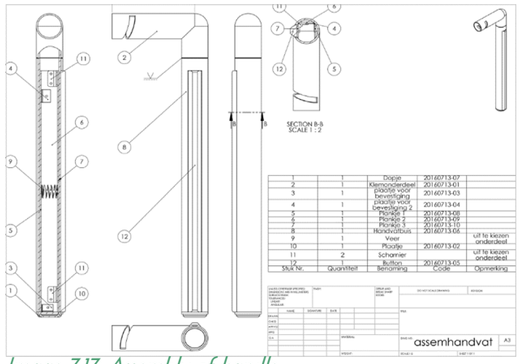


Image 7.17: Assembly of handle

Handles including triggers

The handles contain many different components. Image 7.17 shows the assembly of the left handle. The parts of the tube visible for the user are hollow for a reason. They contain the construction needed for parts to move, which enables users to push the buttons and interact with the VirtuScreen. Since this signifies the presence of cables which need to go to the motherboard, there must be a way for these cables to reach it.

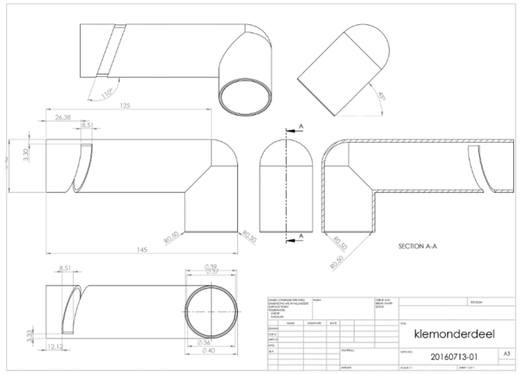


Image 7.18: Connection tube between handle and VirtuScreen

That is why the tube seen in Image 7.18 is both hollow and connected to the constructional backside inside of the case were the hardware is located. The diagonal cut, which can be seen in the drawing, has the purpose of fitting precisely on the ribs welded to the plate seen the previous paragraph. This enables the force created by the user when turning the screen to be directed directly to the constructional part.

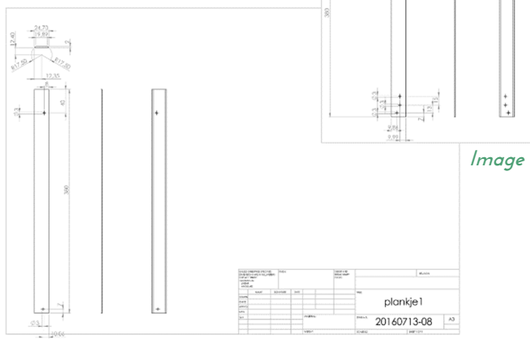


Image 7.19: board

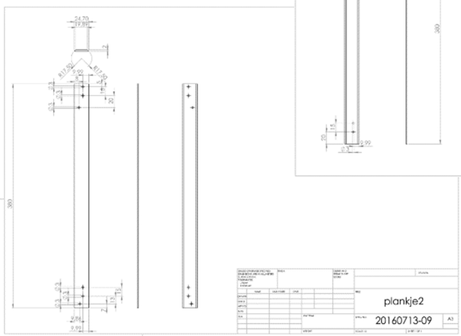


Image 7.20: board 2

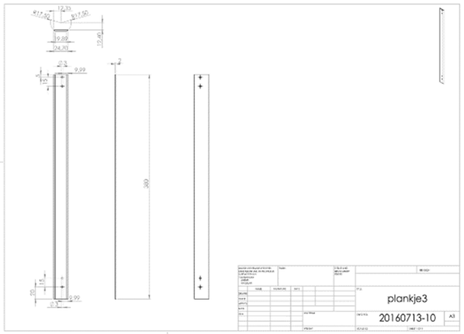


Image 7.21: board 3

In the inside of the tube some important parts are located which are slided in during the assembly. The most important of these components are the boards to which everything is connected. These can be seen in Images 7.19 to 7.21. (Also seen in Appendix A7)

7. Realisation

Screen attachment

The screens attachment is both complicated and minimalistic. The screen needs to be placed inside the constructional part, which means there is not much space for the assembler. Reaching several parts is hard when the screen would be placed first. That is why the assembly shown in Image 7.22 needs to be attached to screen first. This allows the screen to be placed together with the camera while the assembler does not have to reach unreachable locations.

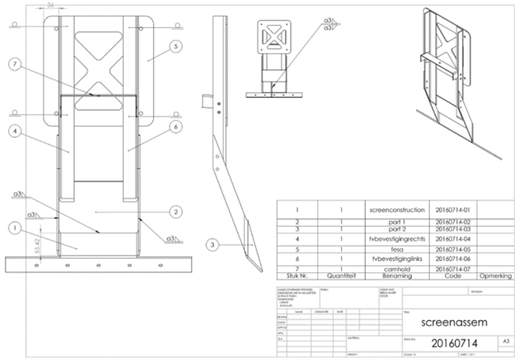


Image 7.22: Assembly of screens attachment

The part seen in Images 7.23 and 7.24 is what connects the screen to the constructional part mentioned before. It is a folded part strengthened with welded on components (these can be found in appendix A7 as well). Using SolidWorks' built in software created to simulate forces, the part is designed to carry the screen and additional parts with ease.

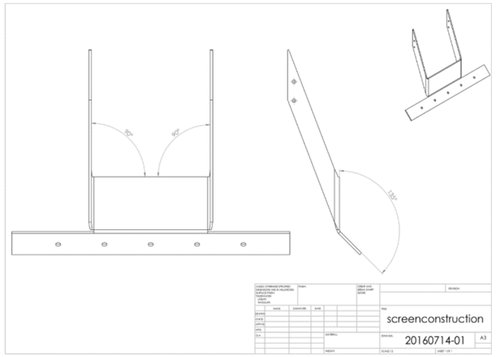


Image 7.23: Folded carying component

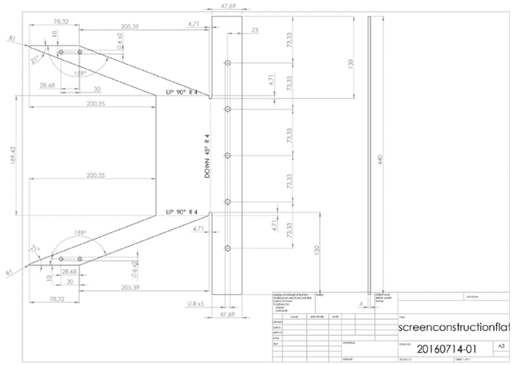


Image 7.24: Unfolded carying component

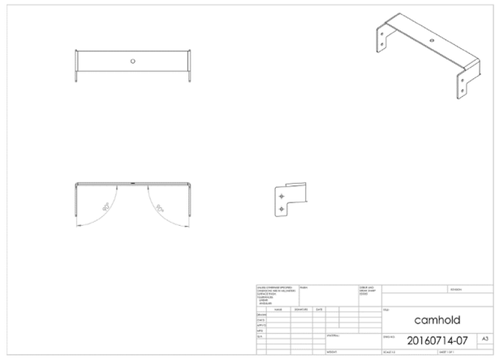


Image 7.25: Folded camera hold component

Connected to the previously mentioned component are two bended plates to which important components are attached. These important components can be seen in Images 7.25 to 7.27. Images 7.25 and 7.26 show the component to which the camera is connected. It is placed in front of the hole in the back side of the product. This enables the camera to film the environment while being protected from the outside world.

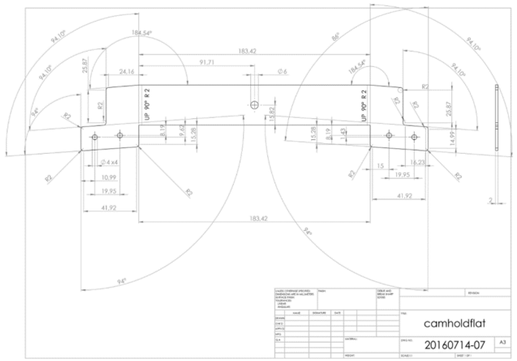


Image 7.26: Unfolded camera hold component

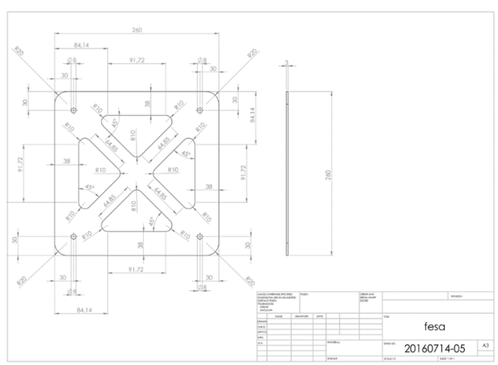


Image 7.27: Fesa hold to whitch tv is attached

The drawing seen in Image 7.27 is an image of the mount to which the screen is attached. It is designed just like a FESA mount in order for different screens to fit inside the VirtuScreen.

7. Realisation

Evaluation of the model

Using the measurements calculated in Chapter 2 and seen in Table 7.1, it is possible to evaluate the SolidWorks model. The measuring tool provided by solidworks was used to check the values which exist in the model while models of a child and adult were used to get a basic idea (this can be seen in Image 7.28).
Both children and adults are able to reach and use the significant aspects of the VirtuScreen at any time. Children are able to look at the screen when not standing on the additional stand while still being able to reach the handles. This means the solidworks model justifies according to the provided measurements. Together with the additional stand the VirtuScreen is to be used with ease by everyone.

	95% of children is more than	**95 Adults is less than**
height	1255mm	1917mm
Shoulder height	992mm	1585mm
Arm length	494mm	811mm
Eye height	1140mm	1802mm

Table 7.1: Measurements of 95% of children and adults

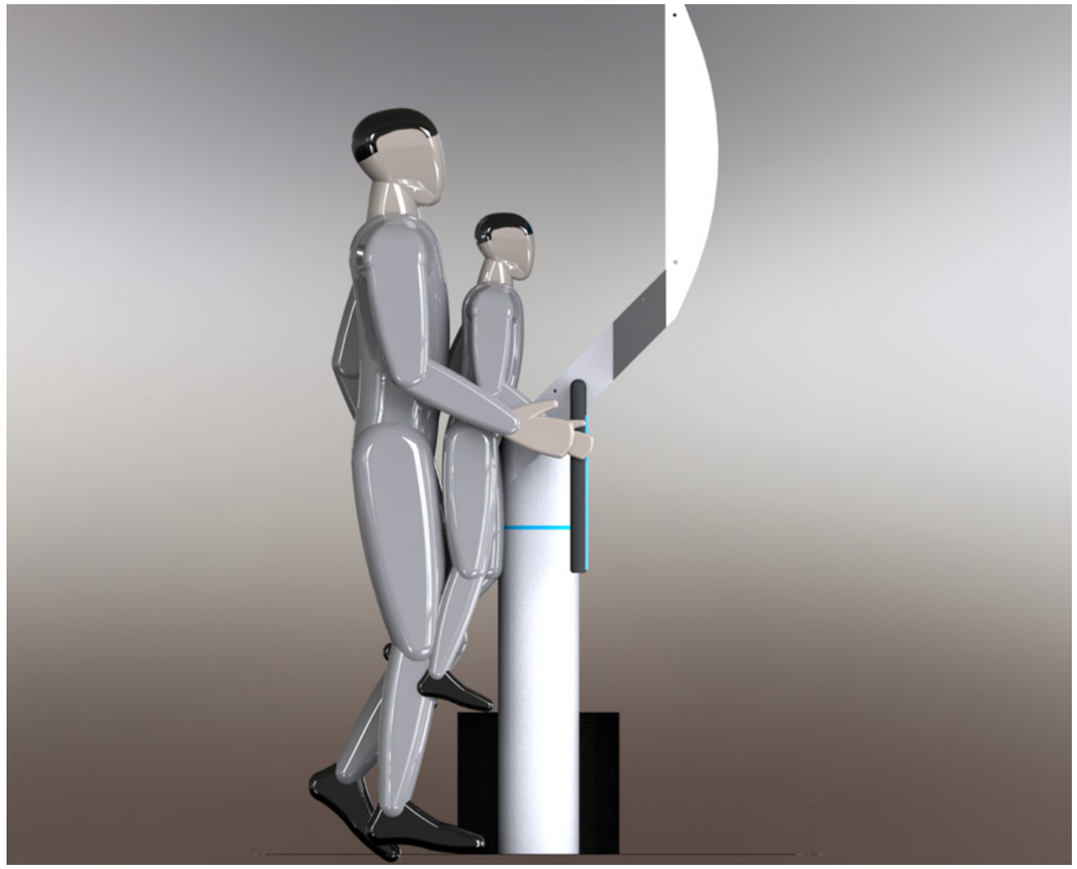


Image 7.28: SolidWorks model with models of an adult and child

8. Promotional material

The VirtuScreen is a fairly easy to understand product once you have seen how it works, however when possible buyers want to know more about the product it is not yet built, which means other media should sell the product. This could be done through a report with all the information accessible. However, this is not recommended since it takes a lot of reading and time, which does not arouse interest. A short promo-video and some flyers are far more effective when it comes to attracting buyers. Should they want more information, a report could be given afterwards for them to read.

Renders of the final product and concept drawings (Images 8.1 to 8.3) which summarize the product, are perfect to promote the VirtuScreen. With just a few words/sentences the product is described well enough for people to understand it. Adding to these forms of media a promotional video was made using solidworks and PowerPoint. Within just a few slides the viewer gets all the information he needs to buy the product. Emphasising on the unique selling points of the product, it presents itself to the potential buyer. The “slides” of the promotional video can be found in appendix A8. Noting that these slides are in Dutch, due to the fact that the market 100%FAT sells to is located in the Netherlands.

“Captivate your customers with new experiences”

Is the slogan used in this promotional video. It tells the potential buyer that with the VirtuScreen he or she might buy is possible to attract people by giving them new experiences. Which persuades the potential buyer due to the fact the VirtuScreen attracts customers to his or her establishment.

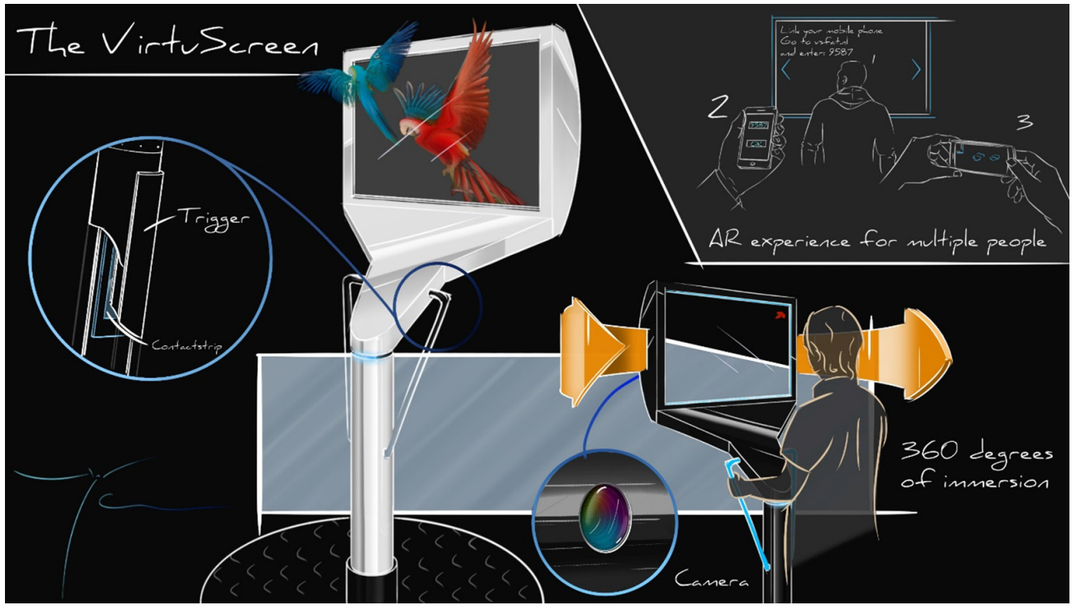


Image 8.1: Concept drawing of the VirtuScreen

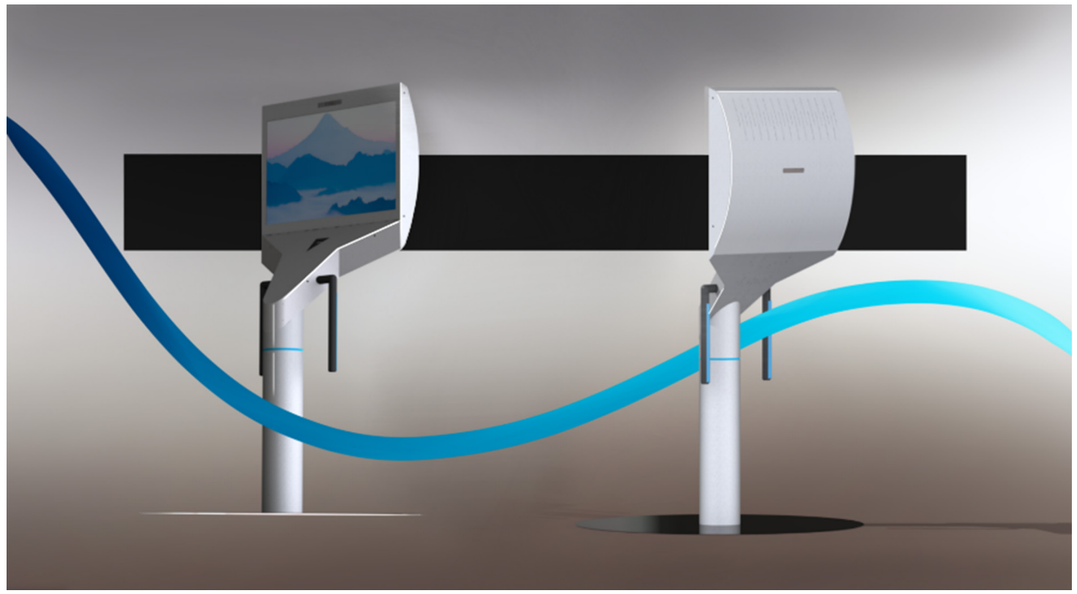


Image 8.2: Renders of the VirtuScreen (Appendix A6)

Image 8.3: Close-up render of the VirtuScreen

9. Conclusions & Recommendations

Conclusions

The VirtuScreen is a product designed with many different features, which all come together to achieve one goal (creating an augmented reality experience for several people at the same time). The objective was to design a VirtuScreen able to deliver an augmented reality experience to three different people, both in terms of physical design (aesthetics and ergonomics) as the experience itself. The concept of the VirtuScreen eventually was to be worked out into technical drawings for construction and assembly.

During this project a design for the VirtuScreen was realised. Focussing on its use and appearance the goal of designing a product which emphasises on both ergonomic and aesthetic aspects which is usable by 95% of the population was achieved. Together with the owners of 100%FAT a design direction was chosen, which met the needs 100%FAT had for the VirtuScreen. The most important components of this design eventually have been worked out into technical drawings. While not all components have been worked out into, it can be said that the objective of creating technical drawings has been achieved as well. This statements is further substantiated when taken into account that during a discussion with 100%FAT it was concluded that not all drawings were necessary.

During the process it also became clear how expensive waterproof screens actually are, which meant a choice was made to design the VirtuScreen for inside uses. This also resonated with the fact that the wind could be able to knock over the VirtuScreen due to the large surface of the screen.

The iterations of the VirtuScreen which were made along the way were really helpful to both the design as the functionality of it. Many ideas and solutions arose while working with the simple models. They clarified how the product was to be used and what kind of experience it would deliver. Eventually concluding into the fact that the product is able to attract the attention of several people at the same time. It became clear that the VirtuScreen is a product with a lot of potential.

Several aspects were thought of and implemented in the final concept during the process. Most of the aspects were accepted and liked by 100%FAT. However, some aspects like the window effect and the mobile phone linking got different thoughts. The window effect was thought to be hard to implement by 100%FAT. However, the functionality could create a more immersive experience due to the fact it is an extra interaction which connects the product and user. That is why this functionality should not be forgotten.

The implementation of the functionality were users could link their phones in order to see what the primary user sees, shows that the VirtuScreen is able to deliver an Augmented Reality experience for three. However, while the concept includes of software able to link mobile phones to the VirtuScreen, it is optional for 100%FAT to use it, since they only saw it as a possibility instead of something necessary to be integrated. The base concept intrinsically attracts several people thanks to the large screen, giving them an augmented reality as well. However integrating it would add another layer of use to it, since the use of mobile phones is becoming more and more popular. Concluding to this, it can be said that the VirtuScreens concept is able to deliver an Augmented Reality experience to three people, however it is recommended to test this functionality with a prototype which has this functionality integrated.

As mentioned before, technical drawings were made, which show how the VirtuScreen is to be produced and assembled. However, these drawings are a basis of what the eventual product should be. A few aspects still need to be worked out. Experienced people should look at the drawings and think of where to place cooling holes and cable holes. Even though these are already implemented, an optimization of these aspects is recommended. In addition to this, the connection between the top part and the pole has been left blank. This due to the fact 100%FAT already knows how this connection is established (same as the VirtuScope).

During this project a certain work method was chosen to complete the assignment. The process consisted mainly of analysing, iterating and realising the findings. This way of working was perfect for this product and is certainly a recommended method for similar products. The creation of physical models which could be used for testing was very helpful together with the iterative sketching which happened simultaneously. In summary it can be said that the project went well and that the objectives of the assignment have been achieved. The VirtuScreen is a product with great potential and definitely something 100%FAT should develop. This report can be of great help during that development.

Recommendations

The designed VirtuScreen and the drawings are some things 100%FAT can definitely use while they pursue the production of the product. However during the project some aspects were not yet tested or were said not to make it to the final product. That is why a list of recommendations has been made to give 100%FAT an idea of what has to be done from now on.

- The functionality of the window effect, which was implemented in the concept, was thought to be hard to implement by 100%FAT.However, it is recommended to research this in order to check how reliable this software would be and if it would work as planned. If it works and it gives the feeling of looking through a window it would add a lot of value to the experience of the user. This way adding another unique selling point.
- As stated in the conclusion it is recommended to analyse the technical drawings and optimize them as much as possible before starting the production.
- A test should be done where the handles and triggers are built to see whether or not this interaction is optimal.
- The attachment of the top part to the turning mechanism designed by Bjorn Karselius has been kept blank due to the fact 100%FAT already has the knowledge of how this mechanism is to be attached. However, the implementation of the braking system mentioned in chapter 6 might change the design of the mechanism. If 100%FAT would chose to implement this aspect further research on the connection between the top part and the bottom part should be done.
- A promotional video has been made during this project, which is recommended to be used when convincing potential buyers and clients.

A. Appendix

A1 Market research

Vision station by Elumens:

$19,995

Is meant to train through simulations, to present products and processes and to use as entertainment. (Jeff Tyson, 2001) The product uses a projector to show a virtual world for the user to move around in. The shape of the screen enables the user to see more than just in front of him. Small movements with your head distract from the immersive feeling it provides.

source:http://www.coolmarketingthoughts.com/2005/10/04/elumens-vision-station/

Pepsi screen:

Not for sale

This screen was an advertising stunt by Pepsi©. The screen shows a few things which aren't real, meant to scare the ones waiting for the bus and get their attention. While most augmented reality products focus on being used by one person this screen managed to entertain several subjects at the same time. Locating it in a bus station, it enabled Pepsi to have the screen look like a window as if what the user is seeing is not augmented reality.

source:http://www.businessinsider.com/pepsi-ad-shocks-londoners-2014-3?IR=T

Kinect face tracking by Microsoft:

€149,99

The Kinect made by Microsoft is able to recognize the faces of humans and send input to a computer for a program to work with. This is used to place the user in a certain virtual environment which can be seen on a screen.

source: http://www.xbox.com/nl-NL/xbox-one/accessories/kinect-for-xbox-one#f-bid=v1zuykvEx6M

Hololens

$3,000

The hololens is a recent invention created by microsoft. It basically is a windows 10 computer which is able to "project" holograms in the room the user is standing. Wearing the glass enables the user to see objects around him or her which are not there. The user is able to see all around him, moving his head, with which the hololens is able to cope. It scans the environment and knows where objects are standing and where certain virtual objects were standing.

source: https://www.microsoft.com/microsoft-hololens/en-us/development-edition

VirtuScope by 100%FAT

~€2000,-

The Virtuscope is an innovative project completed by 100%FAT. The virtuscope uses a camera to film the environment, while the software places moving images as an overlay over the environment. This way showing the user things which are not present at that current time. Using two camera's and two screens it enables the user to see the environment in 3D.

source: http://100fat.nl/virtuscope/wp/

Mobile phone applications / google cardboard

IKEA catalogue app

Free app

The IKEA catalogue app enables its user to project furniture in his or her room when thinking of buying one. This way the user can see how this piece of furniture looks standing in the room and if it fits with the rest of the furniture.

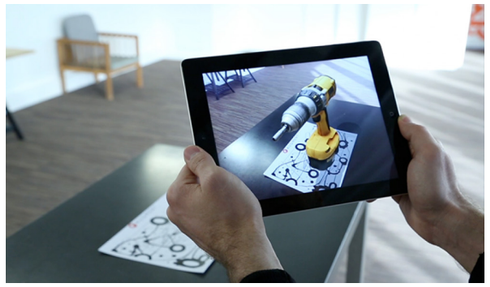
source: http://www.ikea.com/nl/nl/about_ikea/newsitem/catalogus-app

A. Appendix

Augment

Price available on request

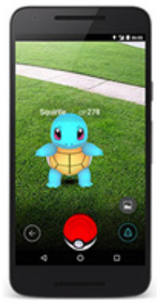
Augment is an application for mobile phones and tablets. The application enables users to put products and other objects in reality just like the IKEA catalogue app.



Pokemon GO

Free

Pokemon GO is a game in development by Niantic commissioned by Nintendo. Using your mobile phone the user can interact with virtual pokemon. Which shown on your screen as if you were standing right in front of one.



source: http://www.worlds-malltrans.com/portfolio-item/fr-app-translation-augment-ed-reality-app/

source: http://www.pokemon.com/us/pokemon-video-games/pokemon-go/

source:https://www.google.com/get/cardboard/

Google cardboard

Prices vary from 14,95 to 120,- (applications not included)

Using cardboard and lenses google managed to design a kind of glasses. Looking through the lenses the user is looking at the screen of his mobile phone. The screen shows two different images of the same beside each other so the user can see the movie or game in 3D.

source: http://prodisplay.com/products/out-door-led-screen/

Prodisplay outdoor screens

Price available on request

Screen which are able to withstand the weather an which are still visible in full sunlight.

Prodisplay smart glass

Price available on request

Glass which is able to change its transparency. When transparency is changed it can be used to be projected on.

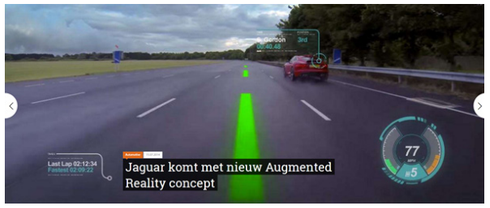
source: http://prodisplay.com/products/toughened-switchable-smart-glass/

Jaguar Windscreen with augmented reality

The windscreen of jaguar cleverly shows aspects of the driving experience. It acts like a HUD where information which generally is to be found on the dashboard can be seen as if in the environment.

source:

http://www.dutchcowboys.nl/automotive/32170



Good aspects are:

- New experiences
- Educative possibilities
- Fun when experienced with multiple people

(Which are aspects that could improve the final product)

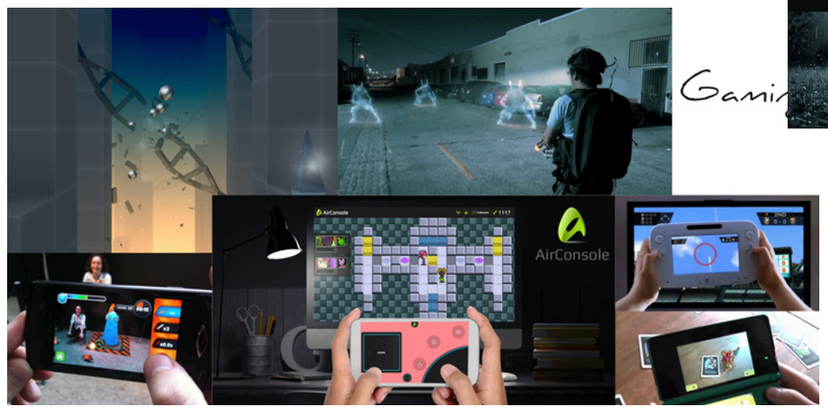
Bad aspects are:

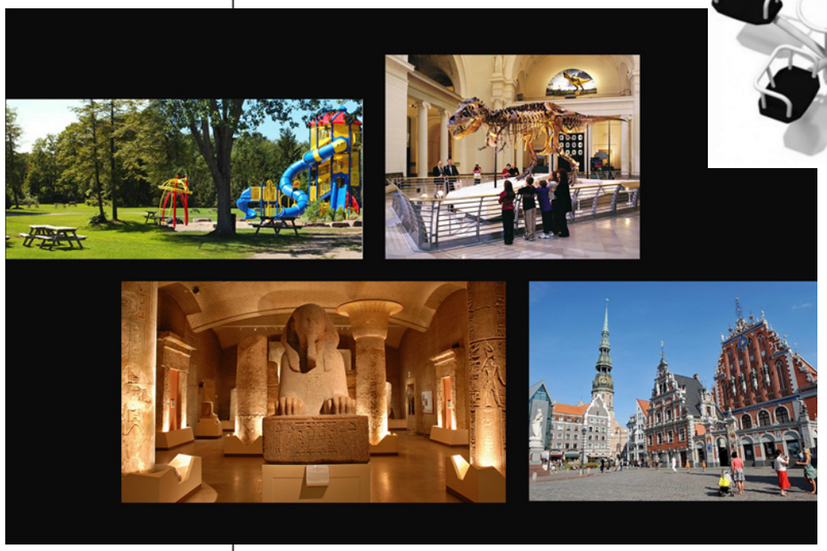
- Slow when installed on mobile phones
- Installation on mobile phones
- Not fitting to certain locations

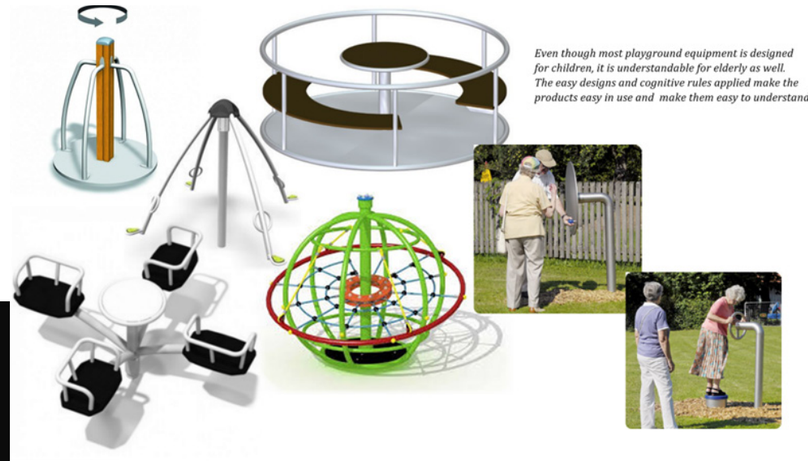
(Which should be avoided during the design process unless it could improve the product which then needs to be tested.)

A. Appendix

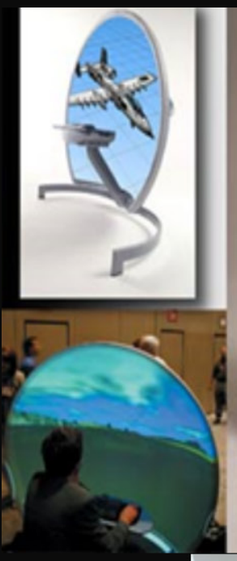
A2 Collages





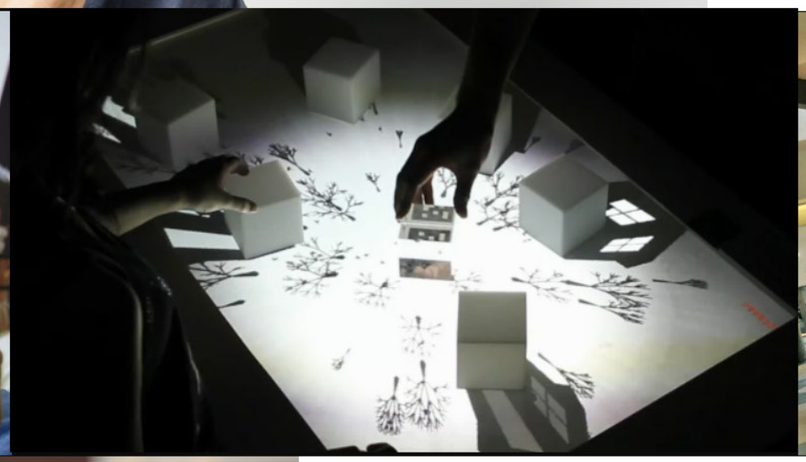


Even though most playground equipment is designed for children, it is understandable for elderly as well. The easy designs and cognitive rules applied make the products easy in use and make them easy to understand.



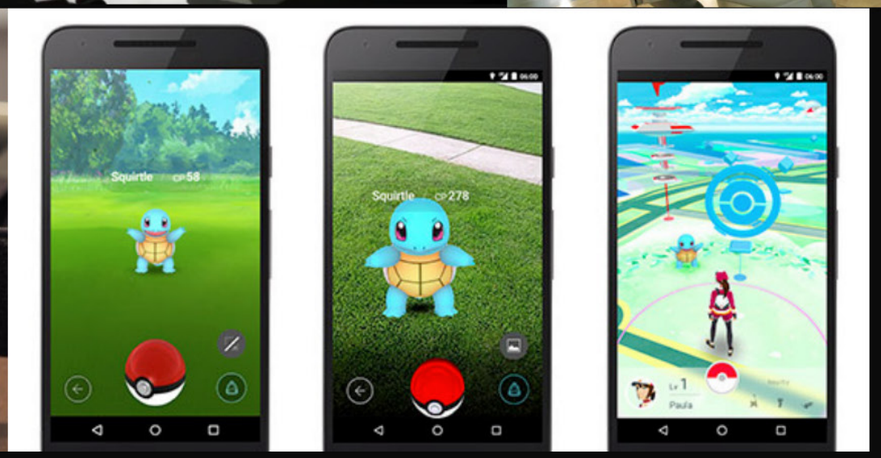

VISIONSTATION
by Elumens


virtuSCOPE




JCDecaux
All new FORD GRAND C-MAX


Gear VR
Powered by Oculus


Squirtle CP 58
Squirtle CP 278
Lv 1
Paula

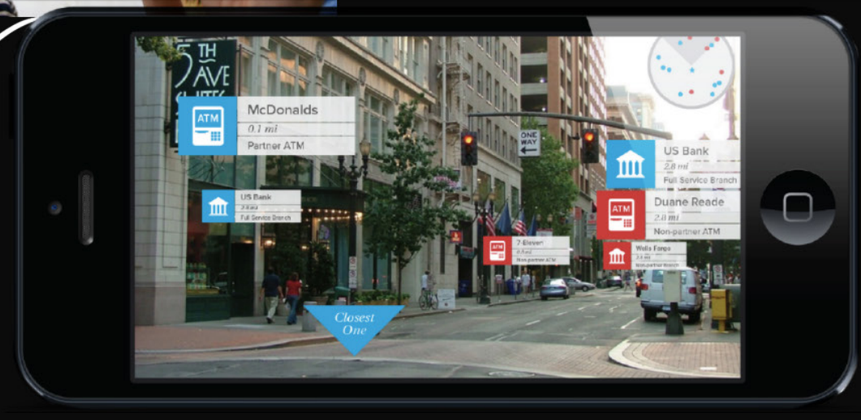
Rimless TV

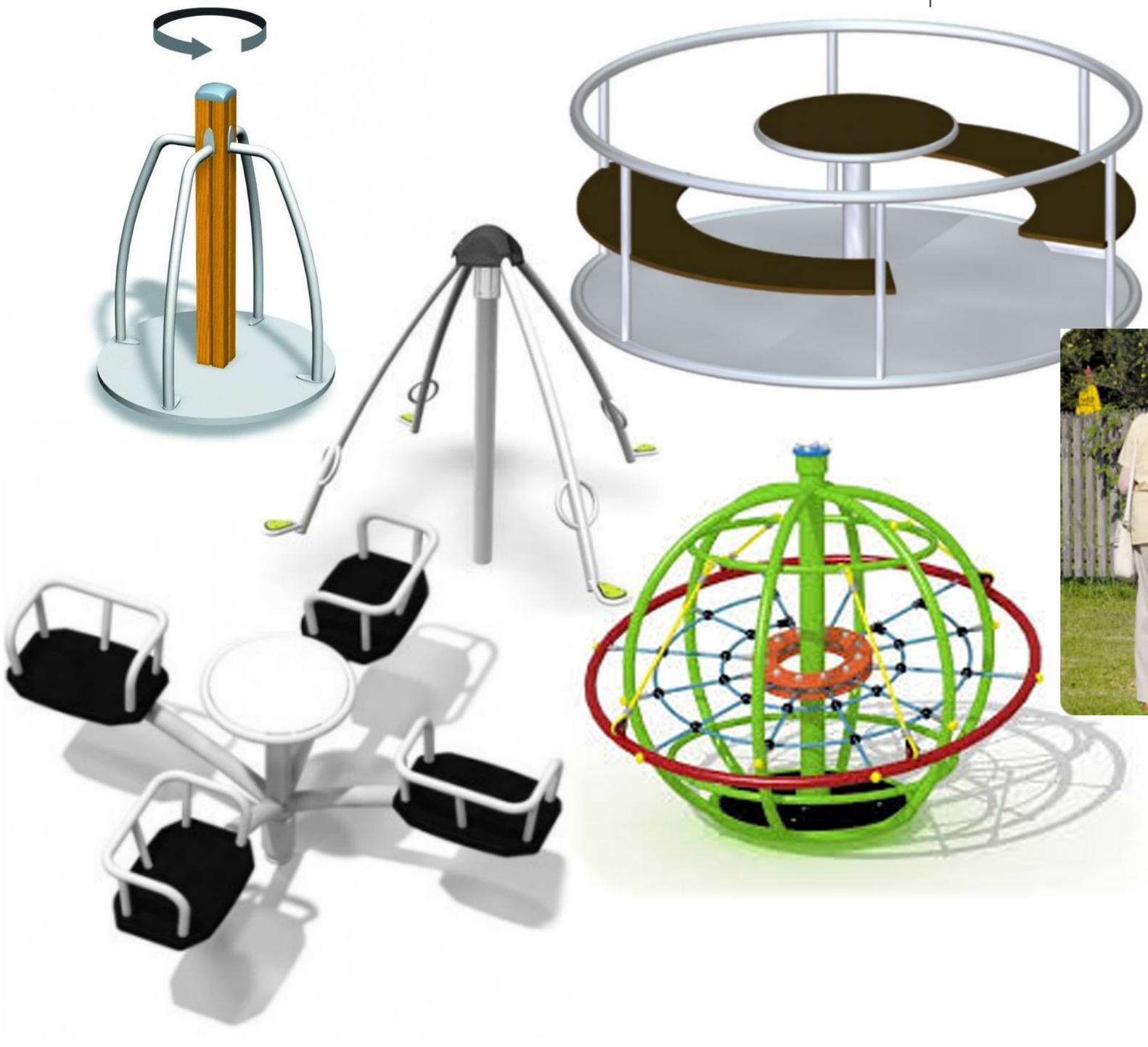
Not that modern area

- Museums mostly match the style of the objects they display.
- The concept is immersive when the transition is fluent

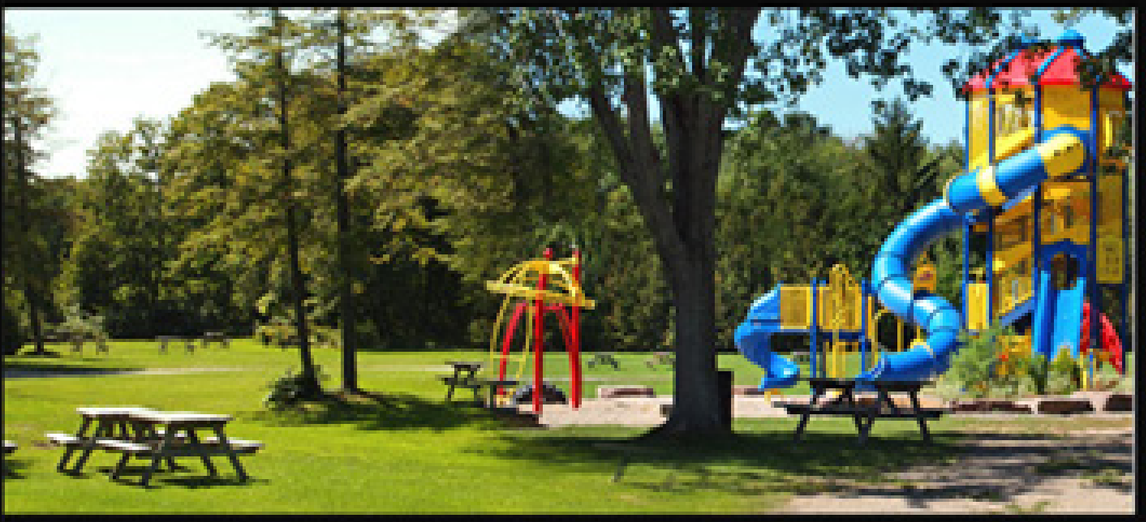
Weather conditions

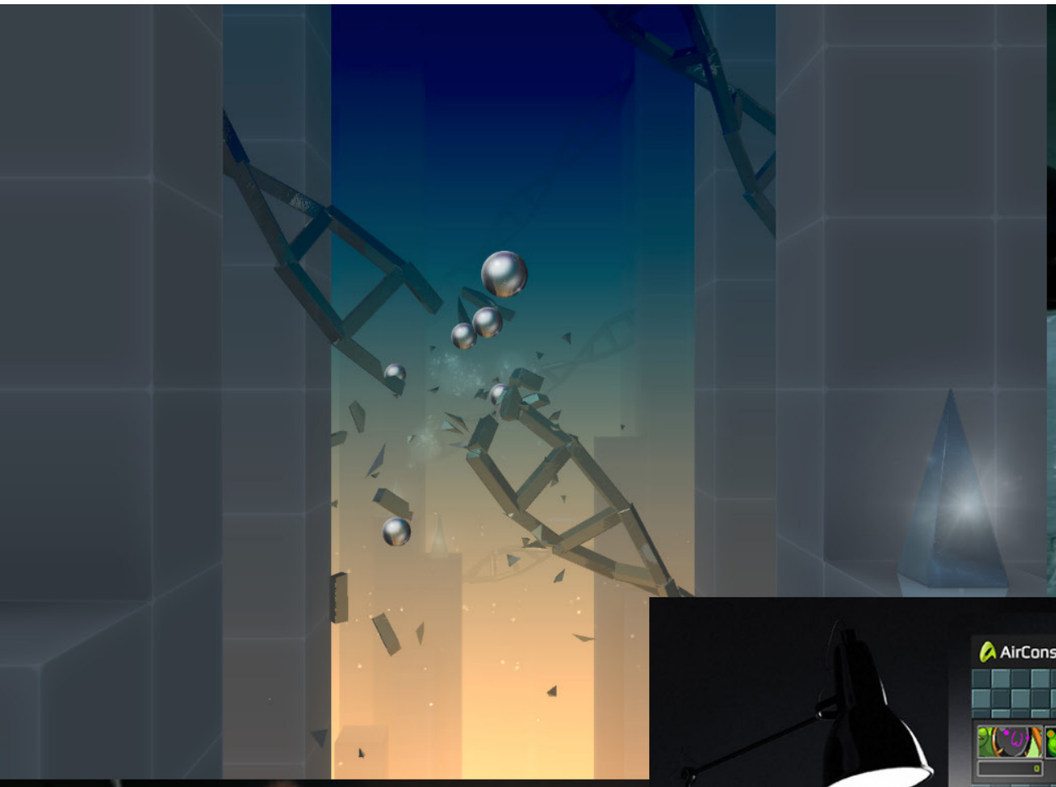
Augmented reality possibilities





Even though most playground equipment is designed for children, it is understandable for elderly as well. The easy designs and cognitive rules applied make the products easy in use and make them easy to understand.





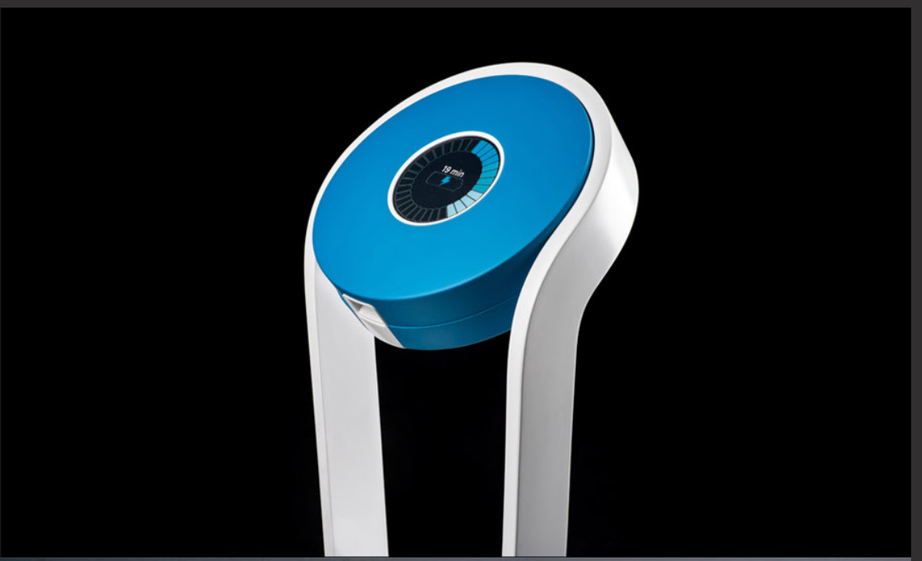
Gaming


Level 02
00:12
x3
x0.0s


AirConsole
Fullscreen
1117
SWIPE
AirConsole


2ND
0 - 0


Nintendo




BRAUN


BRAUN


78
45
33
18

A. Appendix

A3 Iteration schemes & morphological schemes

Testopzet iteratie 1

Observatie met overleg

Scherm achter draaipunt

55inch bord -> comfortabele afstand zoeken -> Comfortabele hoogte zoeken -> comfortabele plaats voor draaien vinden -> Comfortabele hoogte handvat ten opzichte van het scherm vinden -> check effect bewegingen van het hoofd -> (hoe ernstig is een randdikte)

Punten toekennen

≈40 cm van middelpunt -> ≈128 cm boven de grond -> ≈14 cm achter draaipunt -> ≈108 cm boven de grond ≈ 20 cm onder scherm -> Bewegingen van het hoofd hebben weinig effect en zouden uitgevoerd kunnen worden als slim gebruik word gemaakt van een camera. Hoewel het verschil wat 3 personen zien wel groot is.

Punten : 7

45inch bord -> comfortabele afstand zoeken -> Comfortabele hoogte zoeken -> comfortabele plaats voor draaien vinden -> Comfortabele hoogte handvat ten opzichte van het scherm vinden -> check effect bewegingen van het hoofd -> (hoe ernstig is een randdikte)

Punten toekennen

≈36 cm van middelpunt -> ≈128 cm boven de grond -> ≈14 cm achter draaipunt -> ≈108 cm boven de grond ≈ 20 cm onder scherm -> Bewegingen van het hoofd hebben weinig effect en zouden uitgevoerd kunnen worden als slim gebruik word gemaakt van een camera. Hoewel het verschil wat 3 personen zien wel groot is.

Punten : 8,5

35inch bord -> comfortabele afstand zoeken -> Comfortabele hoogte zoeken -> comfortabele plaats voor draaien vinden -> Comfortabele hoogte handvat ten opzichte van het scherm vinden -> check effect bewegingen van het hoofd -> (hoe ernstig is een randdikte)

Punten toekennen

≈28 cm van middelpunt -> ≈138 cm boven de grond -> iets voor of iets achter het draaipunt; op het middelpunt is geen goed idee, draait niet lekker i.v.m. beweging en kracht verdeling -> ≈108 cm boven de grond ≈ 20 cm onder scherm -> Bewegingen van het hoofd hebben effect maar zal nog steeds opgelost kunnen worden. Het verschil wat 3 personen is wel groot en het formaat is niet geschikt voor 3 personen om tegelijkertijd goed naar het beeld te kunnen kijken.

Punten : 6,5

25inch bord -> comfortabele afstand zoeken -> Comfortabele hoogte zoeken -> comfortabele plaats voor draaien vinden -> Comfortabele hoogte handvat ten opzichte van het scherm vinden -> check effect bewegingen van het hoofd -> (hoe ernstig is een randdikte)

Punten toekennen

Scherm te klein voor een goede ervaring

Punten: 4

Scherm op draaipunt

55inch bord -> Comfortabele hoogte zoeken -> comfortabele plaats voor draaien vinden -> Comfortabele hoogte handvat ten opzichte van het scherm vinden -> check effect bewegingen van het hoofd -> (hoe ernstig is een randdikte)

Punten toekennen

Scherm is erg groot, zorgt er voor dat gebruiker erg dicht op het scherm staat om comfortabel te kunnen draaien (handvat ook op middelpunt of iets er voor) wat alsnog ervaren word als omlopen.

Punten: 5

45inch bord -> Comfortabele hoogte zoeken -> comfortabele plaats voor draaien vinden -> Comfortabele hoogte handvat ten opzichte van het scherm vinden -> check effect bewegingen van het hoofd -> (hoe ernstig is een randdikte)

Punten toekennen

Scherm is groot, zorgt er voor dat gebruiker erg dicht op het scherm staat om comfortabel te kunnen draaien (handvat ook op middelpunt of iets er voor) wat alsnog ervaren word als omlopen. Kleiner dan 55 inch word wel als positief gezien.

Punten: 5,5

A. Appendix

35inch bord -> Comfortabele hoogte zoeken -> comfortabele plaats voor draaien vinden -> Comfortabele hoogte handvat ten opzichte van het scherm vinden -> check effect bewegingen van het hoofd -> (hoe ernstig is een randdikte)

Punten toekennen

Het enige formaat waarbij het scherm niet te groot lijkt te zijn voor de afstand tussen persoon en scherm. De draaicirkel is nog wel een punt waar proefpersonen niet vrolijk van worden. Daarnaast is het scherm wel nog te klein voor 3 personen.

Punten: 6,5

25inch bord -> Comfortabele hoogte zoeken -> comfortabele plaats voor draaien vinden -> Comfortabele hoogte handvat ten opzichte van het scherm vinden -> check effect bewegingen van het hoofd -> (hoe ernstig is een randdikte)

Punten toekennen

Zoals eerder is benoemd, is een scherm van 25 inch te klein voor het product.

Scherm voor draaipunt

Is voor geen enkel scherm een goed idee! De manier van rondkijken is onlogisch, onhandig en irritant.

55inch bord -> comfortabele afstand zoeken -> Comfortabele hoogte zoeken -> comfortabele plaats voor draaien vinden -> Comfortabele hoogte handvat ten opzichte van het scherm vinden -> check effect bewegingen van het hoofd -> (hoe ernstig is een randdikte)

Punten toekennen

Is voor geen enkel scherm een goed idee! De manier van rondkijken is onlogisch, onhandig en irritant.

Punten: 0

45inch bord -> comfortabele afstand zoeken -> Comfortabele hoogte zoeken -> comfortabele plaats voor draaien vinden -> Comfortabele hoogte handvat ten opzichte van het scherm vinden -> check effect bewegingen van het hoofd -> (hoe ernstig is een randdikte)

Punten toekennen

Is voor geen enkel scherm een goed idee! De manier van rondkijken is onlogisch, onhandig en irritant.

Punten: 0

35inch bord -> comfortabele afstand zoeken -> Comfortabele hoogte zoeken -> comfortabele plaats voor draaien vinden -> Comfortabele hoogte handvat ten opzichte van het scherm vinden -> check effect bewegingen van het hoofd -> (hoe ernstig is een randdikte)

Punten toekennen

Is voor geen enkel scherm een goed idee! De manier van rondkijken is onlogisch, onhandig en irritant.

Punten: 0

25inch bord -> comfortabele afstand zoeken -> Comfortabele hoogte zoeken -> comfortabele plaats voor draaien vinden -> Comfortabele hoogte handvat ten opzichte van het scherm vinden -> check effect bewegingen van het hoofd -> (hoe ernstig is een randdikte)

Punten toekennen

Is voor geen enkel scherm een goed idee! De manier van rondkijken is onlogisch, onhandig en irritant.

Punten: 0

Punten als randdikte worden bekeken bij het tweede prototype waarbij gebruik zal worden gemaakt van een scherm en camera.

Testopzet Iteratie2

Observation with consult
Sit in front of screen -> Look at different aspects while distance between head and screen is similar to the distance measured during the test with iteration 1 -> Move head and camera using a piece of rope -> Observe if resolution is desirable.

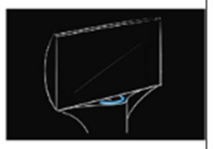
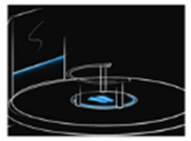
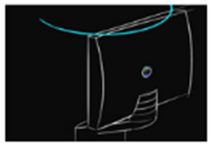
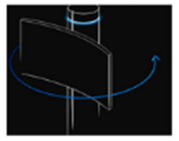
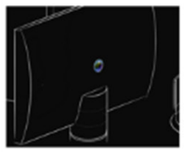
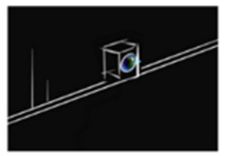
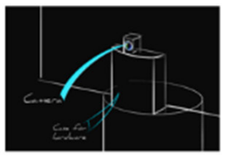
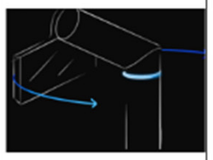
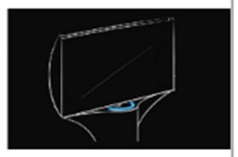
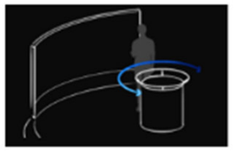
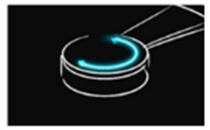
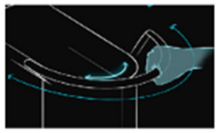
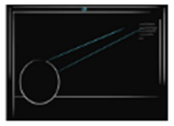
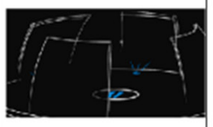
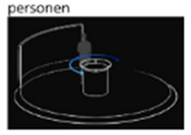
Testopzet iteratie 3

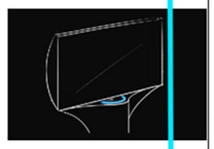
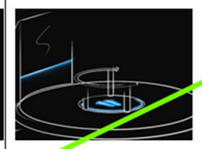
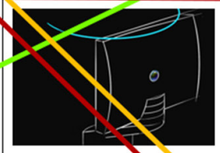
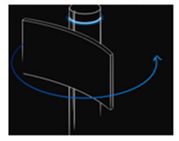
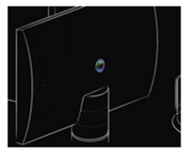
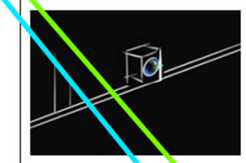
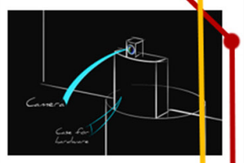
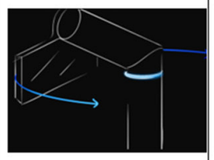
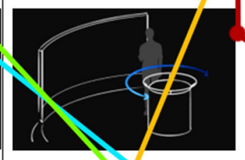
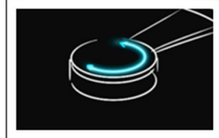
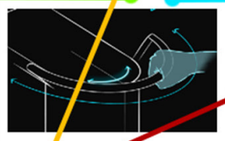
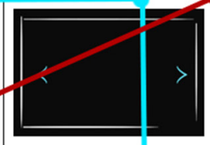
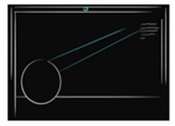
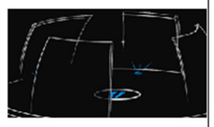
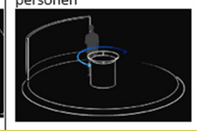
Observation with consult

Turning the screen and analyse the different aspect mentioned above -> gently push the VirtuScreen to check whether or not it falls over easily -> Try movements similar to tilting the screen in order to see whether the interaction is desirable -> use differently placed handles to see what kind of turning interaction is desired.

A. Appendix

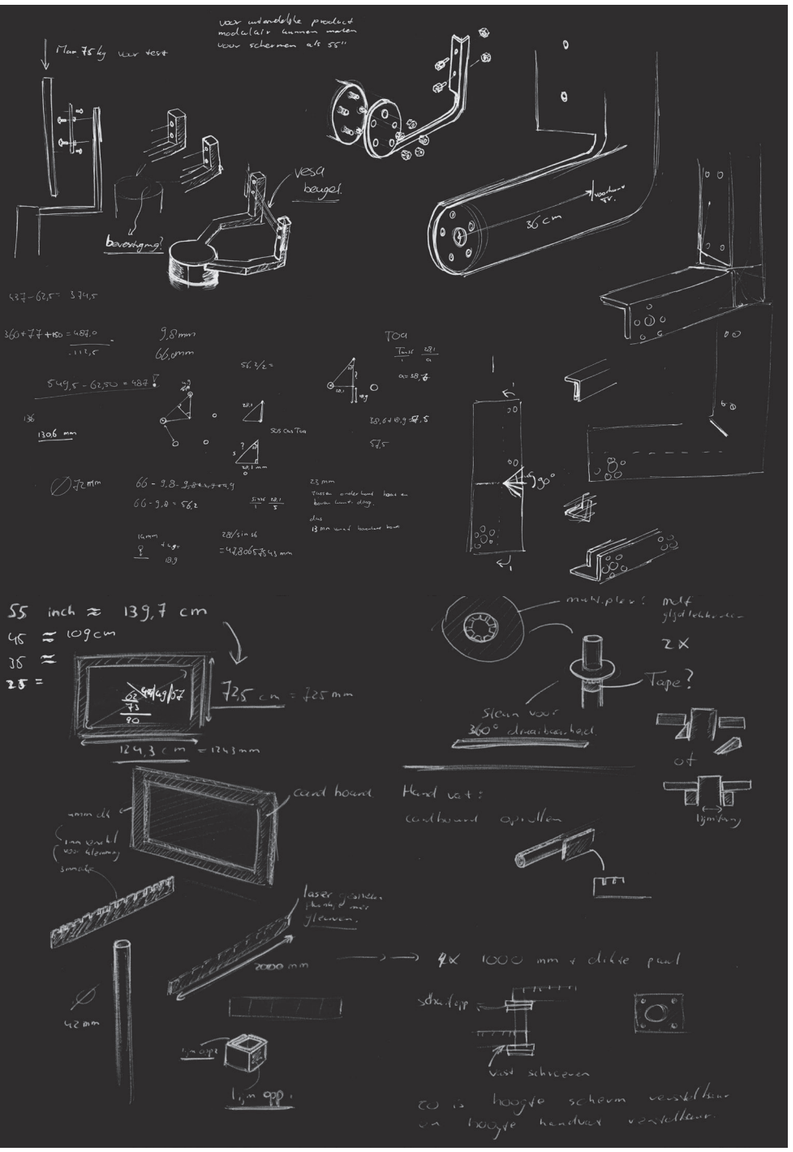
Morphological scheme

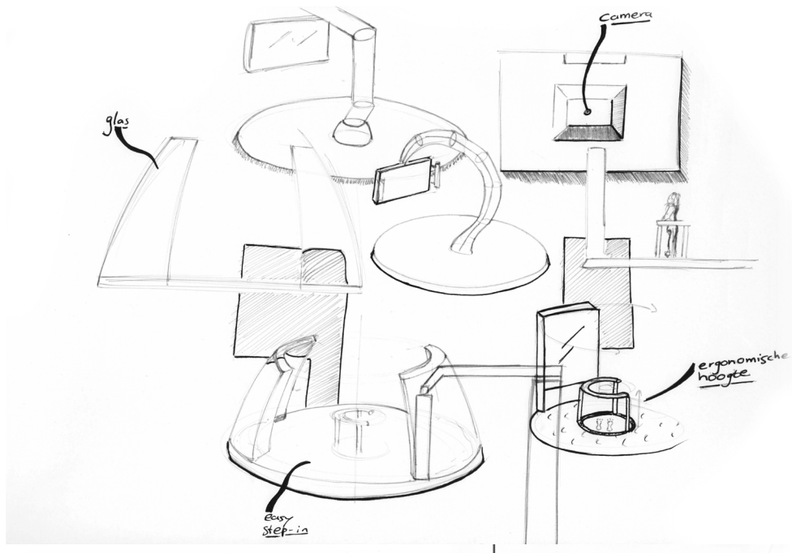
Draai mechanisme	Potje van Bjorn	Rail	Lagers	
Scherm	Waterdicht scherm	Diaprojector op wit oppervlak	Diaprojector op glas	
Manier van interactie	Handvat aan scherm	Handvat aan paal	Geen handvat Knoppen op scherm	Scherm beweegt autonoom
Draaicirkel	Scherm op middel punt (persoon om scherm) 	Persoon op middelpunt (scherm om persoon) 	Persoon en scherm draaien om middelpunt (andere kant van middelpunt) 	Persoon en scherm draaien om middelpunt (zelfde kant van middelpunt) 
Camera	Camera verwerkt in schermkast 	Boven op het scherm 	Achter scherm 	
Ophanging	Overhangend over persoon 	Op een paal 	Op een rails 	
Indicaties	LED 	Pijlen 	Handvaten etc. 	Op scherm 
Immersie	Eye tracking 	Sensoren voor raam effect 	Sensoren voor raam illusie 	Touchscreen 
Augmented reality (3 personen AR ervaring)	Koepel 	Scherm draait om meerdere personen 	Eye tracking van verschillende mensen zodat ieder andere informatie krijgt en een eigen ervaring	Meerdere mogelijkheden te onderzoeken bedenken! En te prototypen

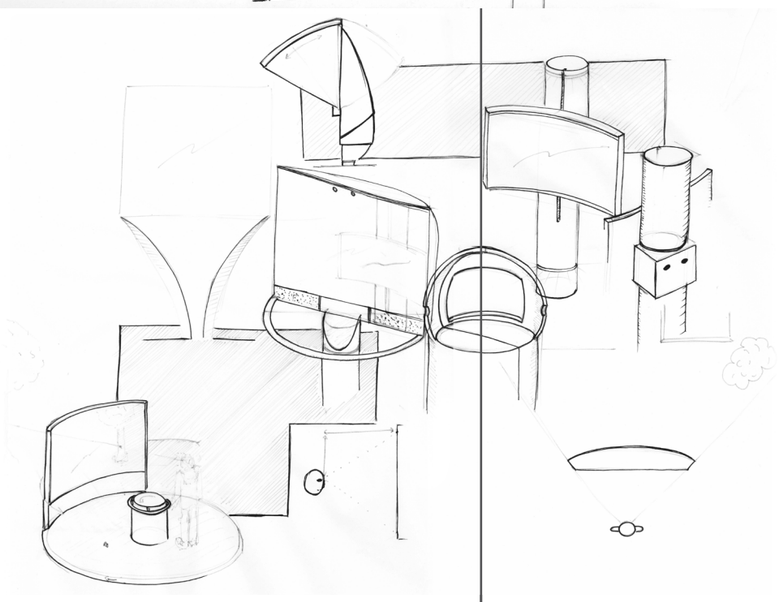
Draai mechanisme	Potje van Bjorn	Rail	Lagers	
Scherm	Waterdicht scherm	Diaprojector op wit oppervlak	Diaprojector op glas	
Manier van interactie	Handvat aan scherm	Handvat aan paal	Geen handvat Knoppen op scherm	Scherm beweegt autonoom
Draaicirkel	Scherm op middel punt (persoon om scherm) 	Persoon op middelpunt (scherm om persoon) 	Persoon en scherm draaien om middelpunt (andere kant van middelpunt) 	Persoon en scherm draaien om middelpunt (zelfde kant van middelpunt) 
Camera	Camera verwerkt in schermkast 	Boven op het scherm 	Achter scherm 	
Ophanging	Overhangend over persoon 	Op een paal 	Op een rails 	
Indicaties	LED 	Pijlen 	Handvaten etc. 	Op scherm 
Immersie	Eye tracking 	Sensoren voor raam effect 	Sensoren voor raam illusie 	Touchscreen 
Augmented reality (3 personen AR ervaring)	Koepel 	Scherm draait om meerdere personen 	Eye tracking van verschillende mensen zodat ieder andere informatie krijgt en een eigen ervaring	Meerdere mogelijkheden te onderzoeken bedenken! En te prototypen

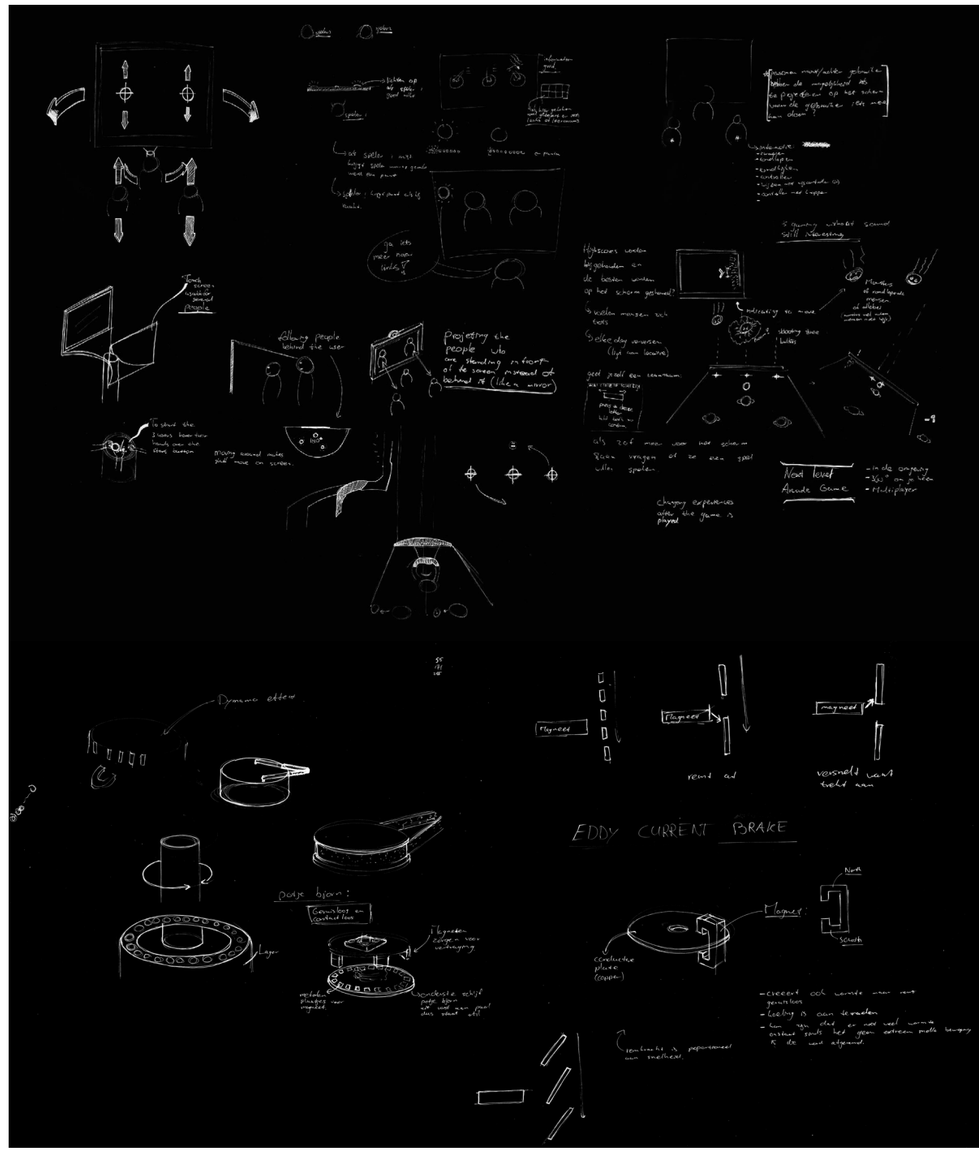
A. Appendix

A4 Drawings 1





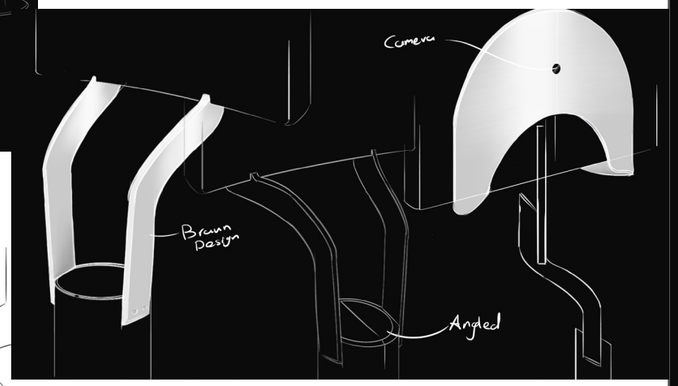


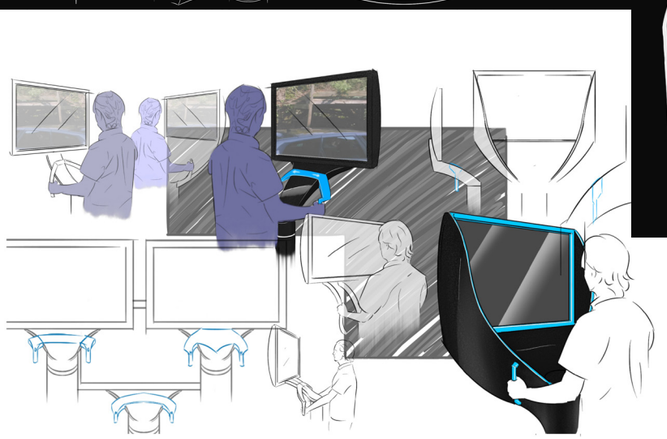


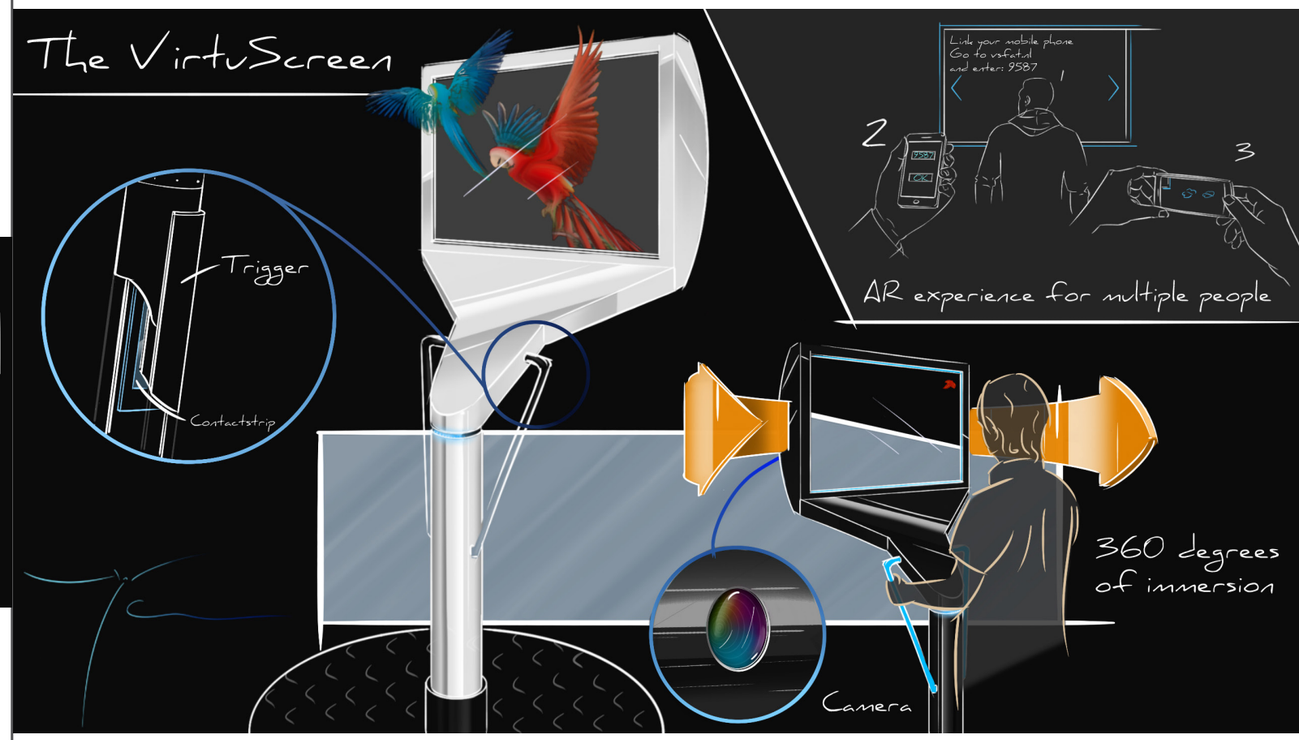
Sketches on paper*

A. Appendix

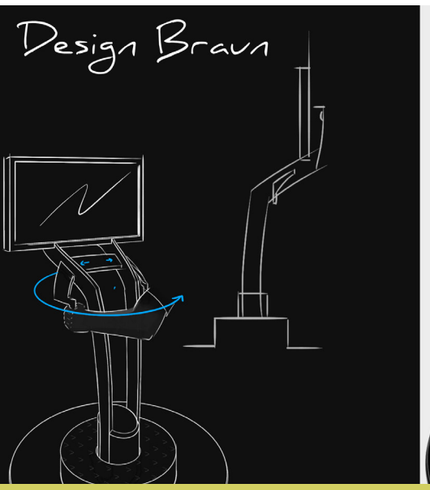
A5 Drawings 2

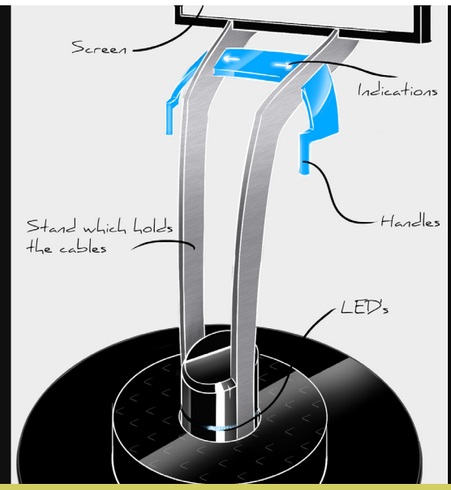


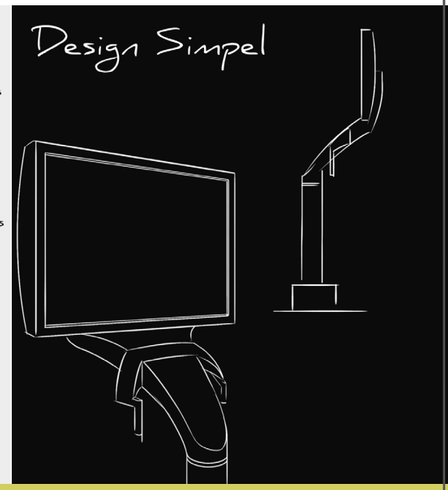


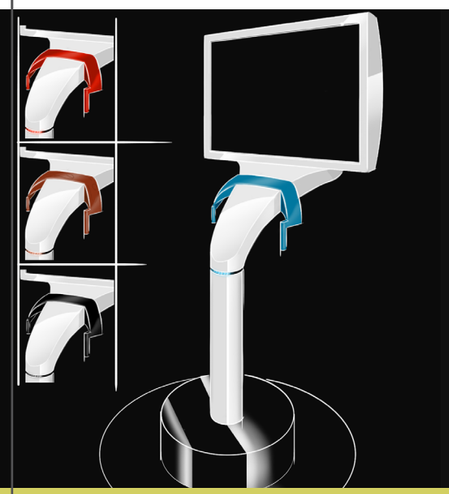


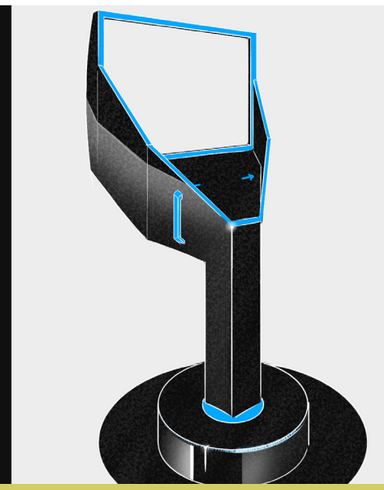
Drawings on tablet*





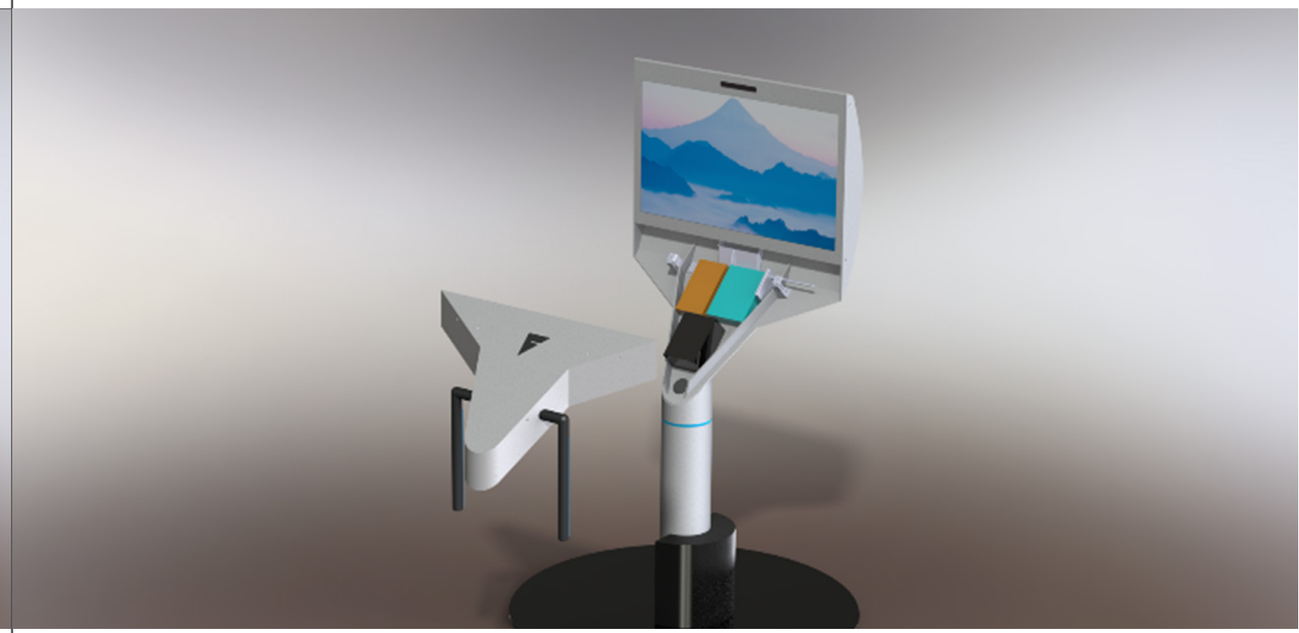


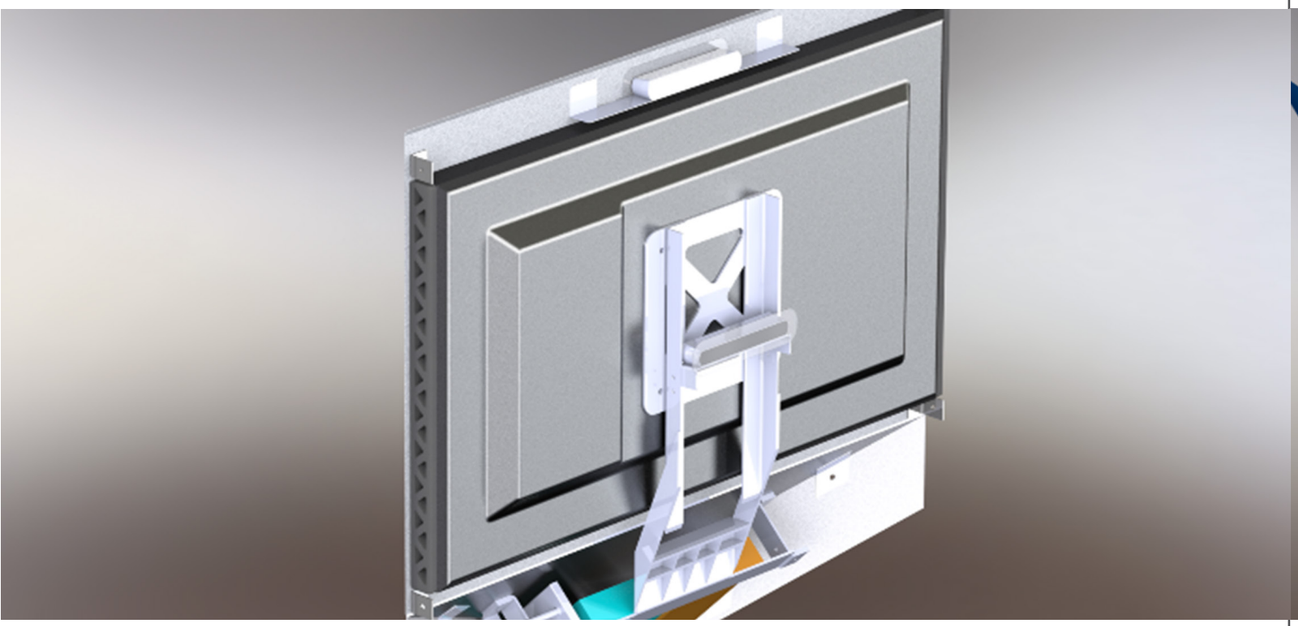


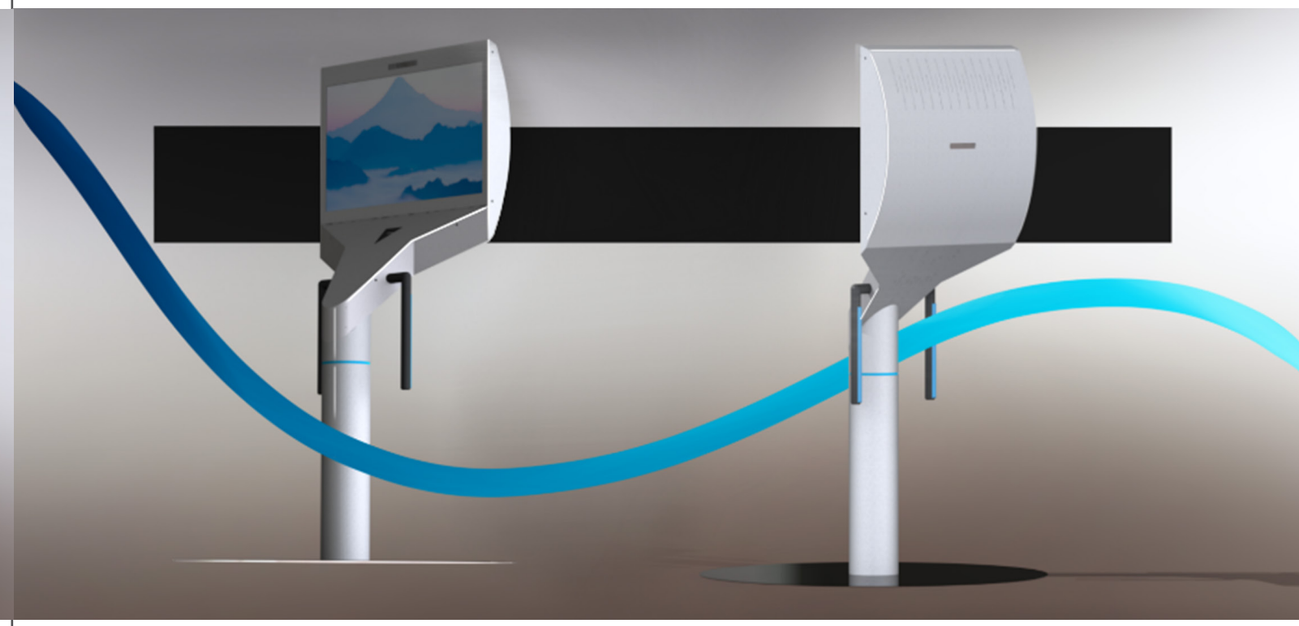


A. Appendix

A6 SolidWorks model

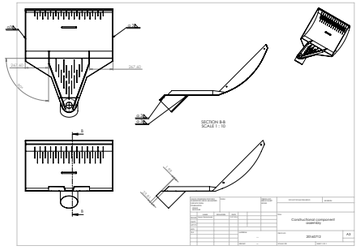


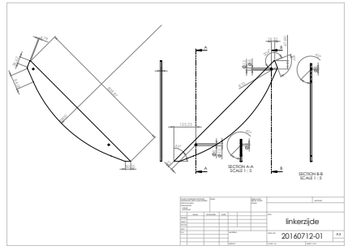


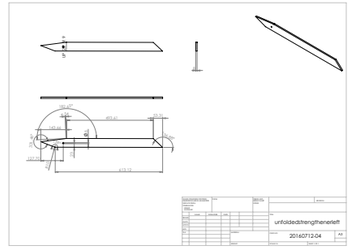


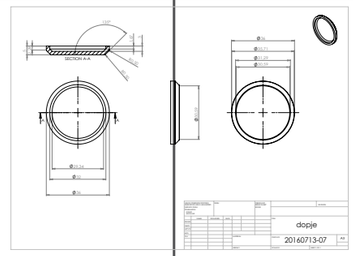
A. Appendix

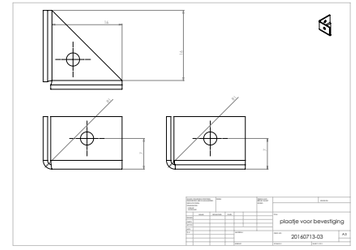
A7 Technical drawings

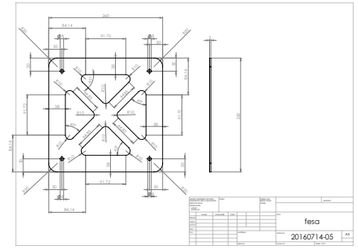


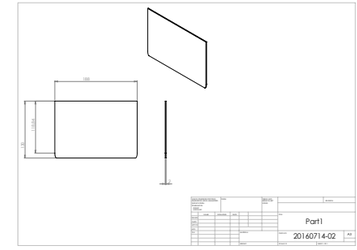


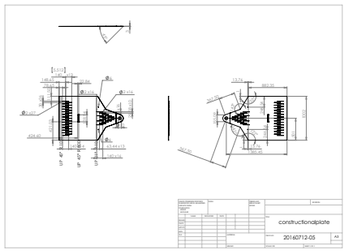


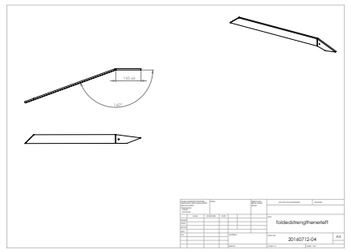


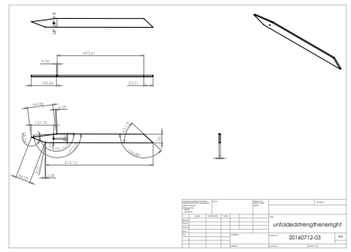


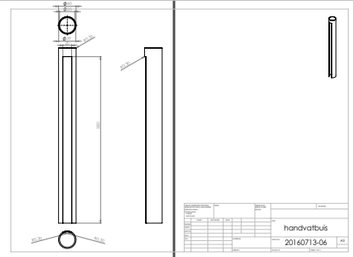


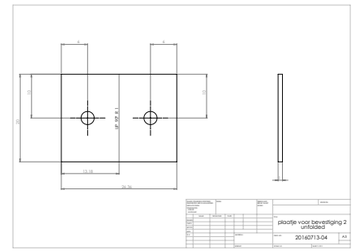


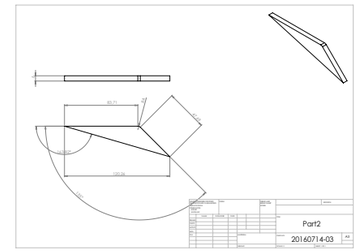


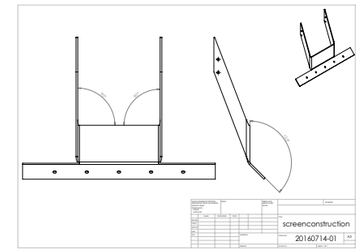


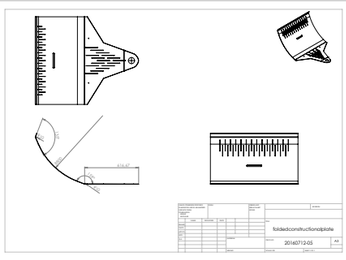


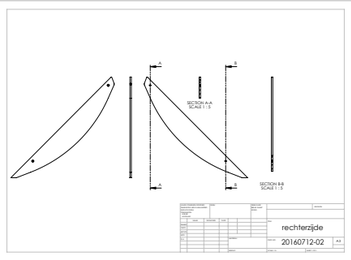


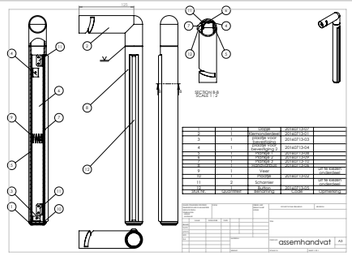


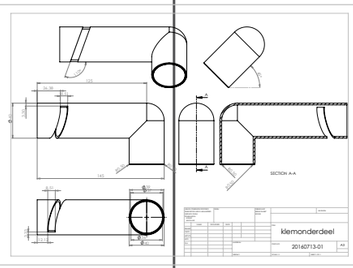


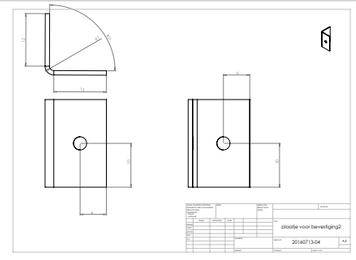


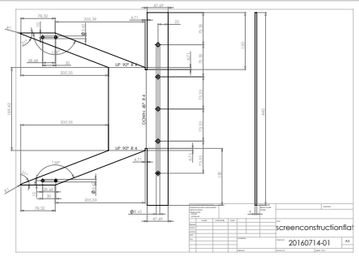


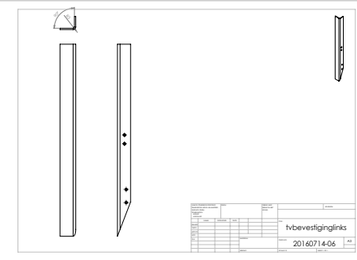


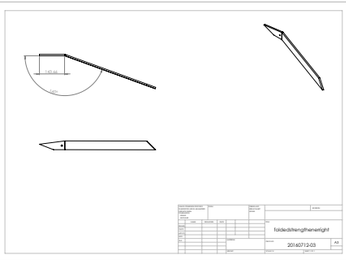


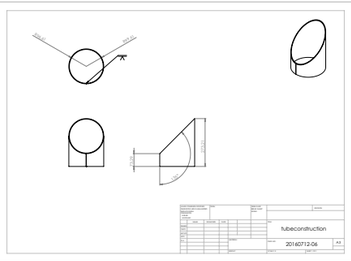


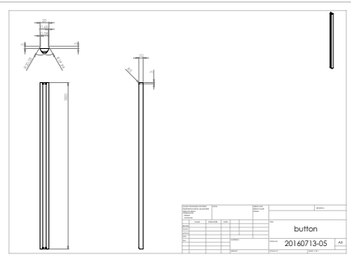


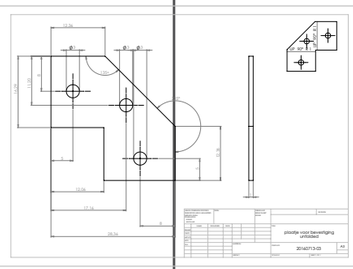


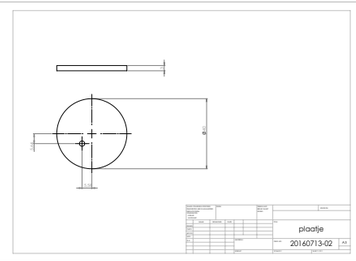


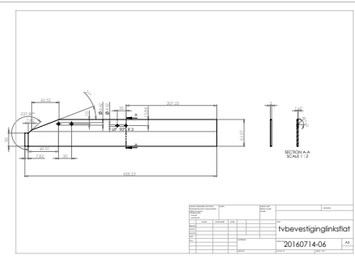


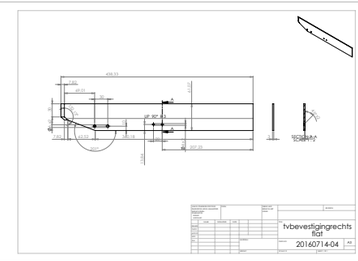


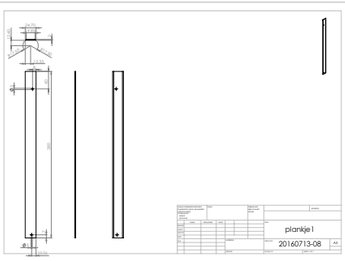


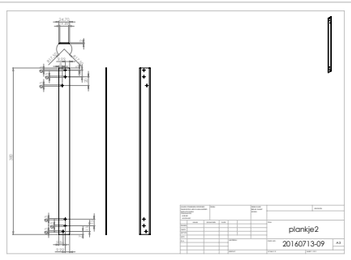


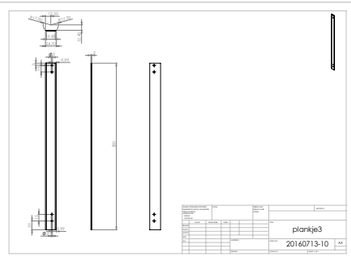


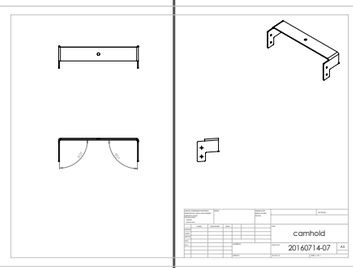


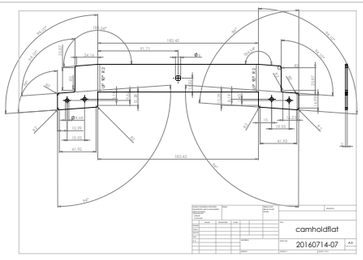


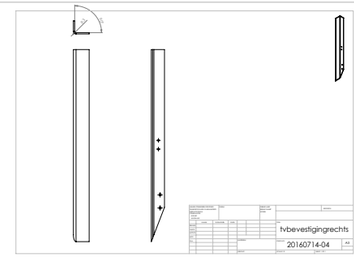


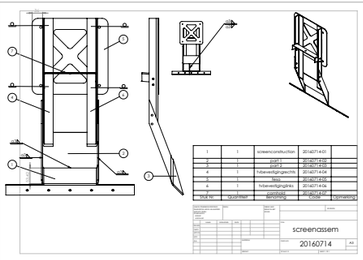


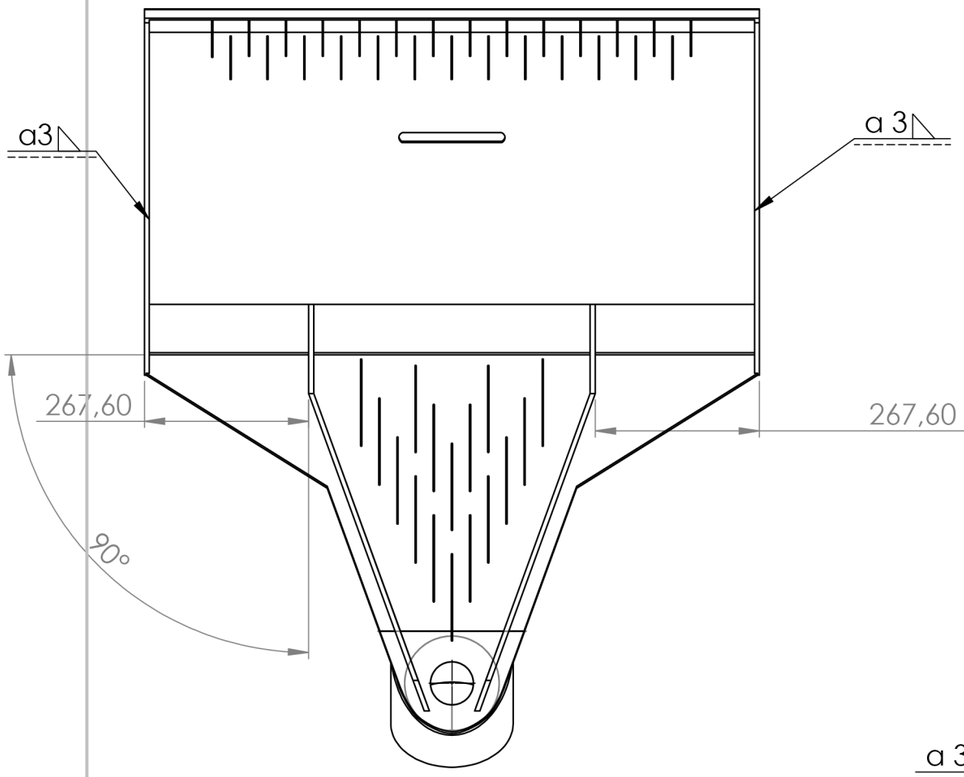


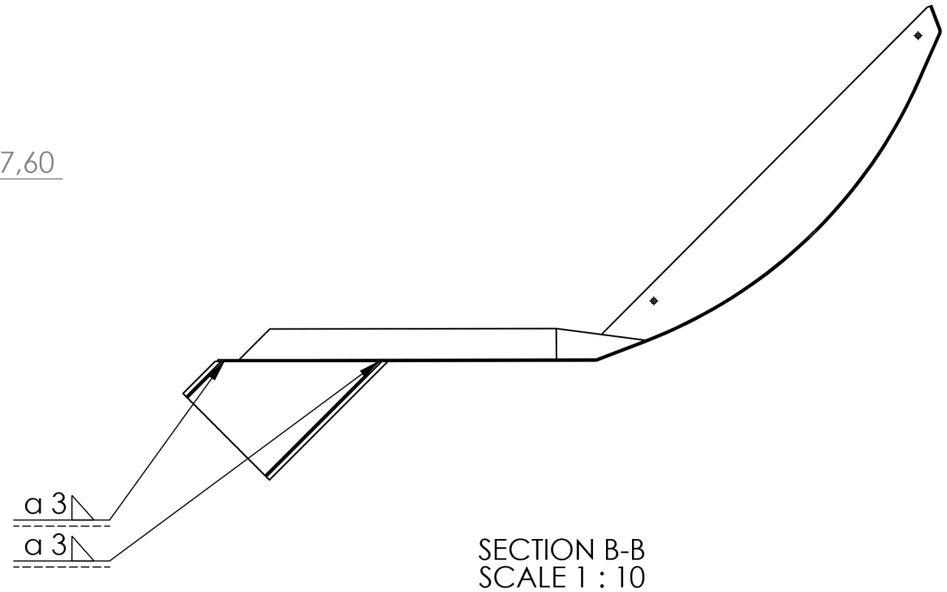












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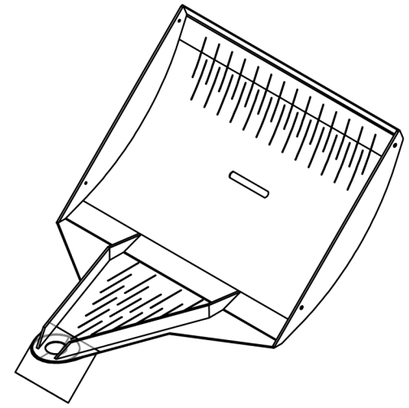

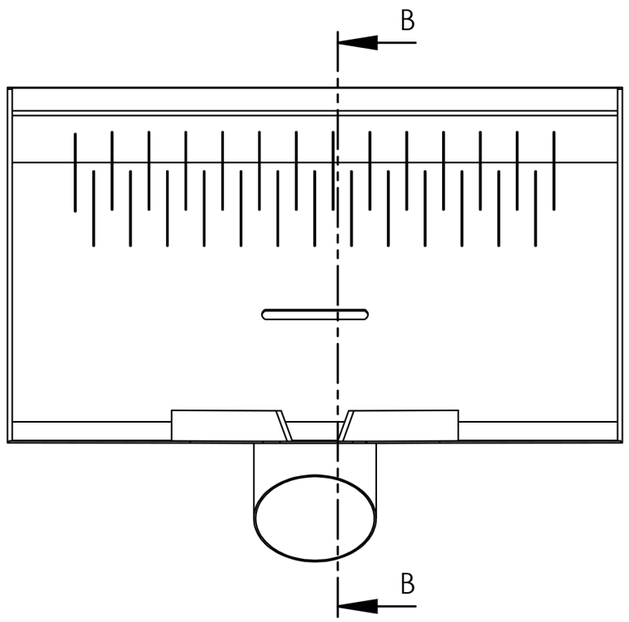

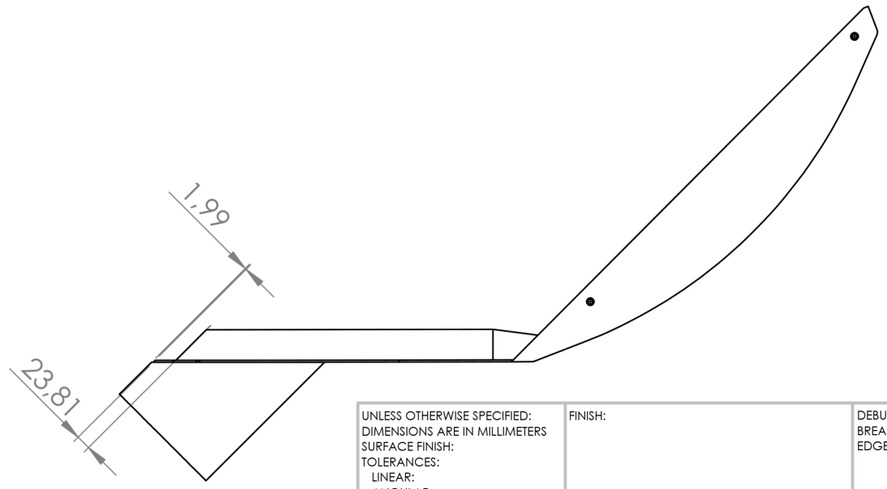

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:				DEBUR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING / REVISION
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DRAWN	Jasper Westenbroek		12-07-2016				
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL: --			DWG NO. 20160712 / A3
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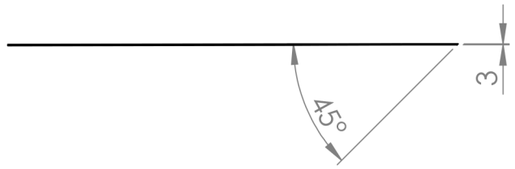

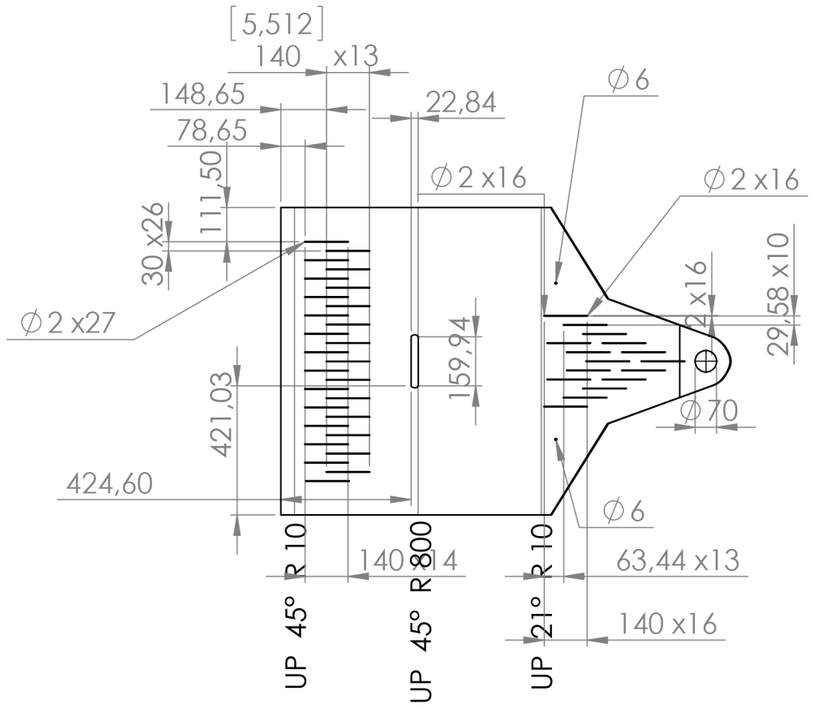

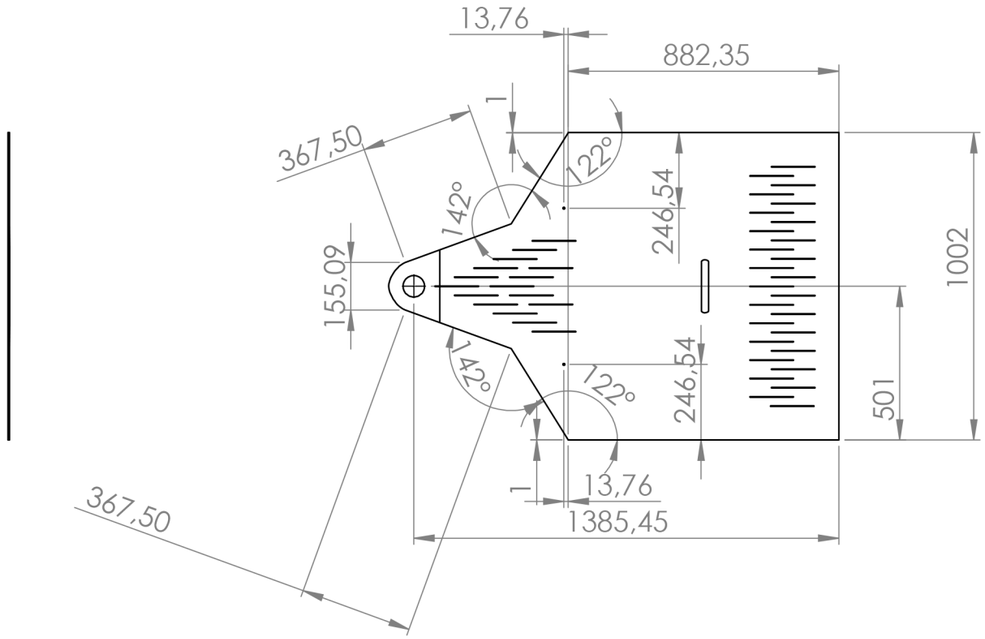

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:			DEBUR AND BREAK SHARP EDGES		REVISION
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CHK'D							
APPV'D							
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Q.A				MATERIAL:			DWG NO. 20160712-05 A3
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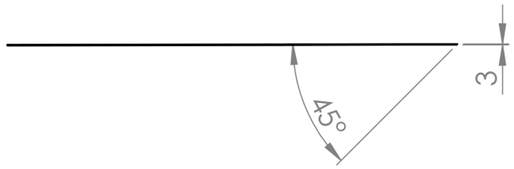

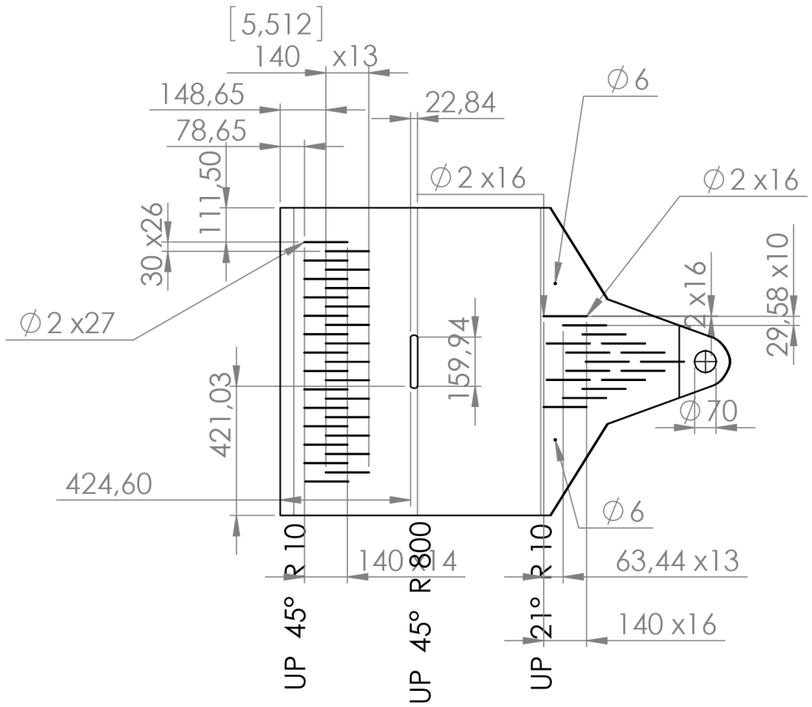

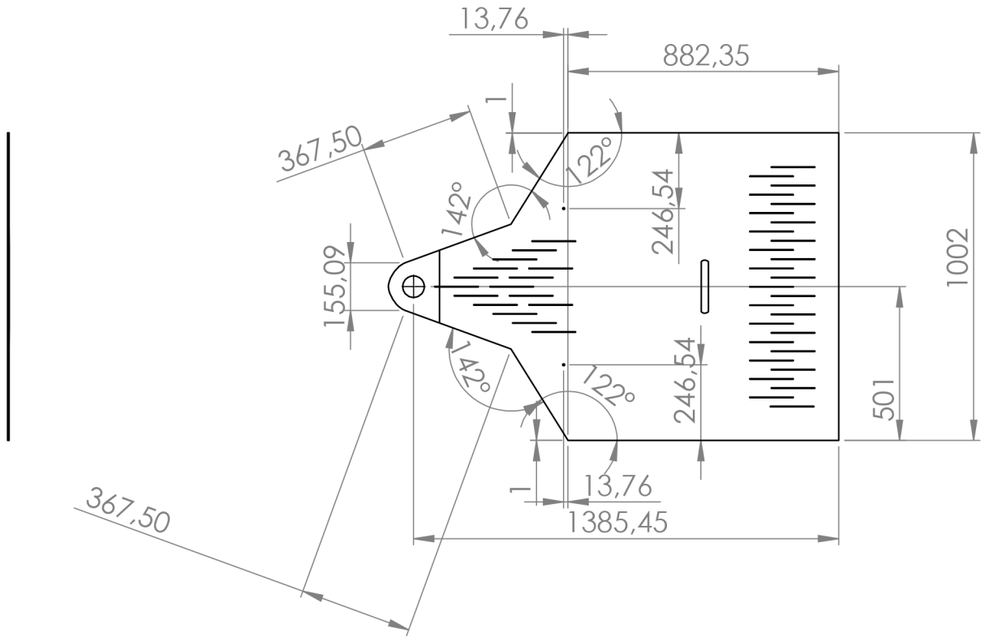

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:			DEBUR AND BREAK SHARP EDGES		REVISION
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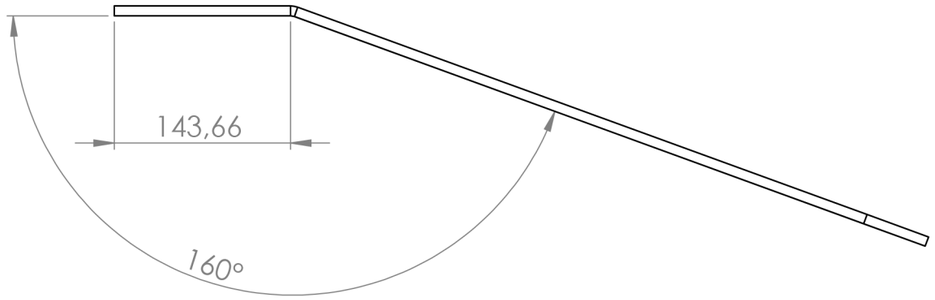

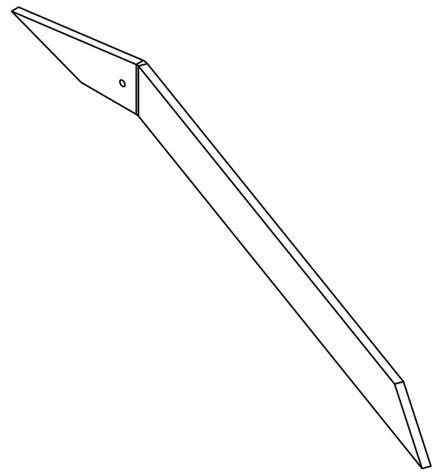

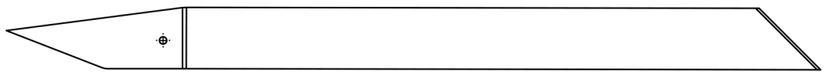

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:				DEBUR AND BREAK SHARP EDGES	REVISION
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CHK'D							
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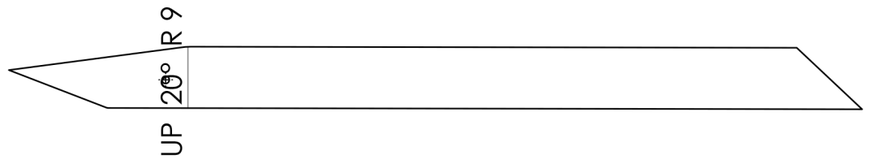

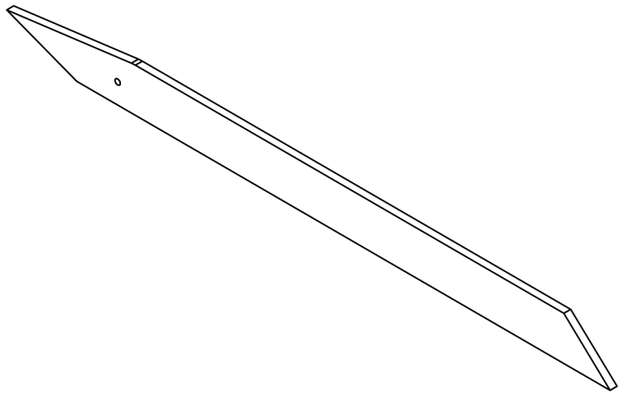

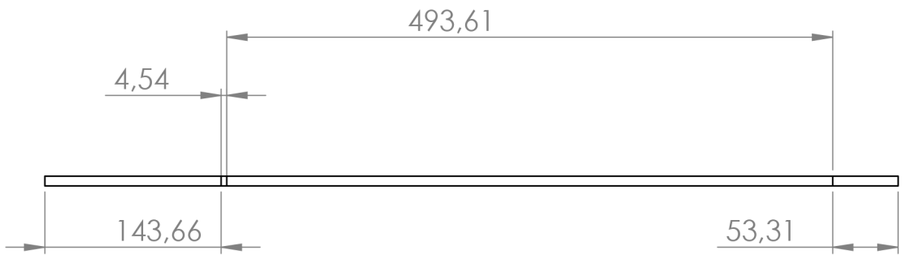

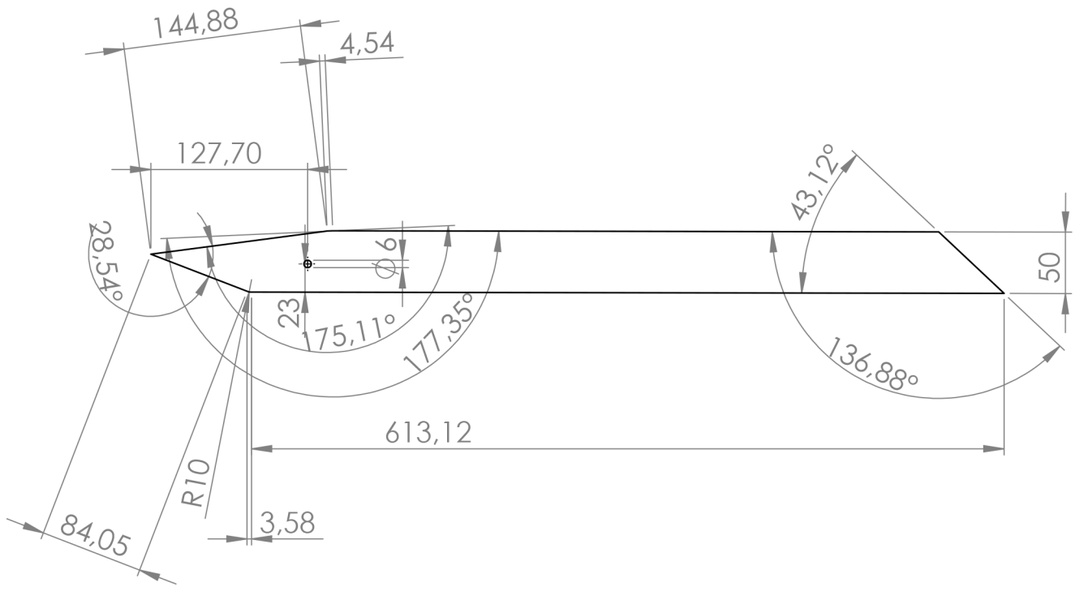

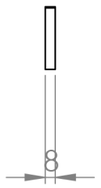

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:			DEBUR AND BREAK SHARP EDGES		REVISION
	NAME	SIGNATURE	DATE				TITLE: unfoldedstrengthenerright
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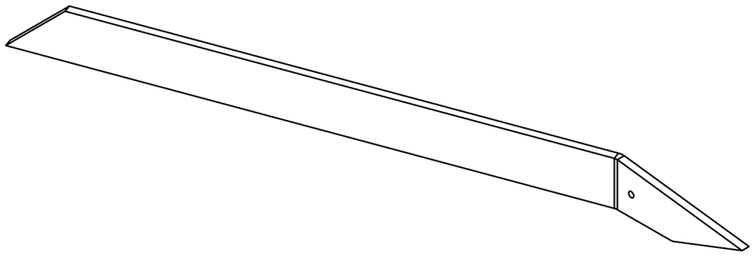

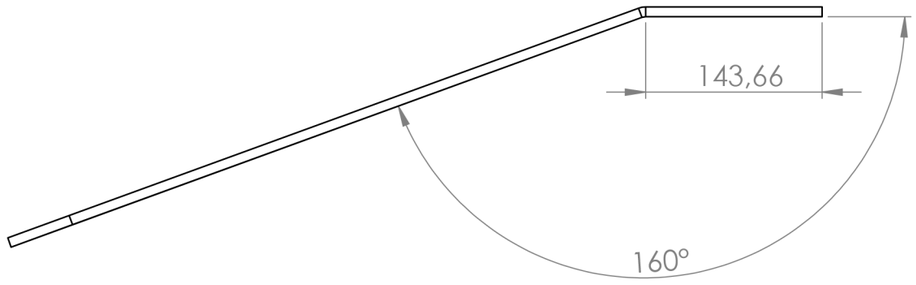

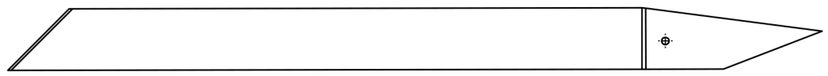

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:				DEBUR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING / REVISION
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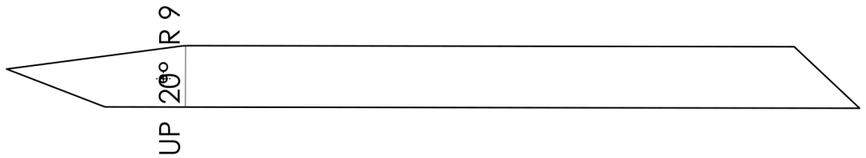
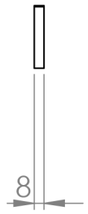
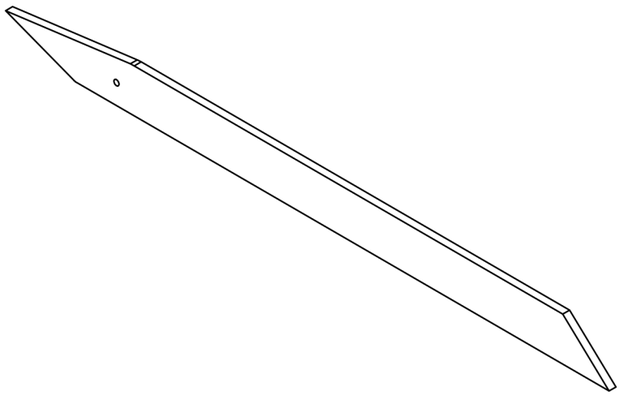
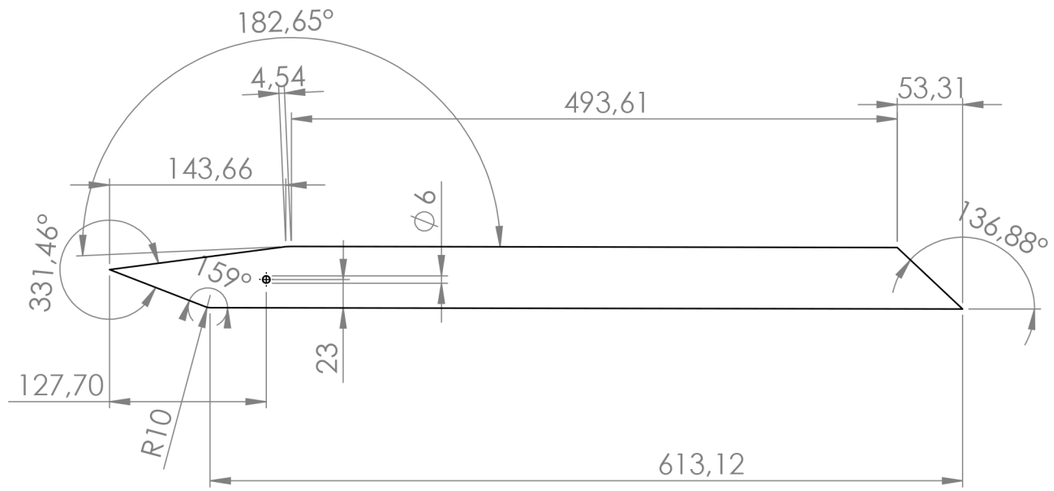
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL:			DWG NO. 20160712-04 / A3
				WEIGHT:			SCALE:1:5 / SHEET 1 OF 1

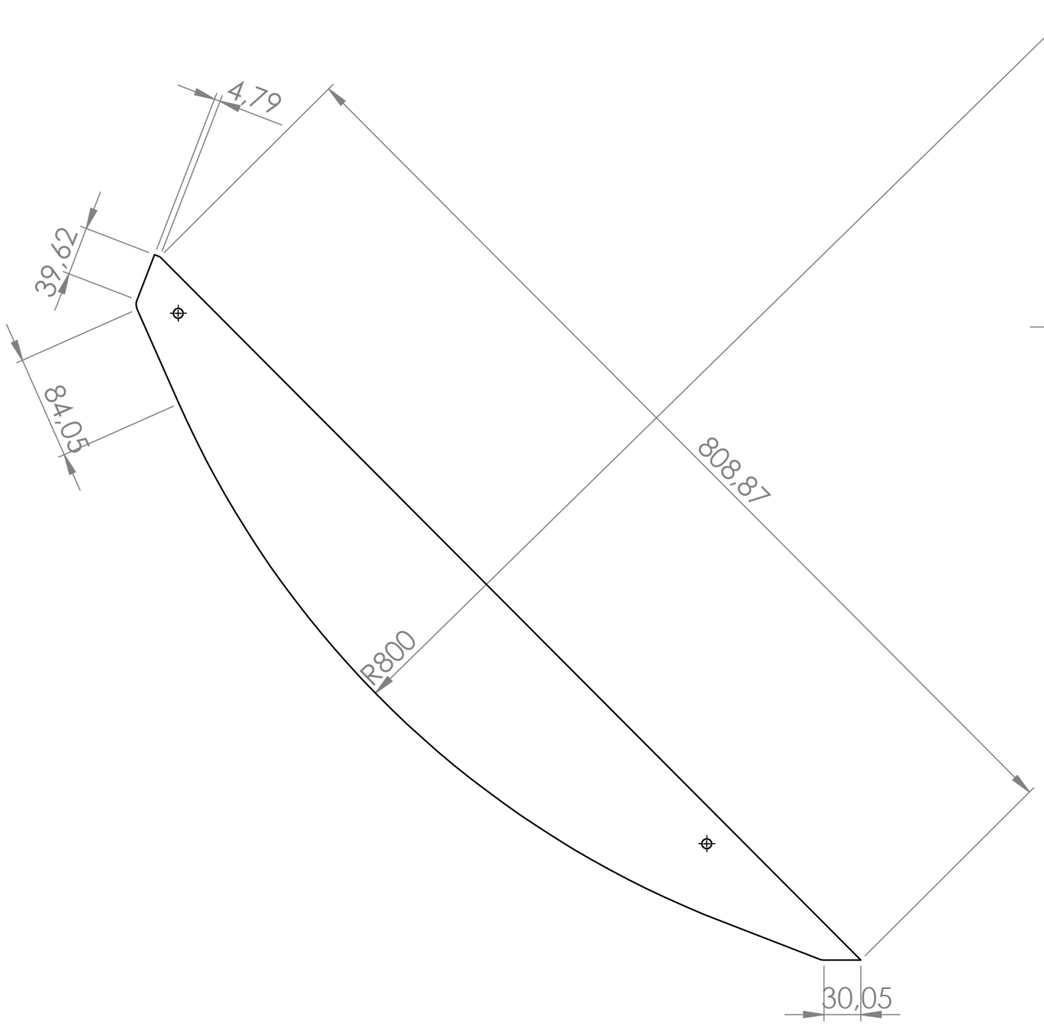


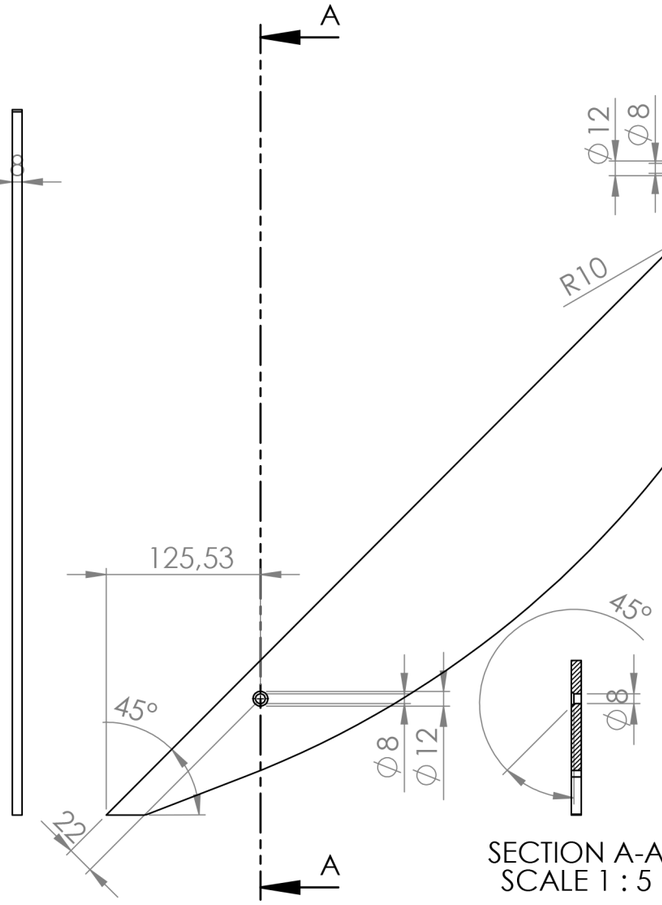






UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:				DEBUR AND BREAK SHARP EDGES	REVISION
	NAME	SIGNATURE	DATE				TITLE: unfoldedstrengthenerleft
DRAWN							
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL:			DWG NO. 20160712-04 / A3
				WEIGHT:		SCALE:1:5	SHEET 1 OF 1

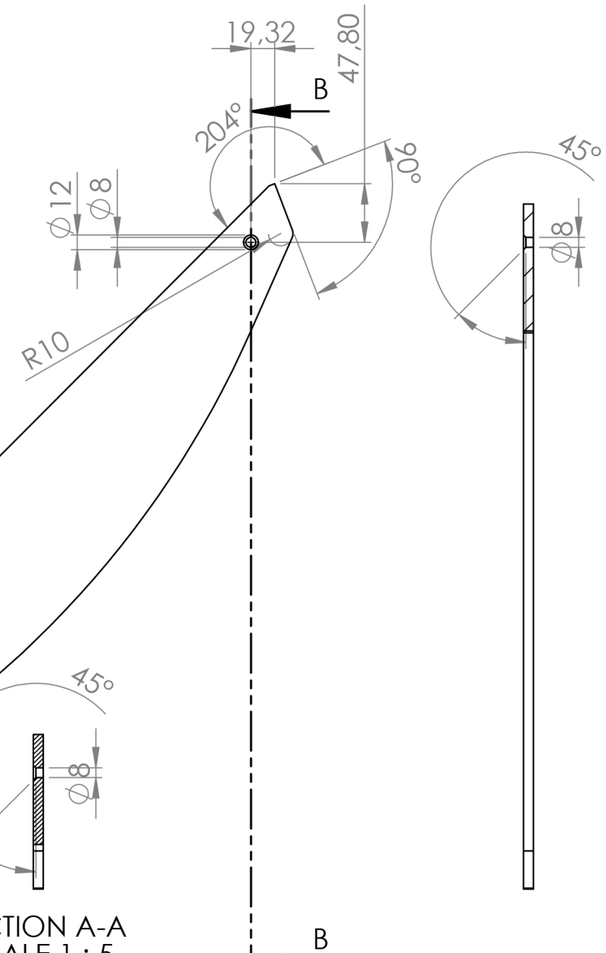




A

A

SECTION A-A
SCALE 1 : 5

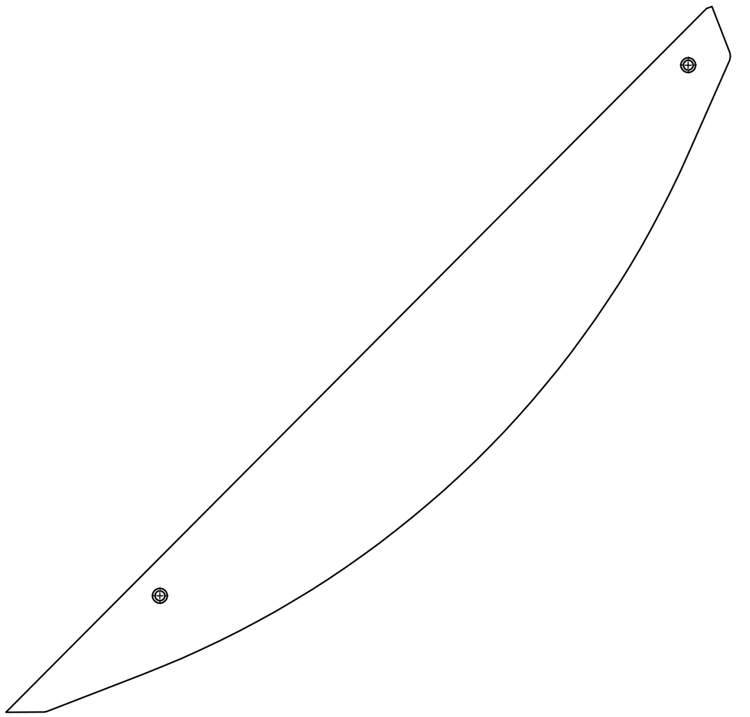


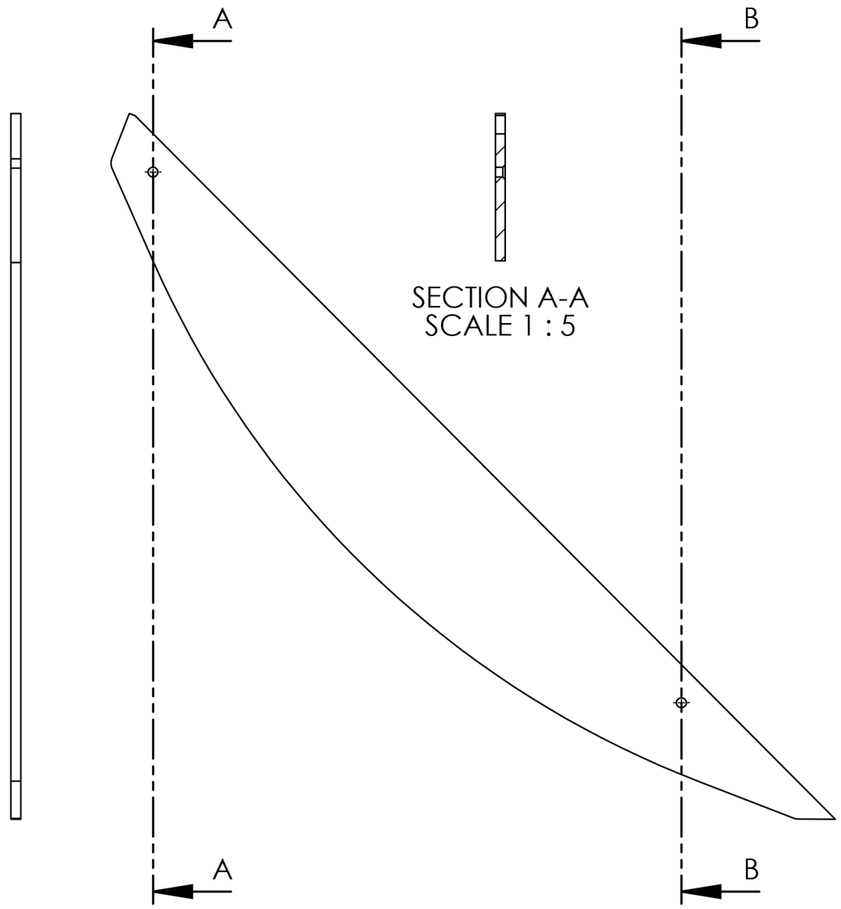
B

B

SECTION B-B
SCALE 1 : 5

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:			DEBUR AND BREAK SHARP EDGES		REVISION
	NAME	SIGNATURE	DATE				TITLE: linkerzijde
DRAWN							
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL:			DWG NO. 20160712-01 A3
				WEIGHT:		SCALE :1:5	SHEET 1 OF 1

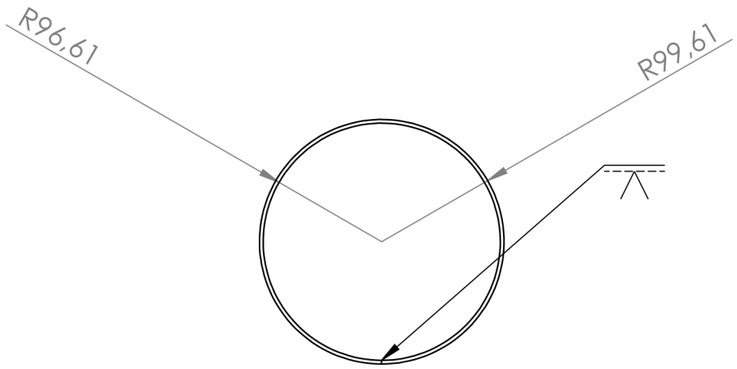


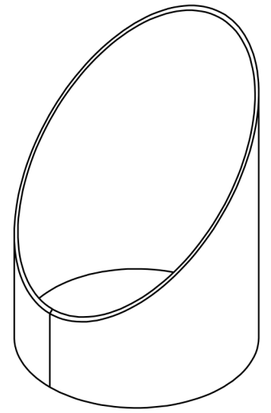


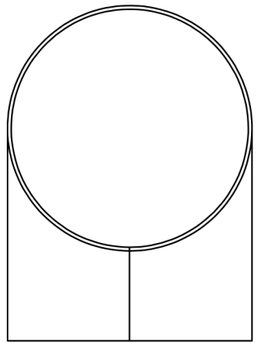
SECTION A-A
SCALE 1 : 5

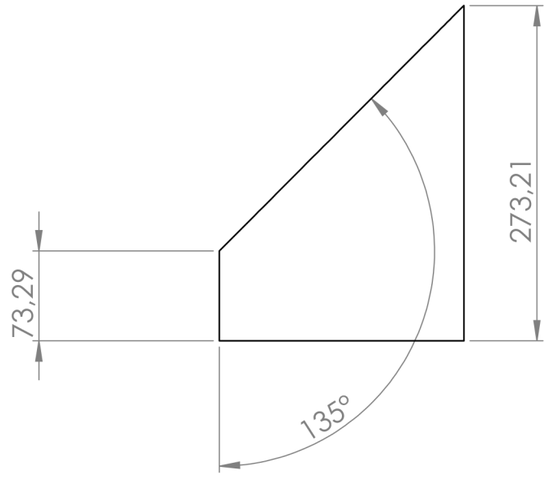
SECTION B-B
SCALE 1 : 5

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:				DEBUR AND BREAK SHARP EDGES	REVISION
	NAME	SIGNATURE	DATE				TITLE: rechterzijde
DRAWN							
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL:			DWG NO. 20160712-02 A3
				WEIGHT:			SCALE: 1:5 SHEET 1 OF 1

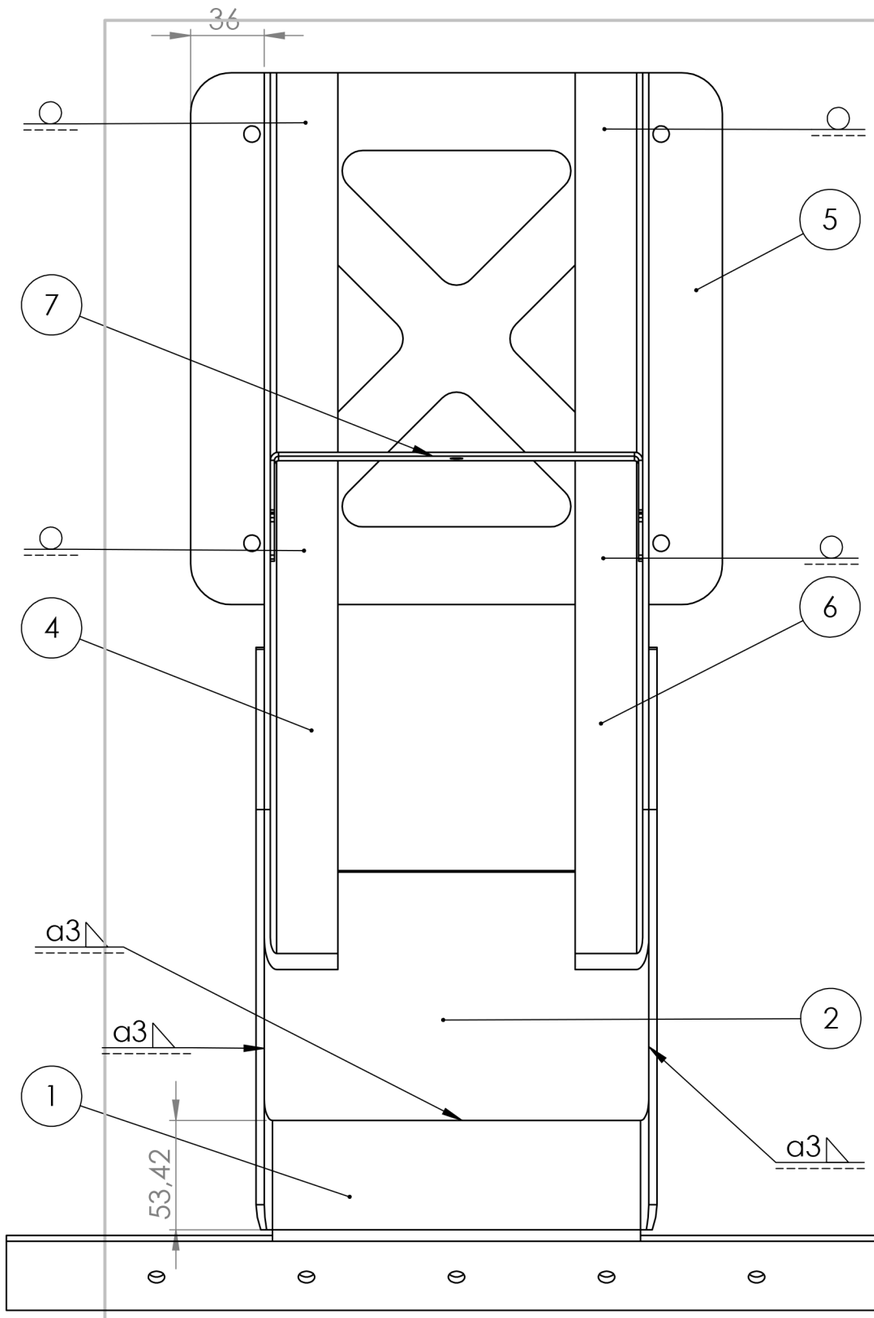


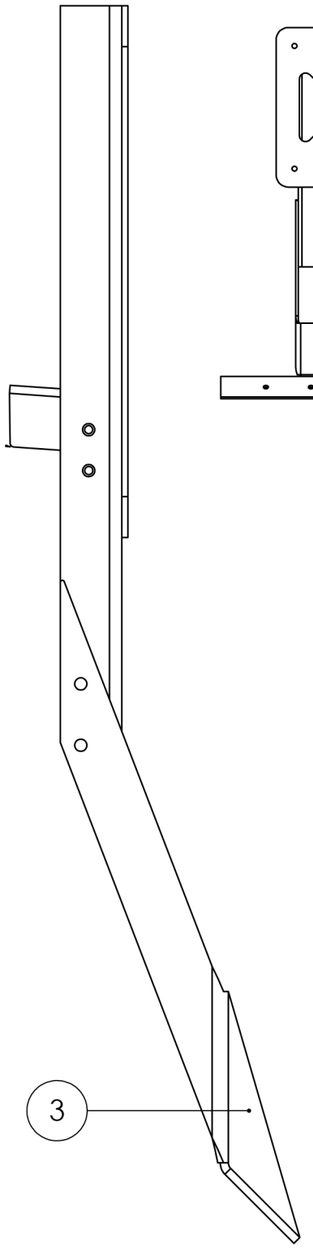


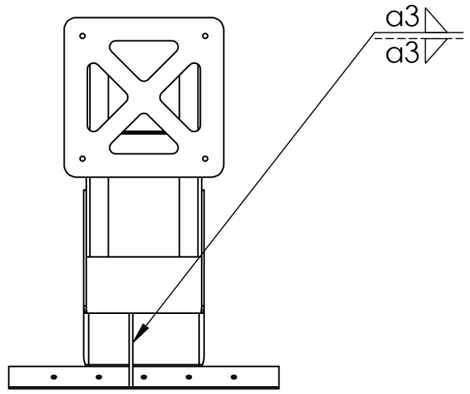


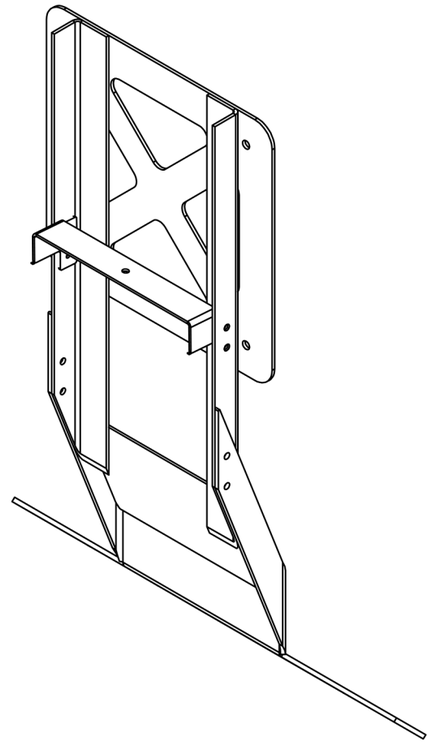


UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:			DEBUR AND BREAK SHARP EDGES		REVISION
	NAME	SIGNATURE	DATE				TITLE: tubeconstruction
DRAWN							
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL:			DWG NO. 20160712-06 A3
				WEIGHT:		SCALE:1:5	SHEET 1 OF 1









Stuk Nr.	Quantiteit	Benaming	Code	Opmerking
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2	1	part 1	20160714-02	
3	1	part 2	20160714-03	
4	1	tvbevestigingrechts	20160714-04	
5	1	fesa	20160714-05	
6	1	tvbevestiginglinks	20160714-06	
7	1	camhold	20160714-07	

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS
SURFACE FINISH:
TOLERANCES:
LINEAR:
ANGULAR:

FINISH:

DEBUR AND BREAK SHARP EDGES

REVISION

	NAME	SIGNATURE	DATE
DRAWN			
CHK'D			
APPV'D			
MFG			
Q.A			

MATERIAL:

WEIGHT:

TITLE:

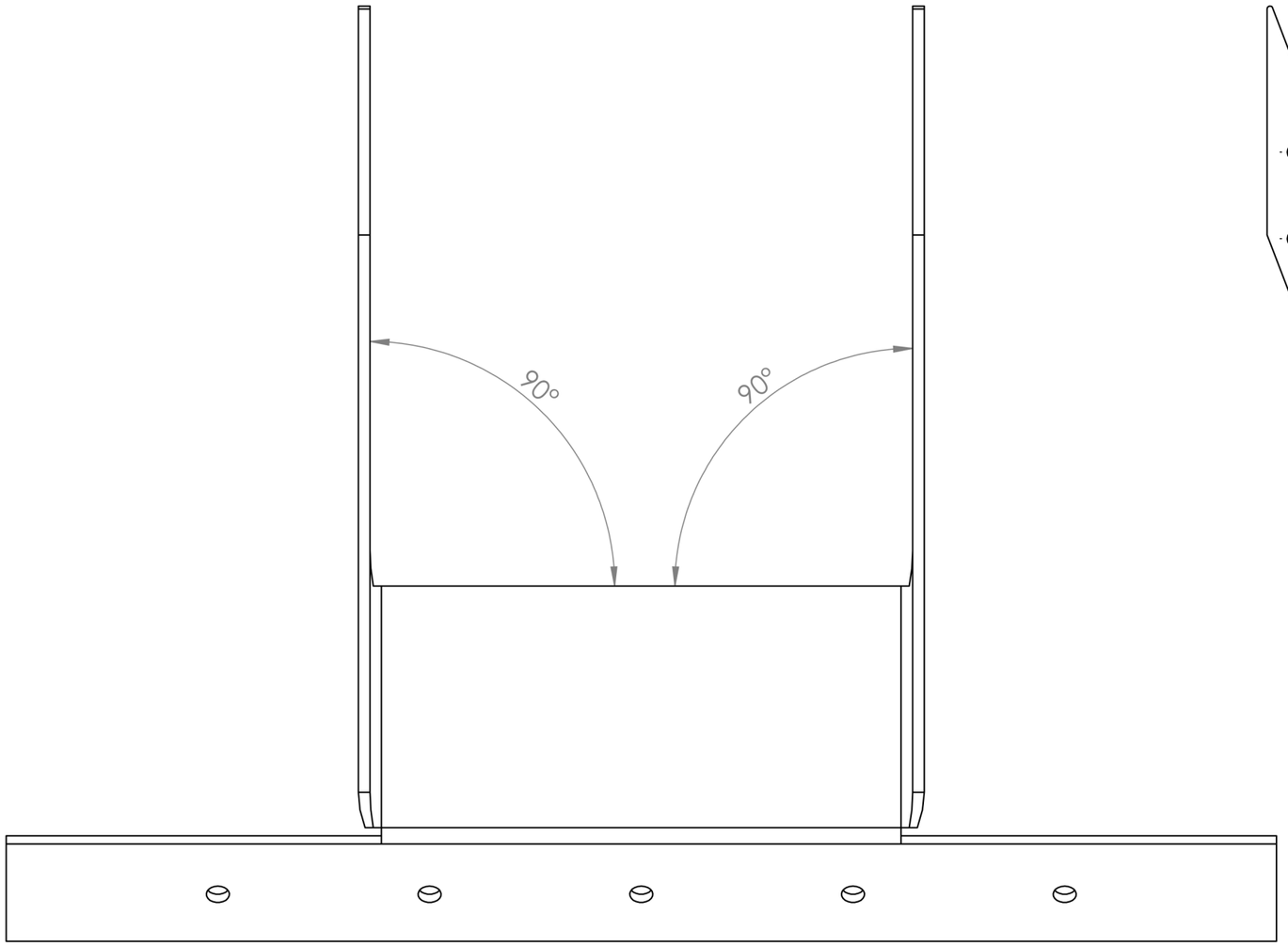
screenassem

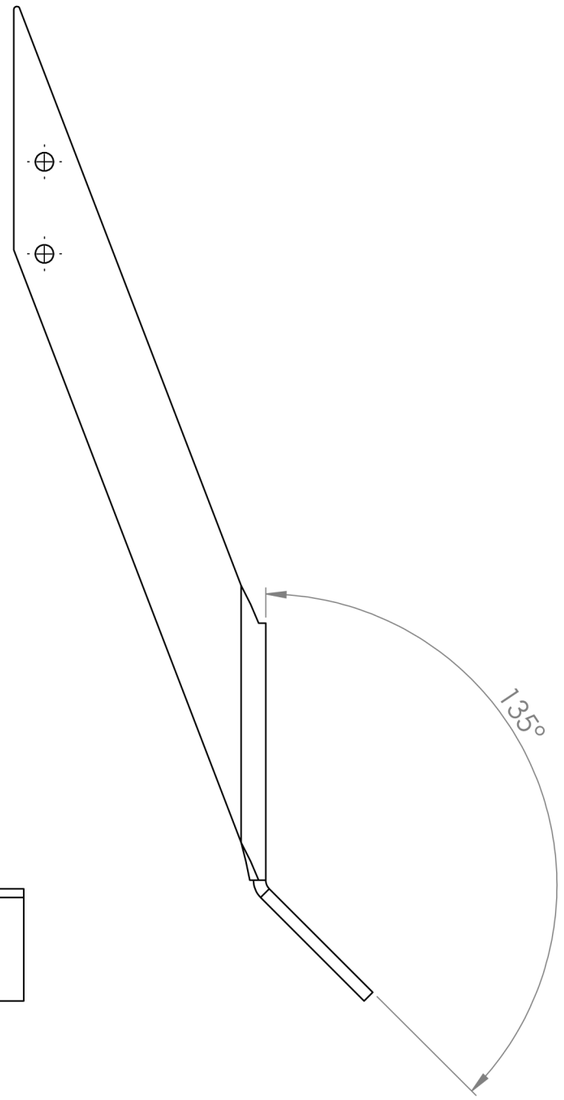
DWG NO. 20160714

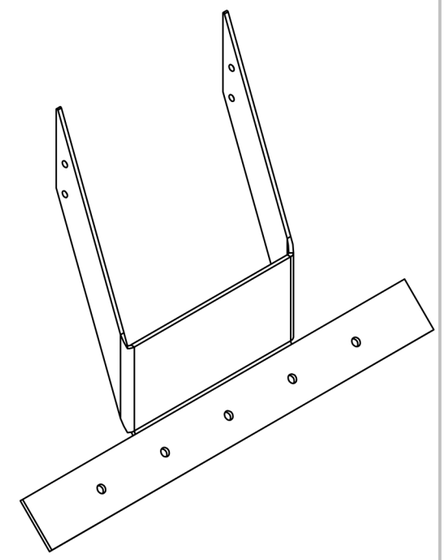
A3

SCALE:1:3

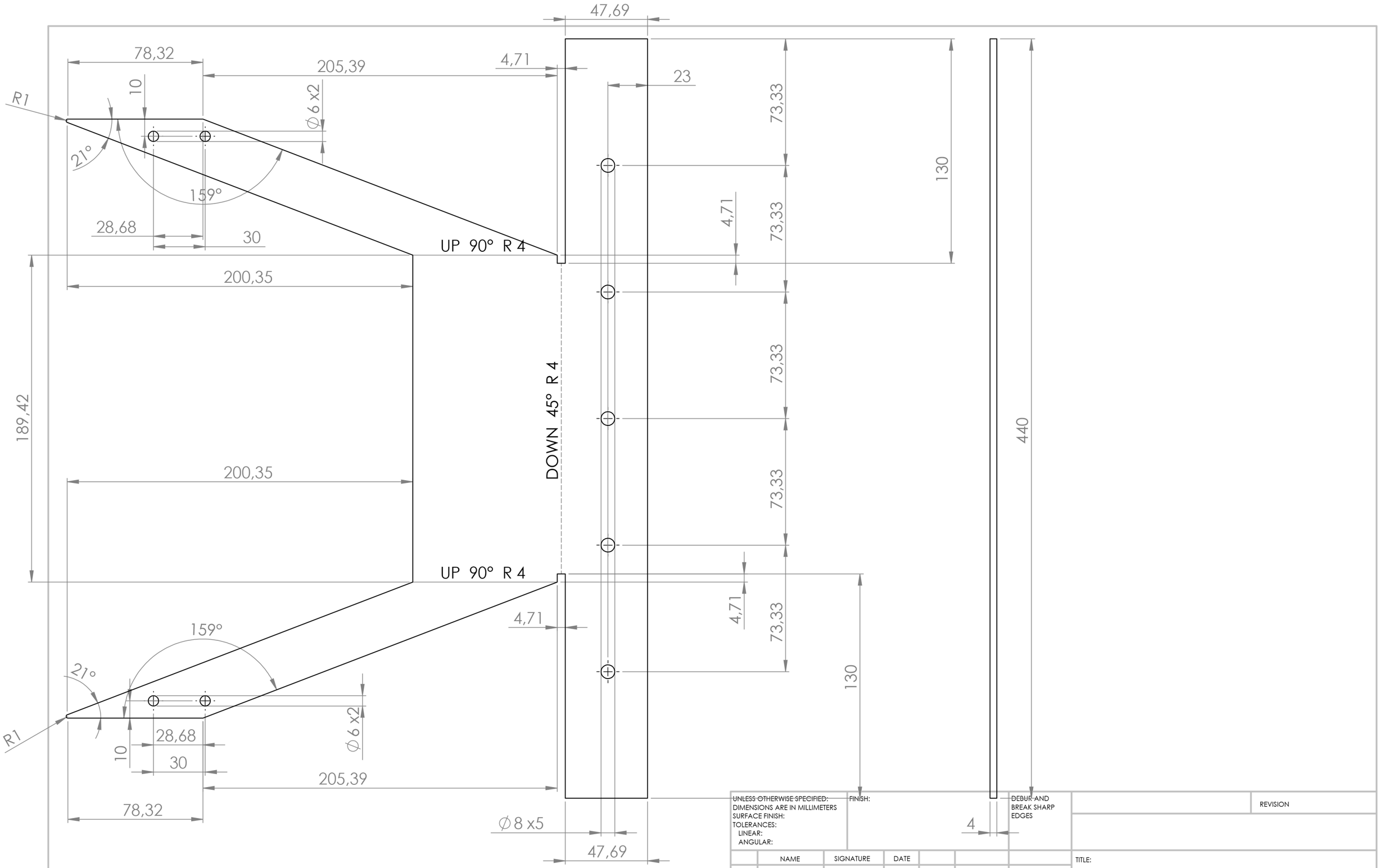
SHEET 1 OF 1







UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:			DEBUR AND BREAK SHARP EDGES		REVISION
	NAME	SIGNATURE	DATE				TITLE: screenconstruction
DRAWN							
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL:			DWG NO. 20160714-01 A3
				WEIGHT:		SCALE:1:2	SHEET 1 OF 1



UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS
SURFACE FINISH:
TOLERANCES:
LINEAR:
ANGULAR:

FINISH:

DEBUR AND BREAK SHARP EDGES

REVISION

	NAME	SIGNATURE	DATE
DRAWN			
CHK'D			
APPV'D			
MFG			
Q.A			

MATERIAL:

WEIGHT:

TITLE:

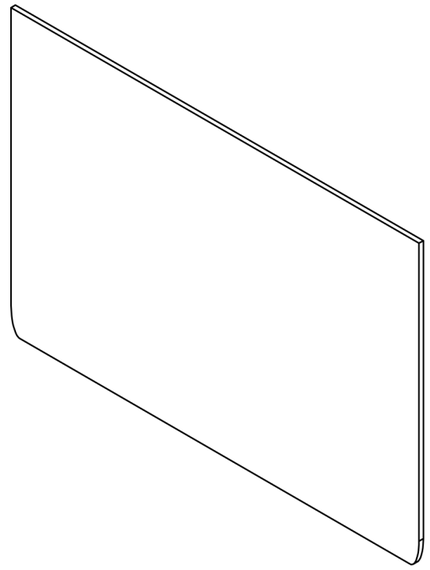
screenconstructionflat

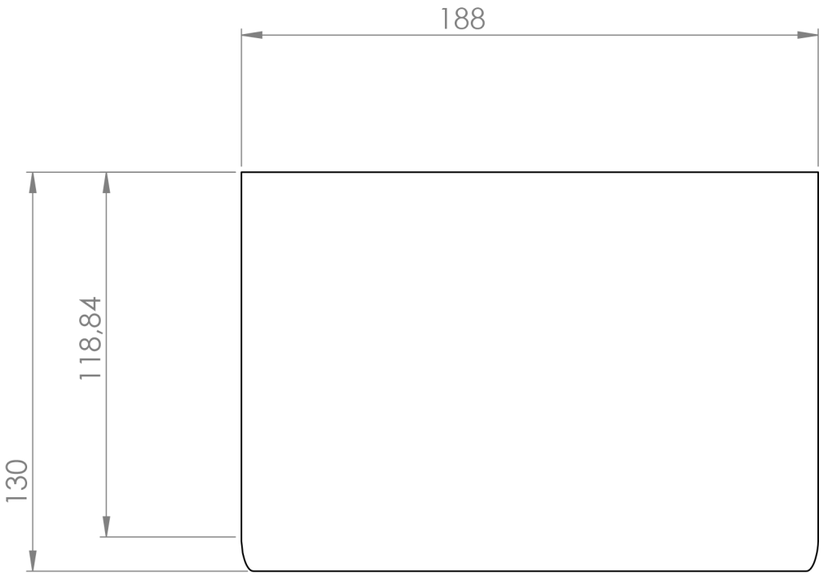
DWG NO. 20160714-01

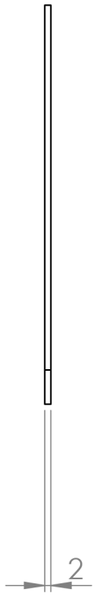
A3

SCALE:1:2

SHEET 1 OF 1







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	NAME	SIGNATURE	DATE				TITLE: Part1
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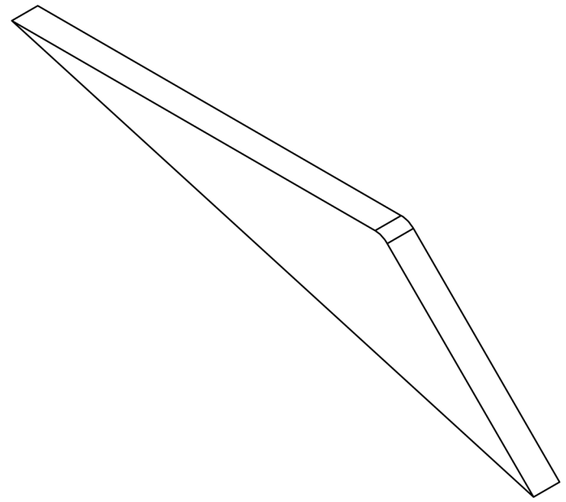
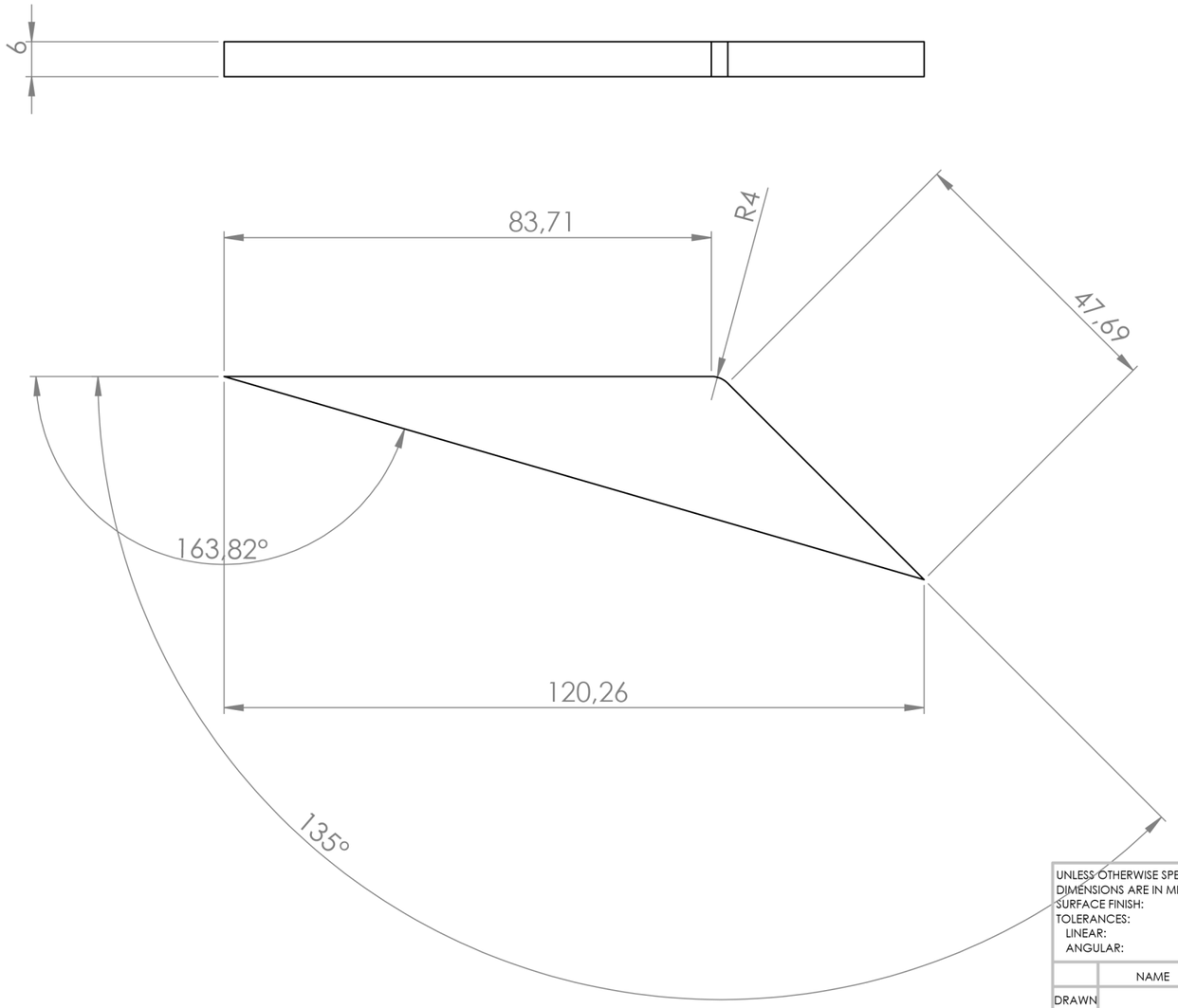
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL:			DWG NO. 20160714-02 A3
				WEIGHT:			SCALE:1:2 SHEET 1 OF 1





UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:			DEBUR AND BREAK SHARP EDGES		REVISION
	NAME	SIGNATURE	DATE				TITLE: Part2
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CHK'D							
APPV'D							
MFG							
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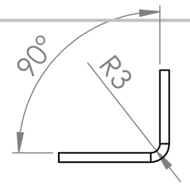
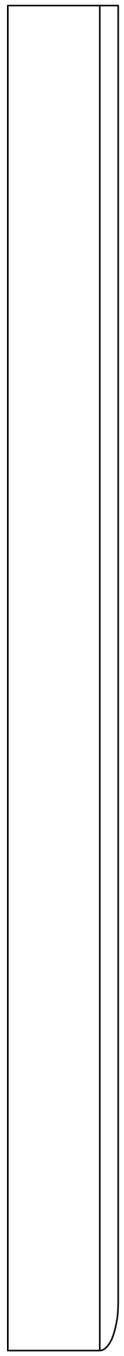
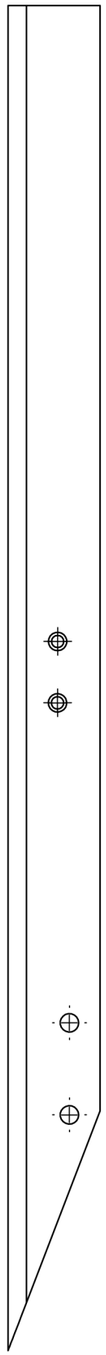
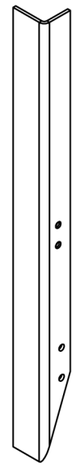
				WEIGHT:			SCALE:1:1 SHEET 1 OF 1

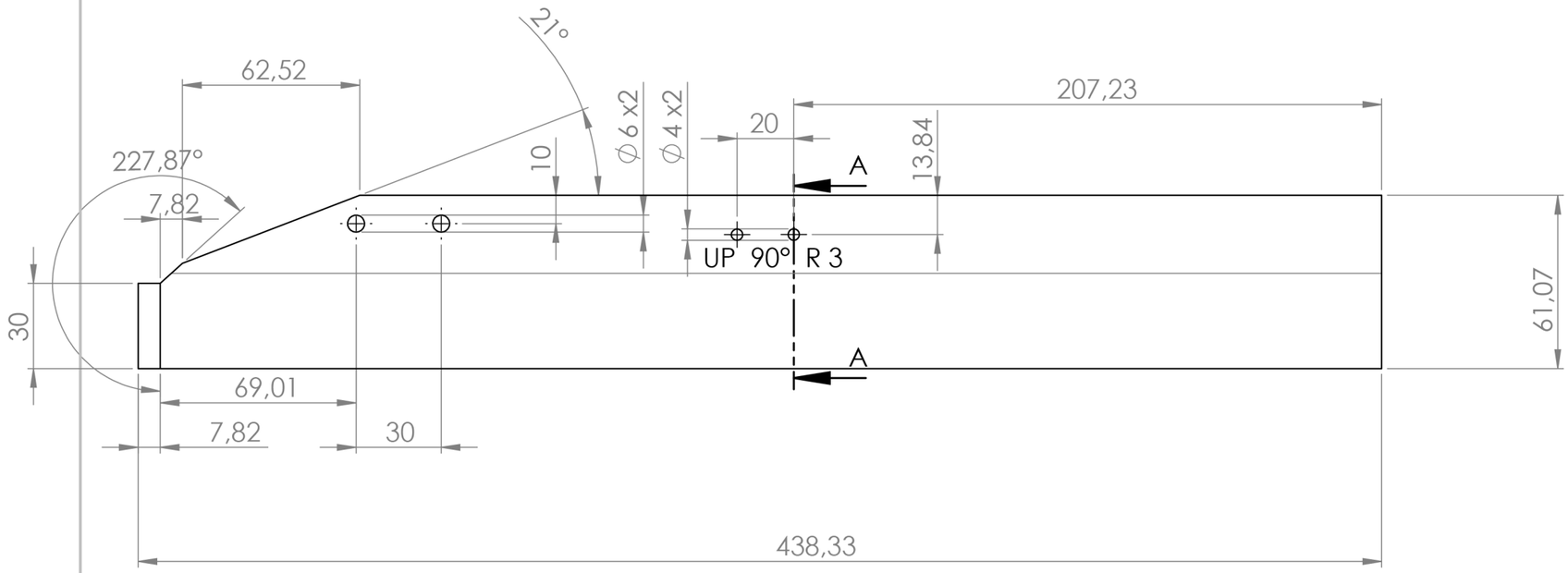


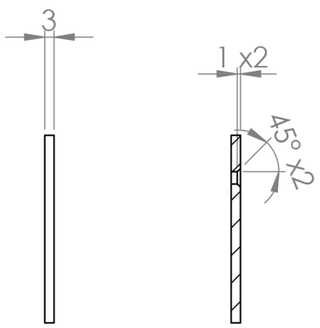






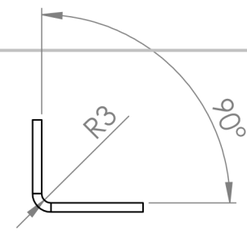
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:			DEBUR AND BREAK SHARP EDGES		REVISION
	NAME	SIGNATURE	DATE				TITLE: tvbevestiginglinks
DRAWN							
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL:			DWG NO. 20160714-06 A3
				WEIGHT:		SCALE:1:2	SHEET 1 OF 1

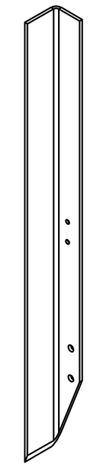


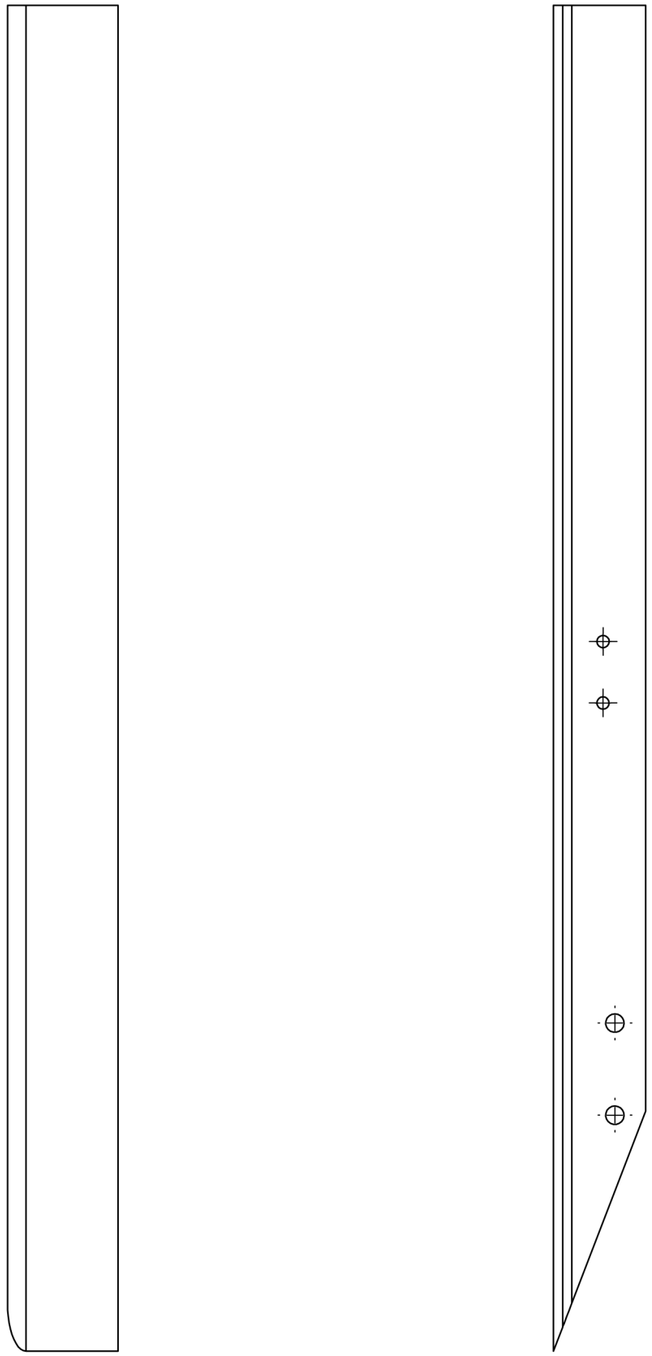


SECTION A-A
SCALE 1 : 2

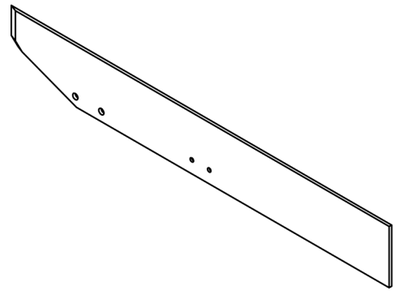
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:			DEBUR AND BREAK SHARP EDGES		REVISION
	NAME	SIGNATURE	DATE				TITLE: tvbevestiginglinksflat
DRAWN							
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL:			DWG NO. 20160714-06 A3
				WEIGHT:		SCALE:1:2	SHEET 1 OF 1

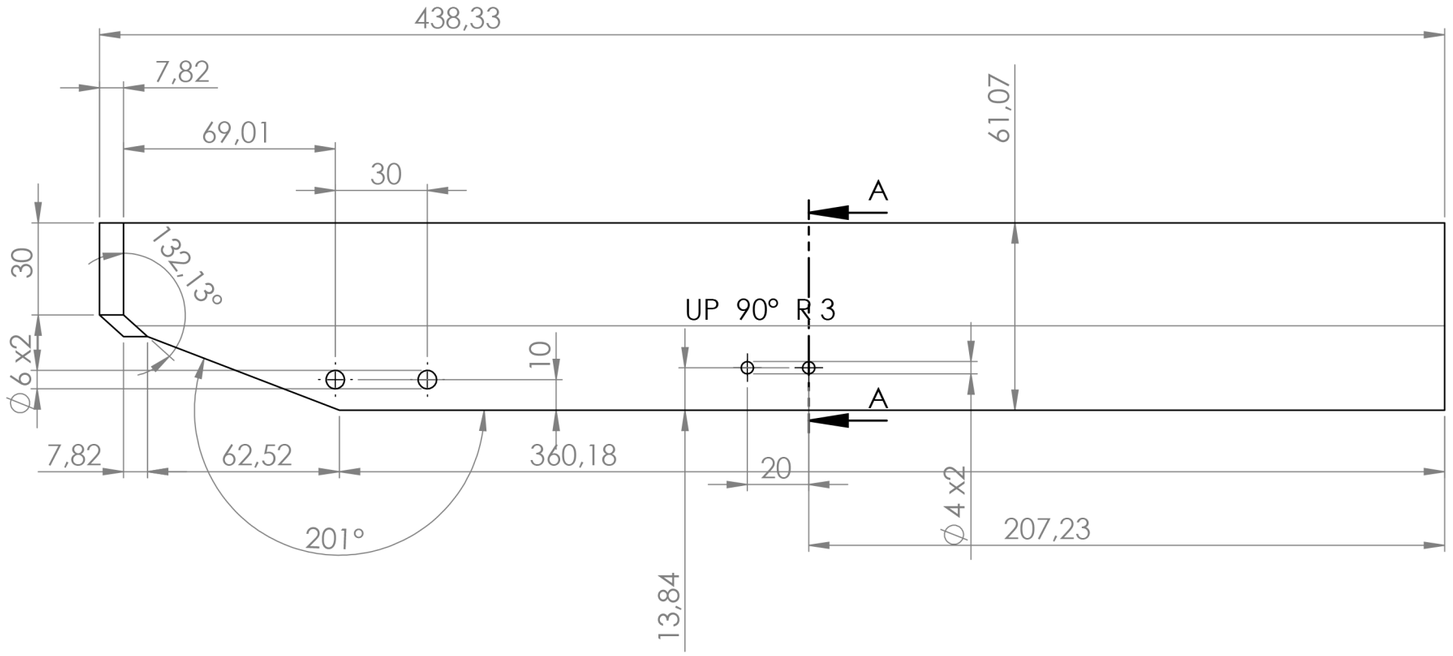


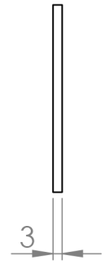


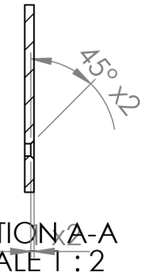


UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:			DEBUR AND BREAK SHARP EDGES		REVISION
	NAME	SIGNATURE	DATE				TITLE: tvbevestigingrechts
DRAWN							
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL:			DWG NO. 20160714-04 A3
				WEIGHT:		SCALE:1:2	SHEET 1 OF 1









SECTION A-A
SCALE 1 : 2

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:			DEBUR AND BREAK SHARP EDGES		REVISION
	NAME	SIGNATURE	DATE				TITLE: tvbevestigingrechts flat
DRAWN							
CHK'D							
APPV'D							
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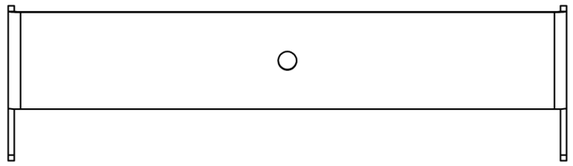
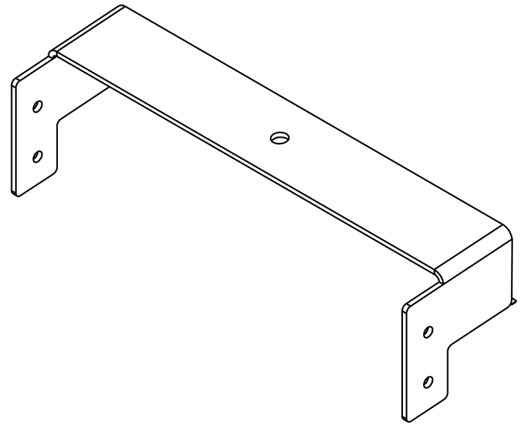
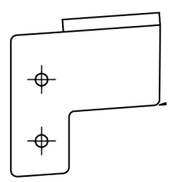
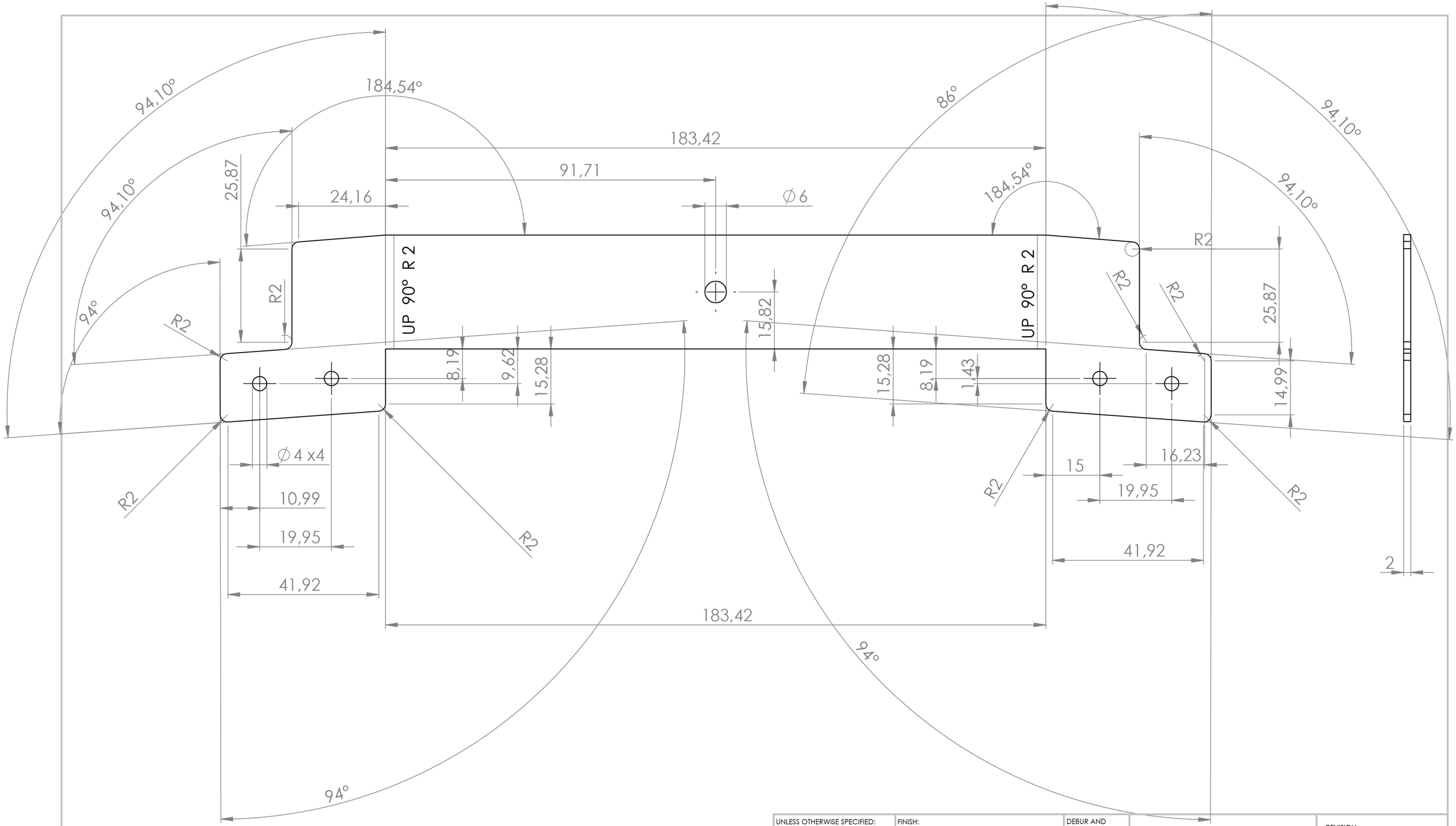
Q.A				MATERIAL:			DWG NO. 20160714-04 A3
				WEIGHT:		SCALE:1:2	SHEET 1 OF 1



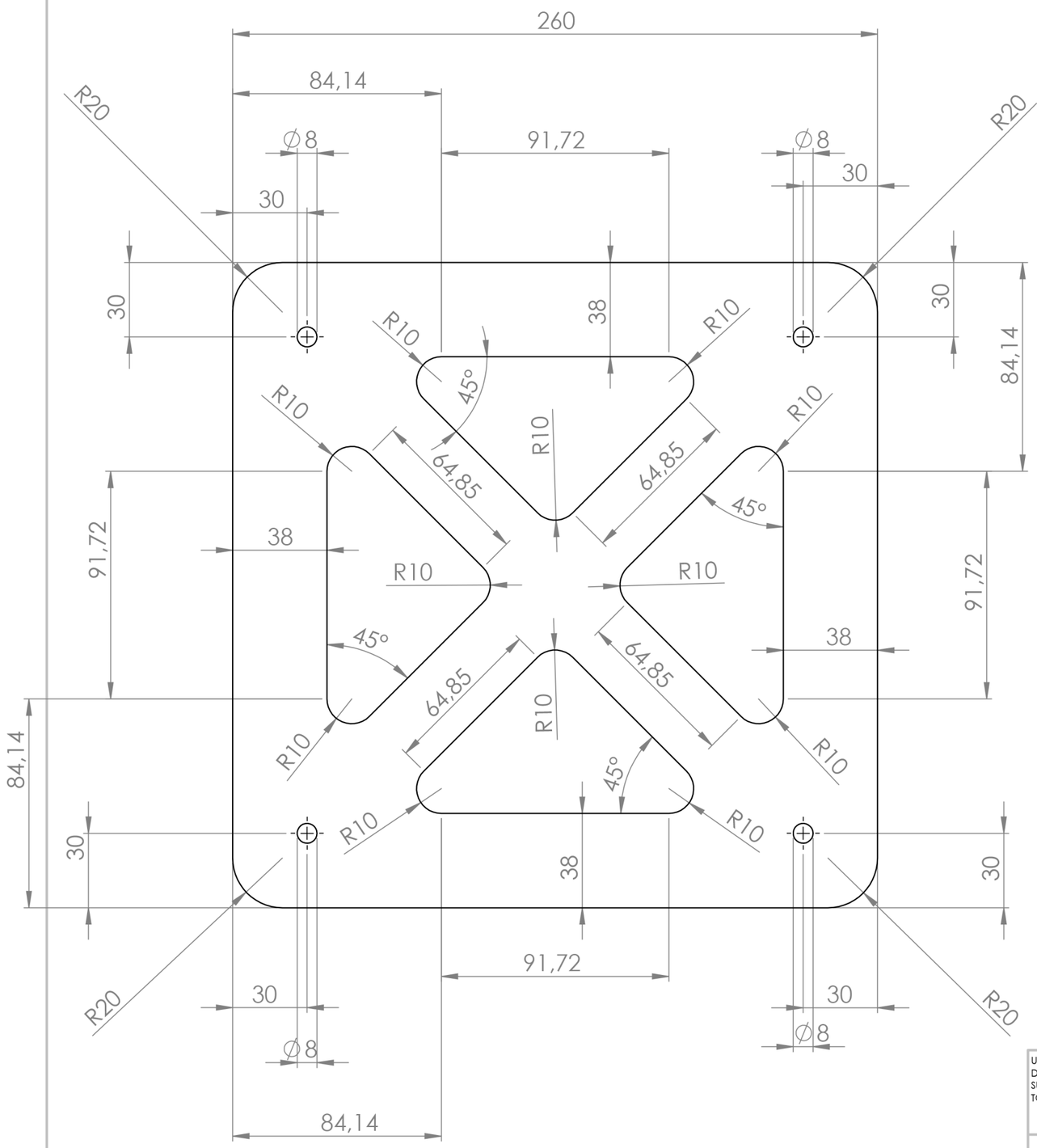


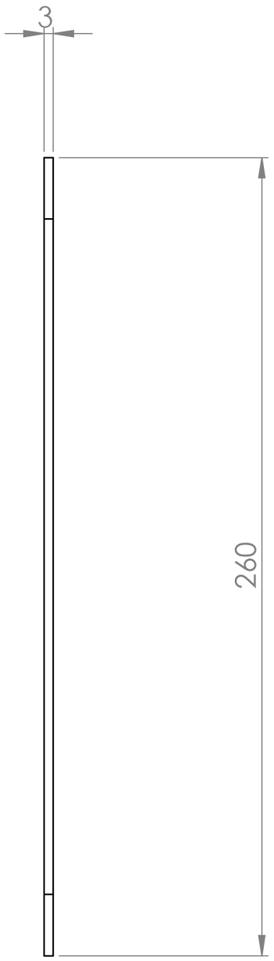


UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:				DEBUR AND BREAK SHARP EDGES	REVISION
	NAME	SIGNATURE	DATE				TITLE: camhold
DRAWN							
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL:			DWG NO. 20160714-07 A3
				WEIGHT:		SCALE:1:2	SHEET 1 OF 1



UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:			DEBUR AND BREAK SHARP EDGES		REVISION
	NAME	SIGNATURE	DATE				TITLE: camholdflat
DRAWN							
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL:			DWG NO. 20160714-07 A3
				WEIGHT:		SCALE:1:1	SHEET 1 OF 1





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CHK'D							
APPV'D							
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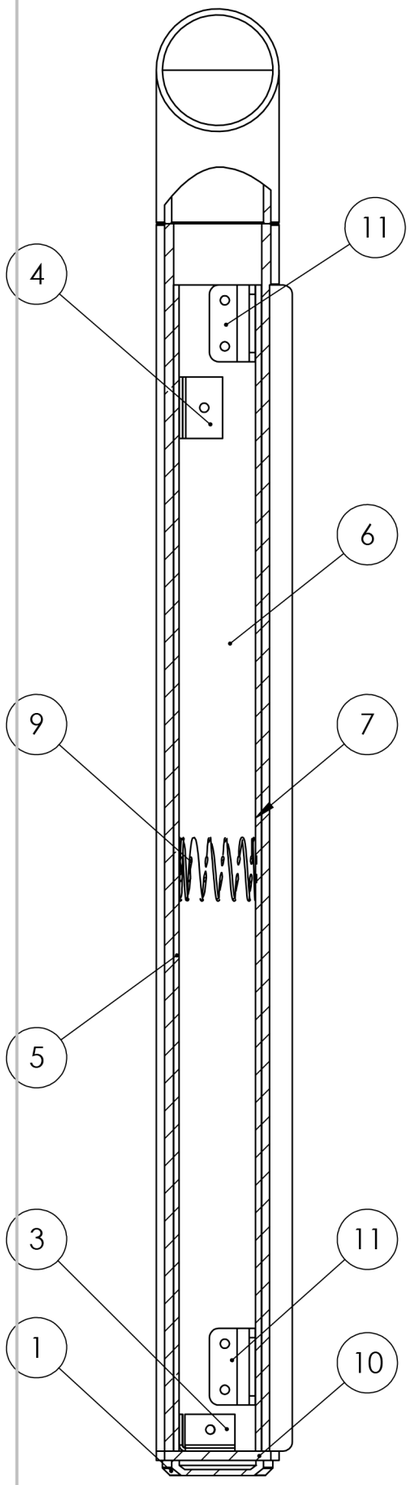

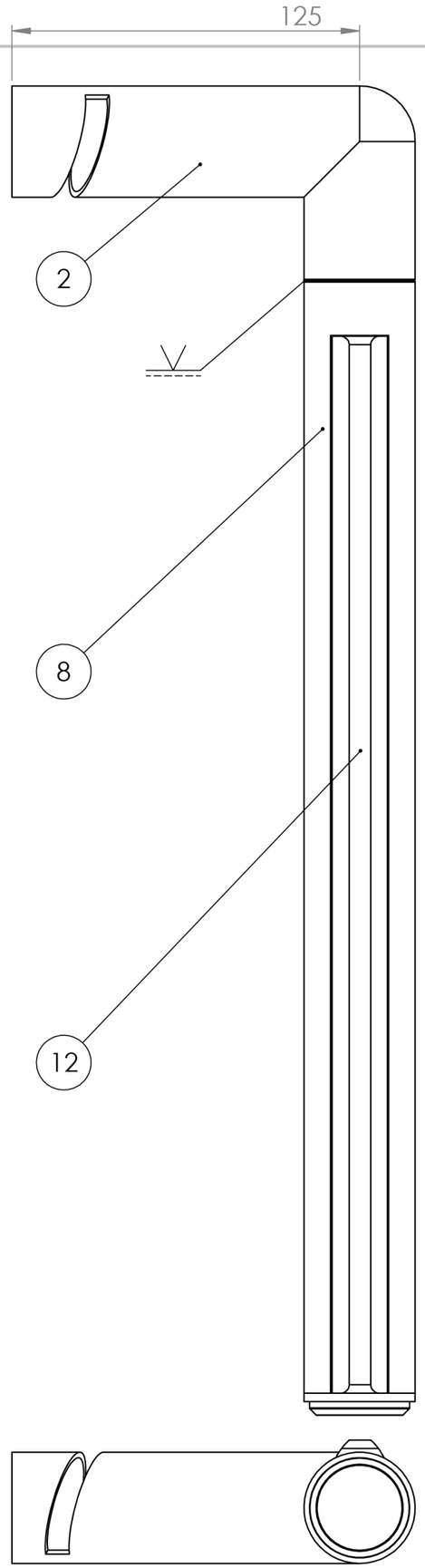

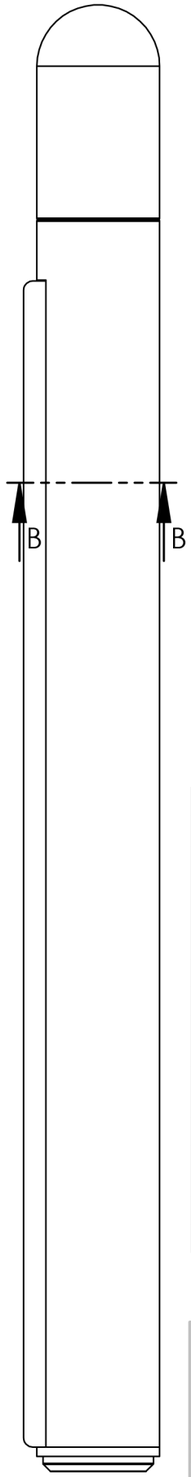

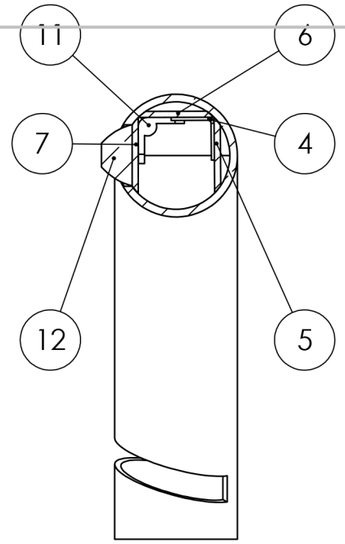

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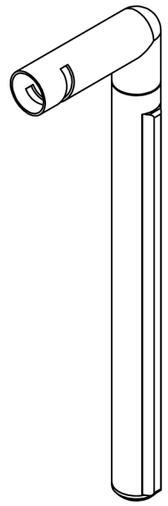

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2	1	Klemonderdeel	20160713-01	
3	1	plaatje voor bevestiging	20160713-03	
4	1	plaatje voor bevestiging 2	20160713-04	
5	1	Plankje 1	20160713-08	
6	1	Plankje 2	20160713-09	
7	1	Plankje 3	20160713-10	
8	1	Handvatbuis	20160713-06	
9	1	Veer		uit te kiezen onderdeel
10	1	Plaatje	20160713-02	
11	2	Scharnier		uit te kiezen onderdeel
12	1	Button	20160713-05	

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS
SURFACE FINISH:
TOLERANCES:
LINEAR:
ANGULAR:

FINISH:

DEBUR AND BREAK SHARP EDGES

DO NOT SCALE DRAWING | REVISION

	NAME	SIGNATURE	DATE
DRAWN			
CHK'D			
APPV'D			
MFG			
Q.A			

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assemhandvat

DWG NO. 20160713

A3

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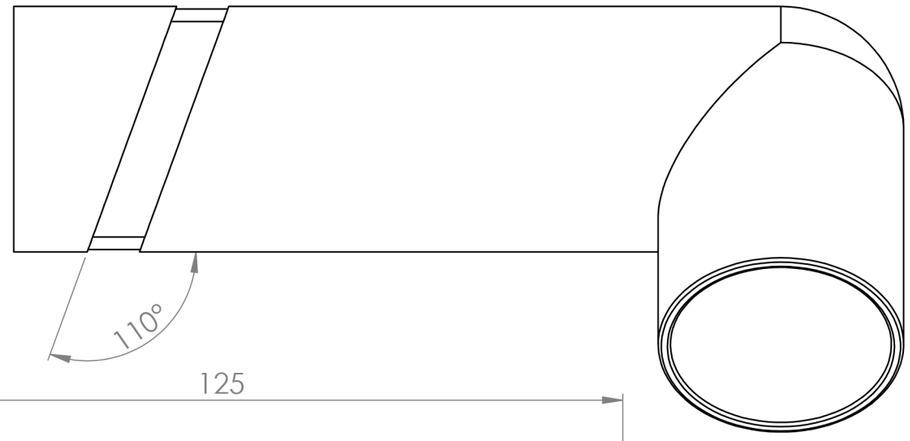
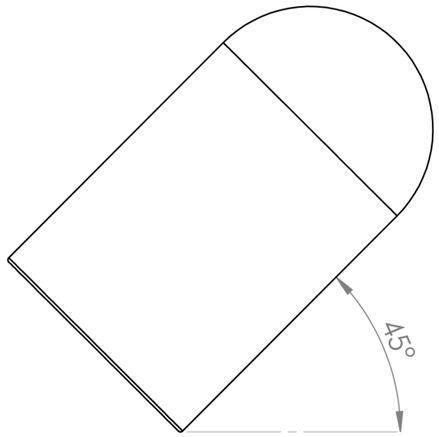
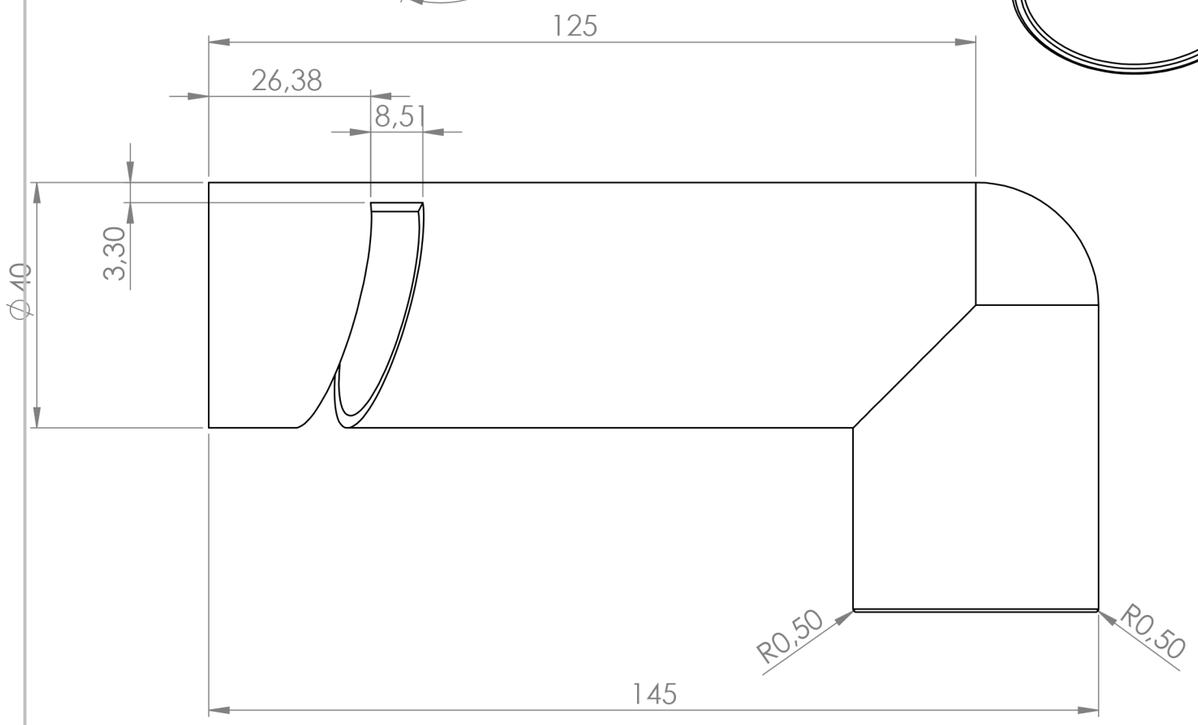
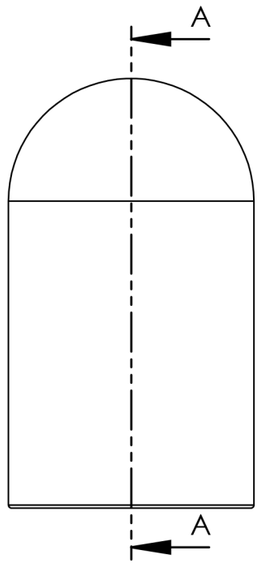
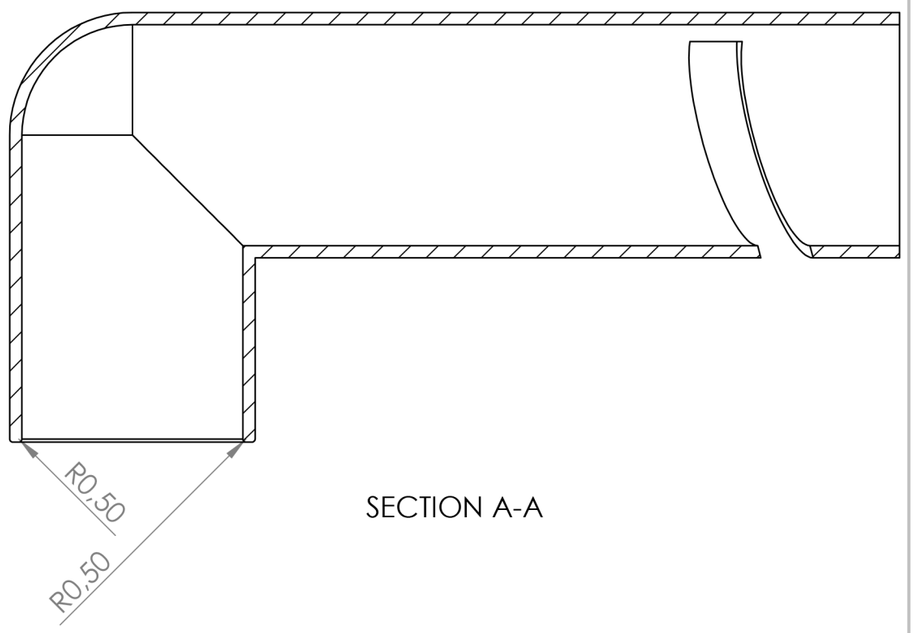
SHEET 1 OF 1



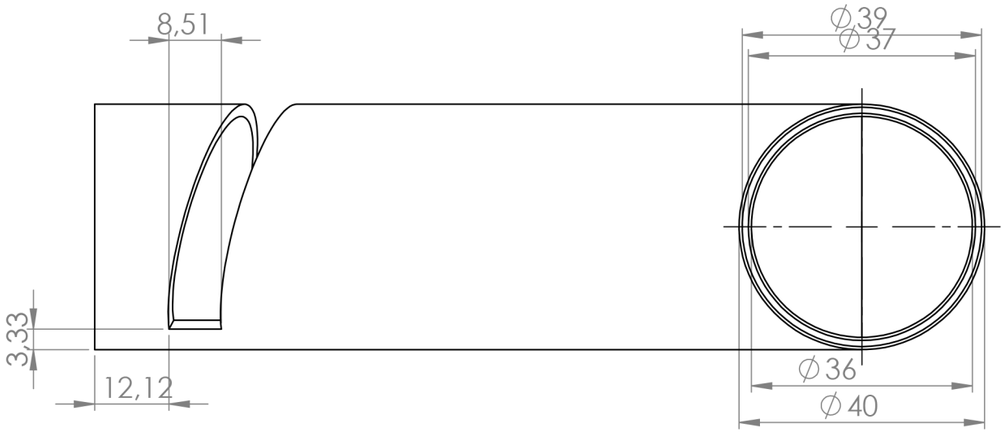








SECTION A-A



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CHK'D							
APPV'D							
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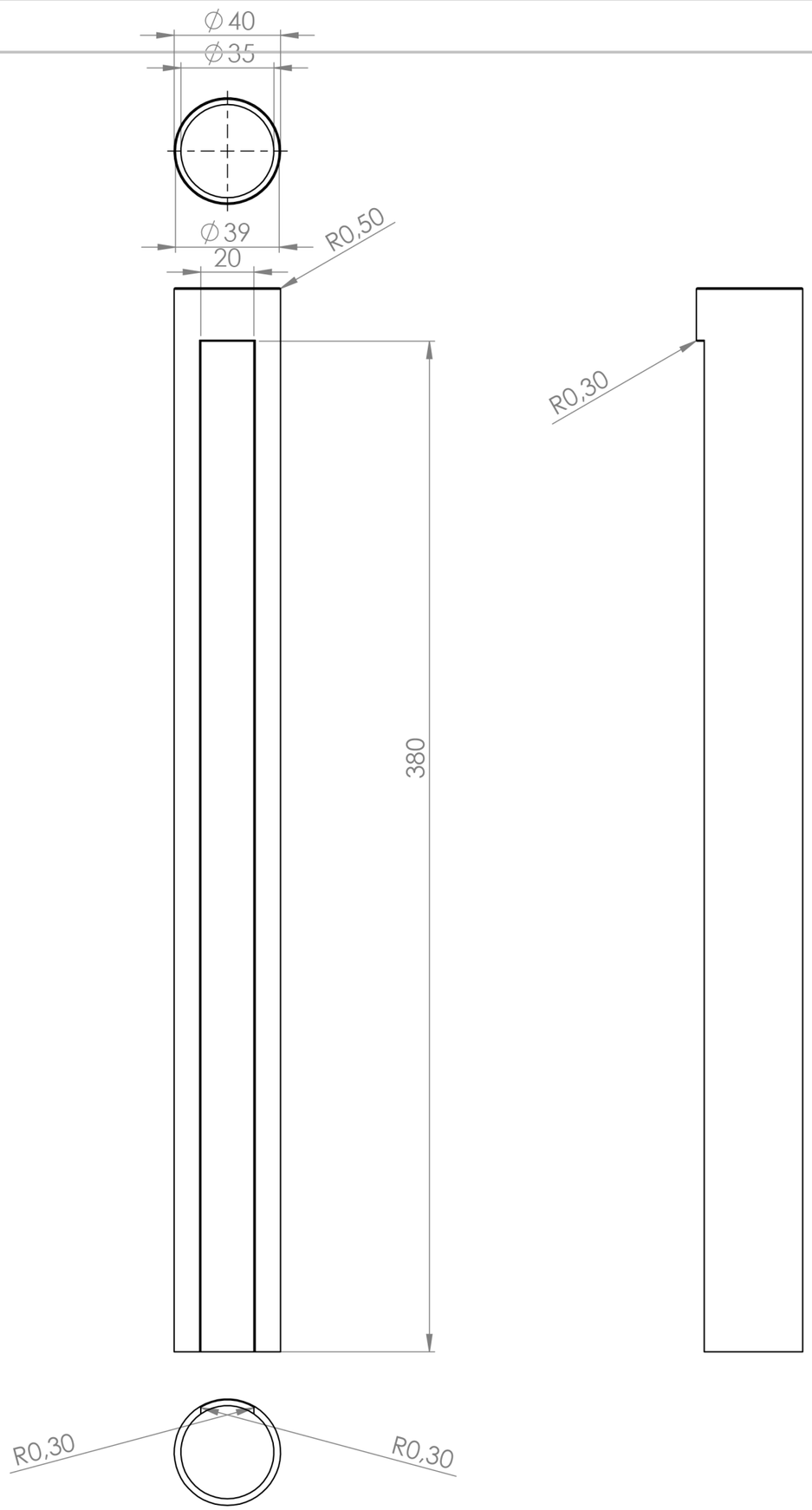

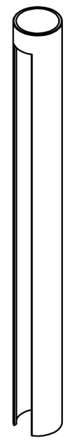

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							REVISION
	NAME	SIGNATURE	DATE				TITLE: handvatbuis
DRAWN							
CHK'D							
APPV'D							
MFG							
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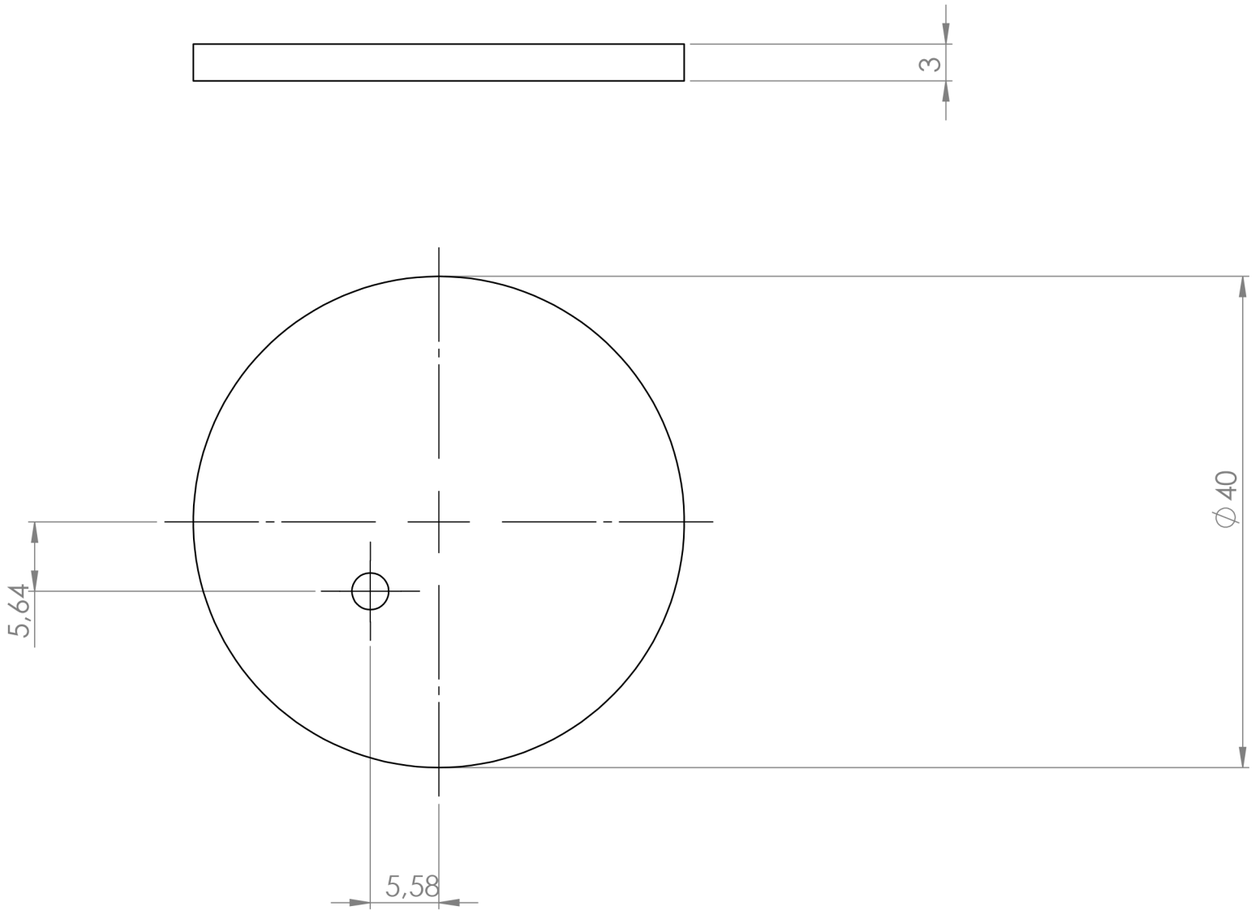

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CHK'D							
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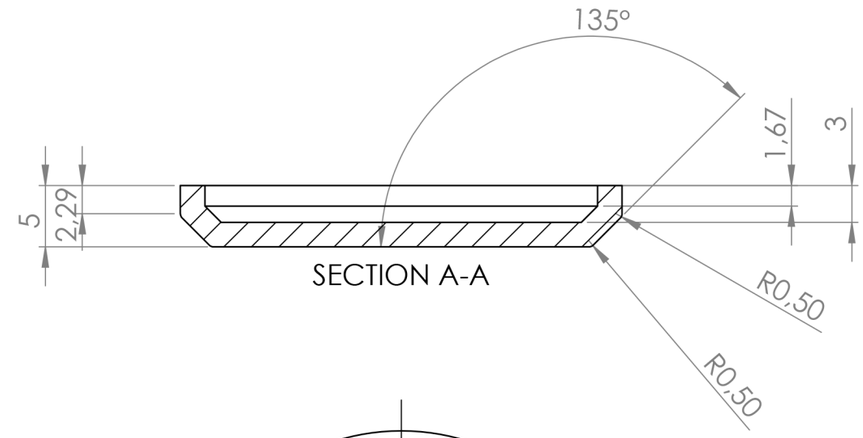

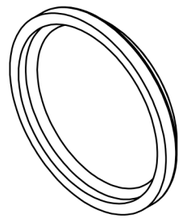

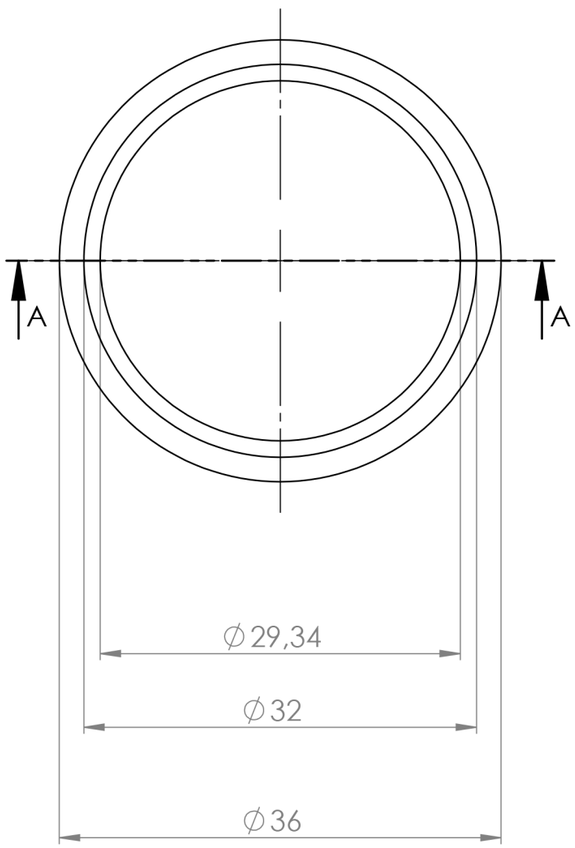

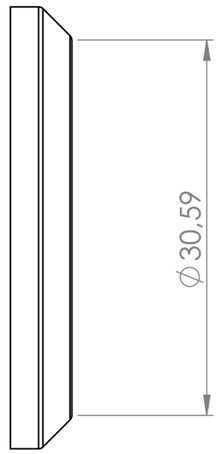

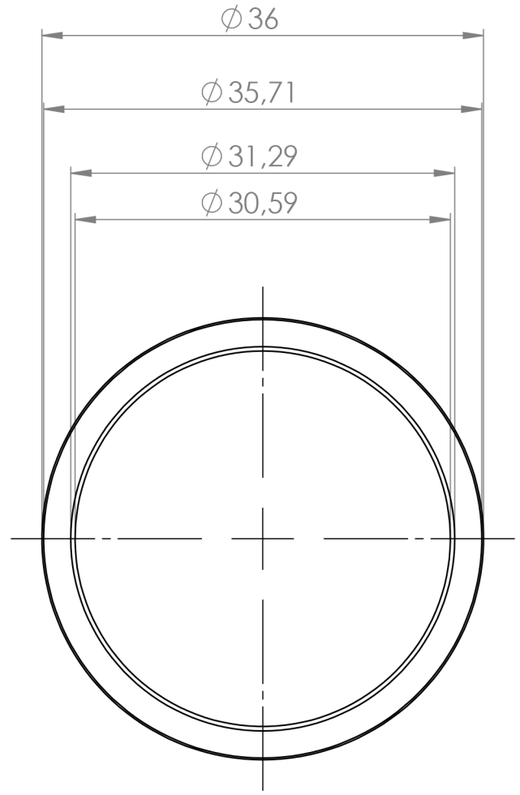

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CHK'D							
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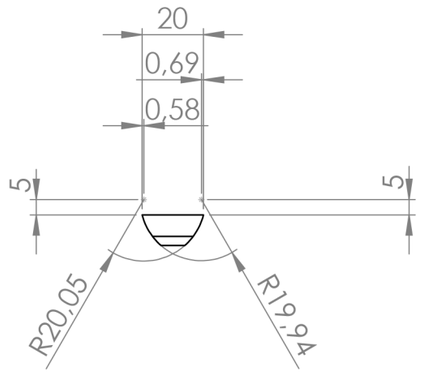

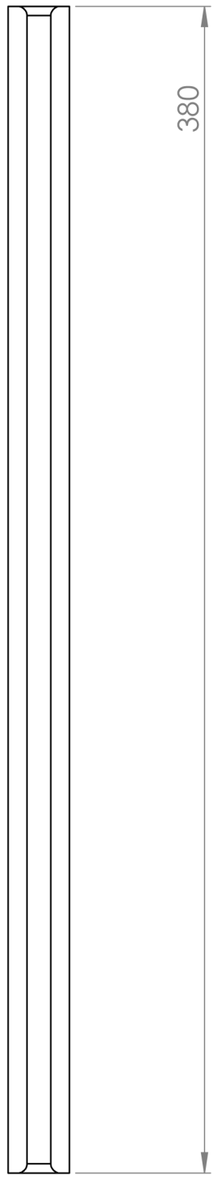

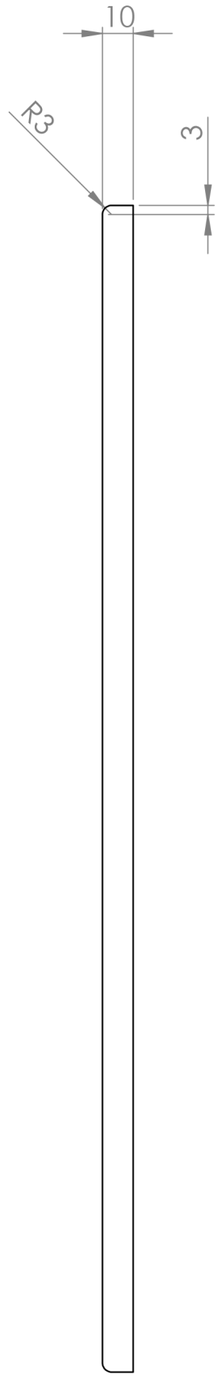

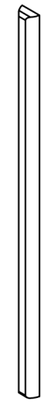

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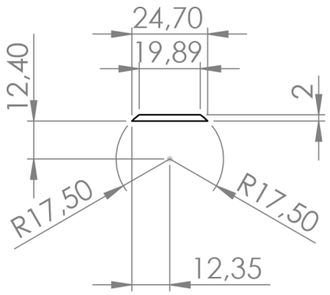

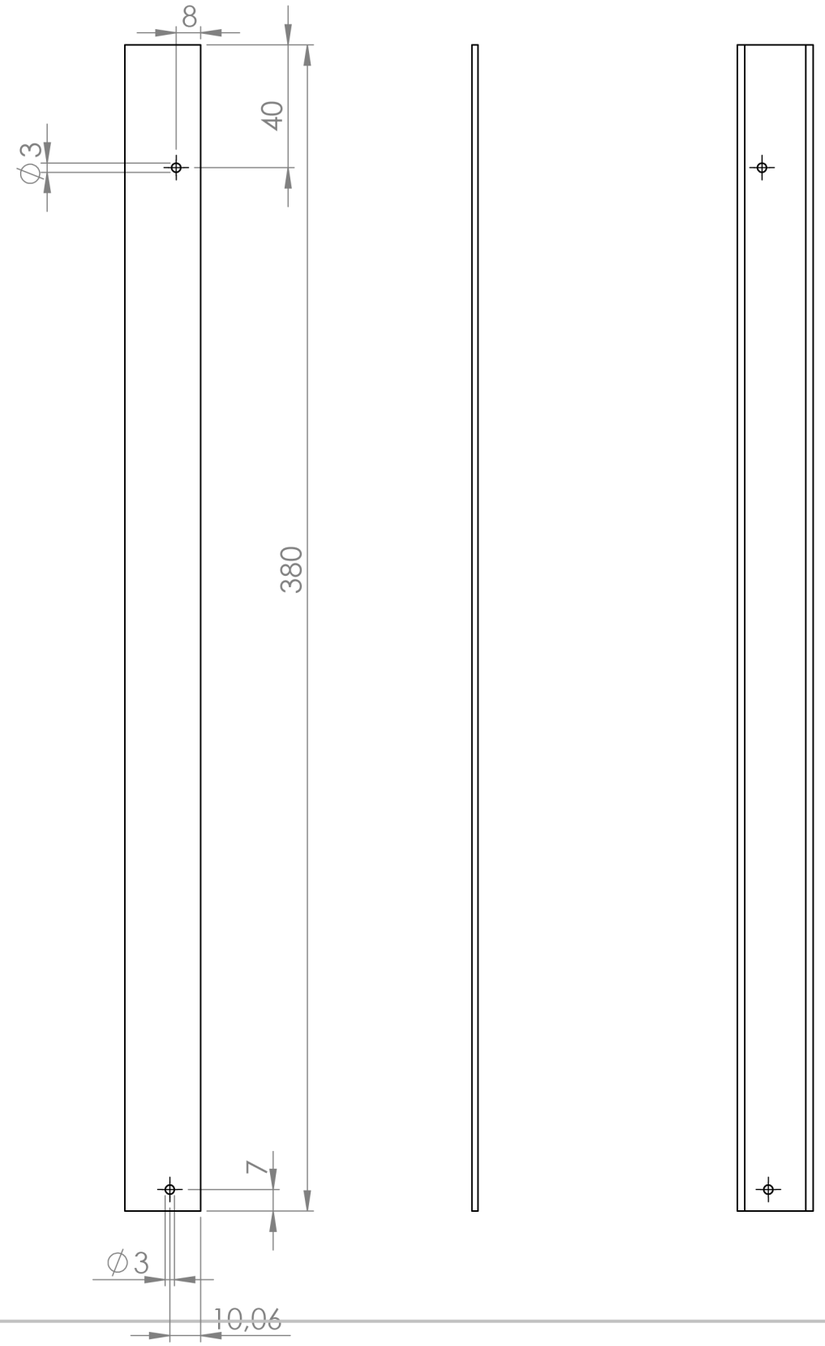

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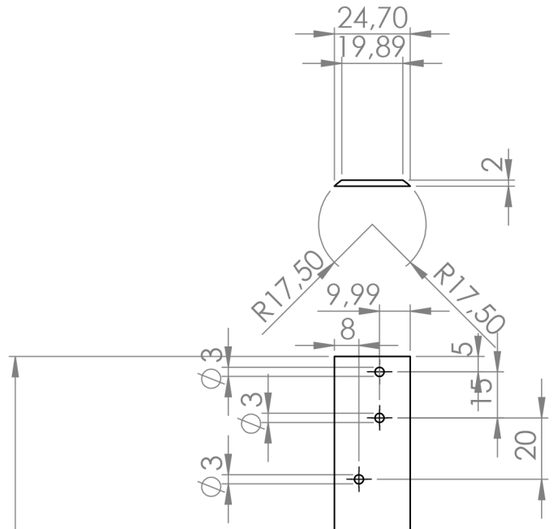

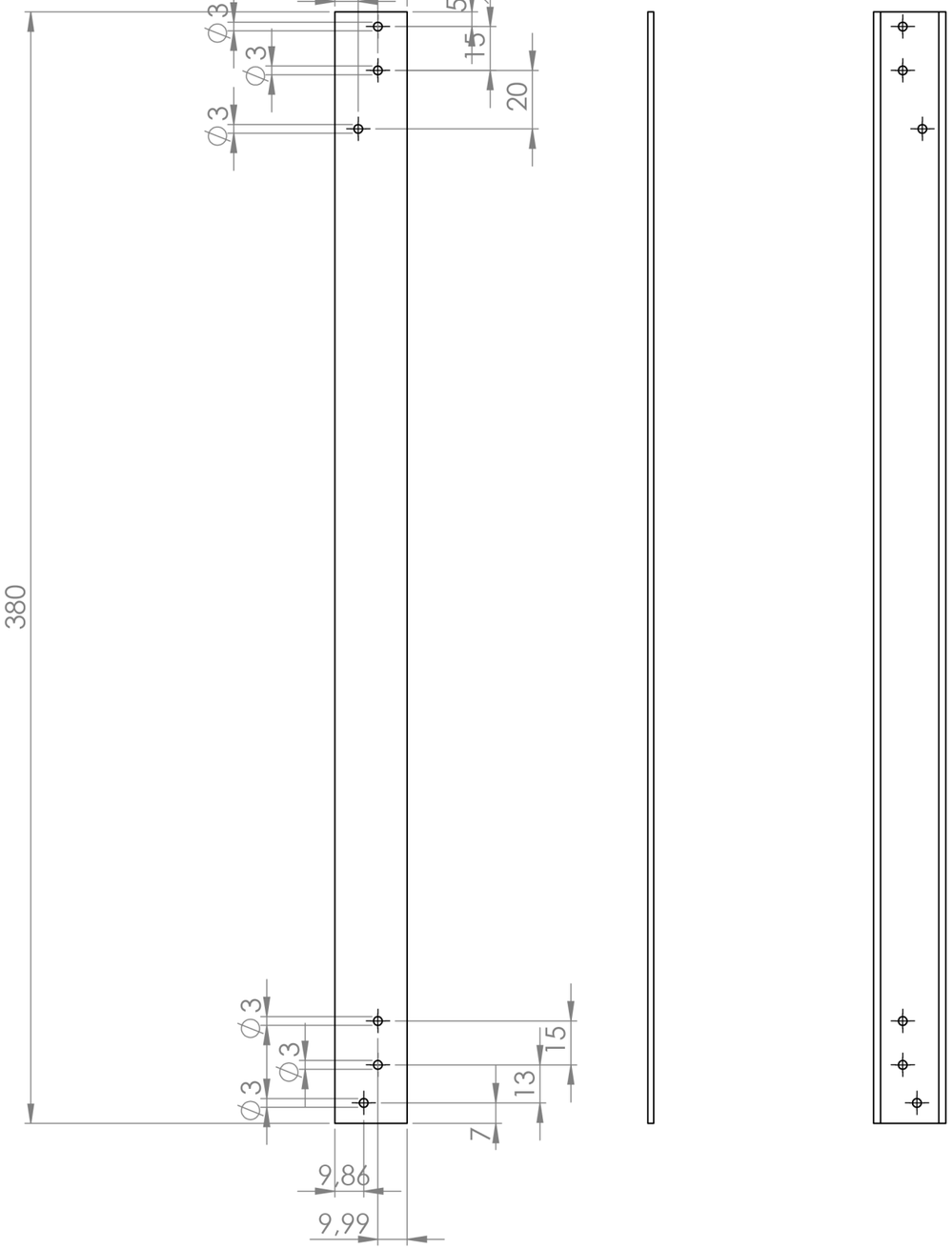

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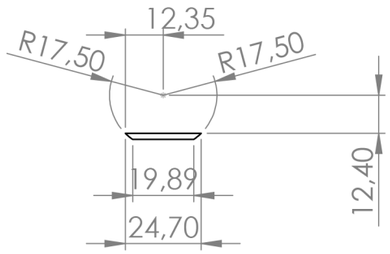

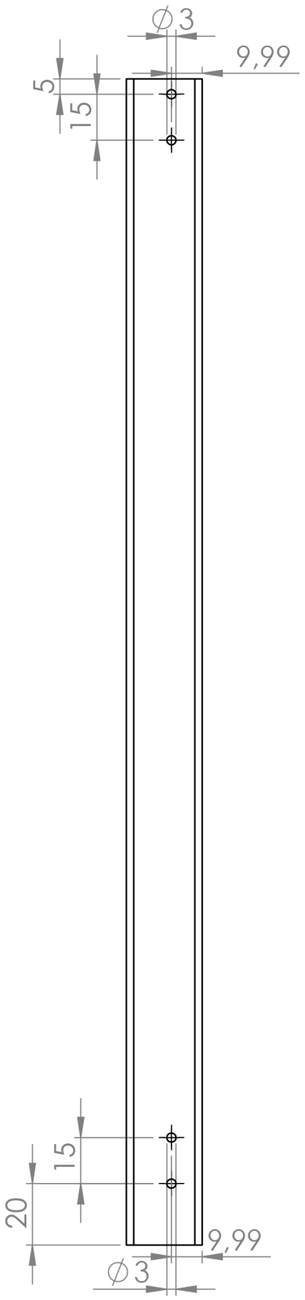

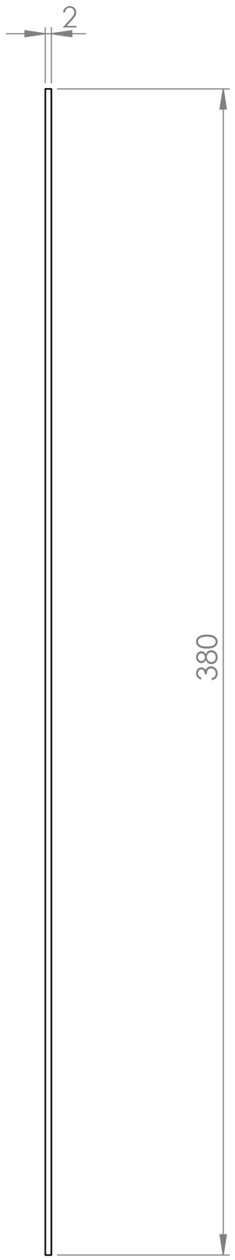

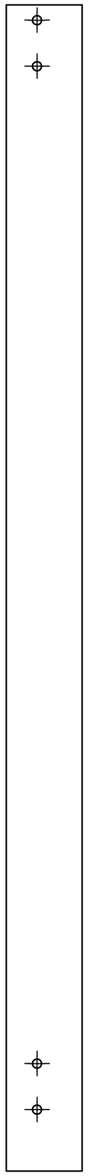

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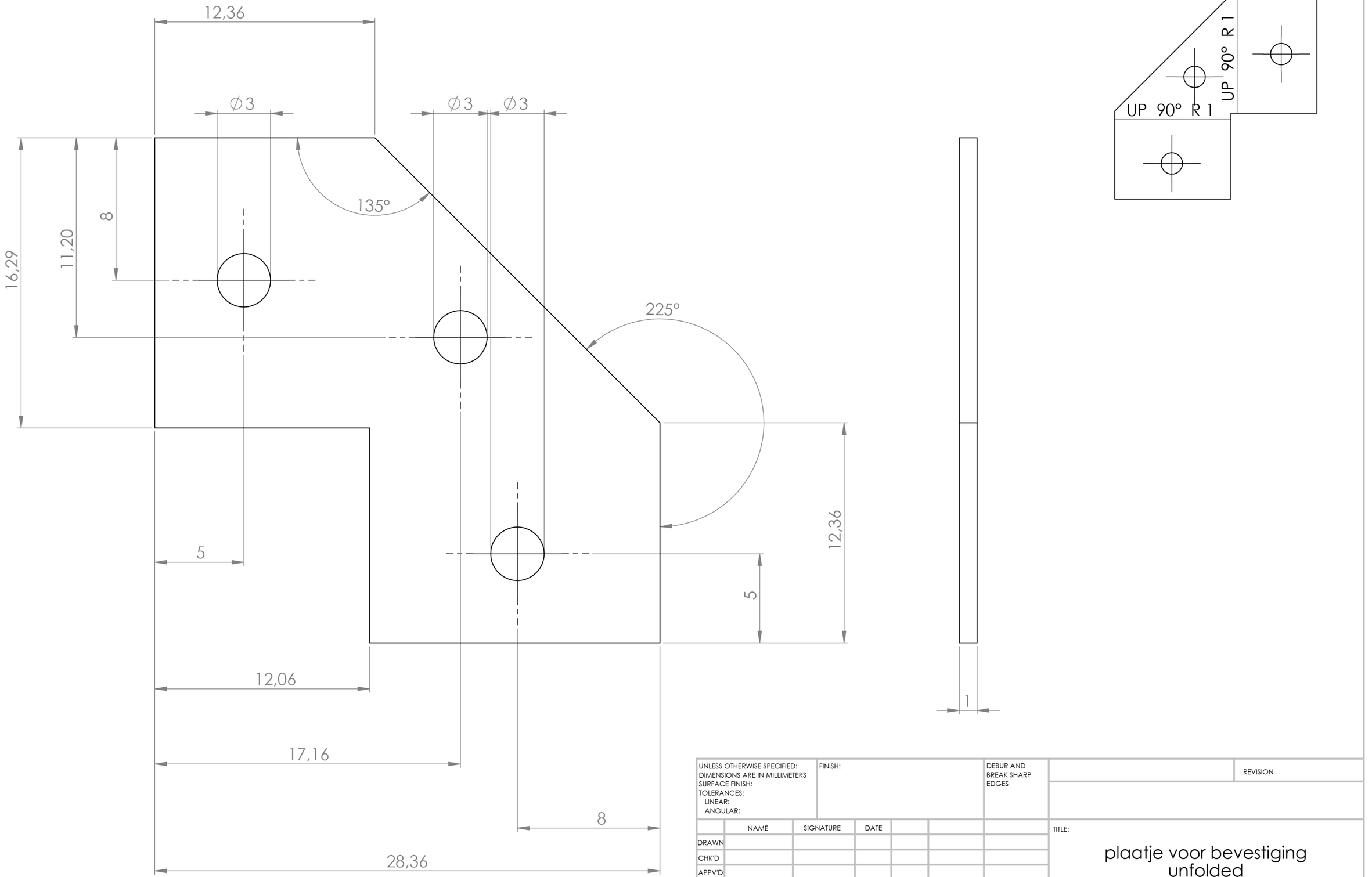

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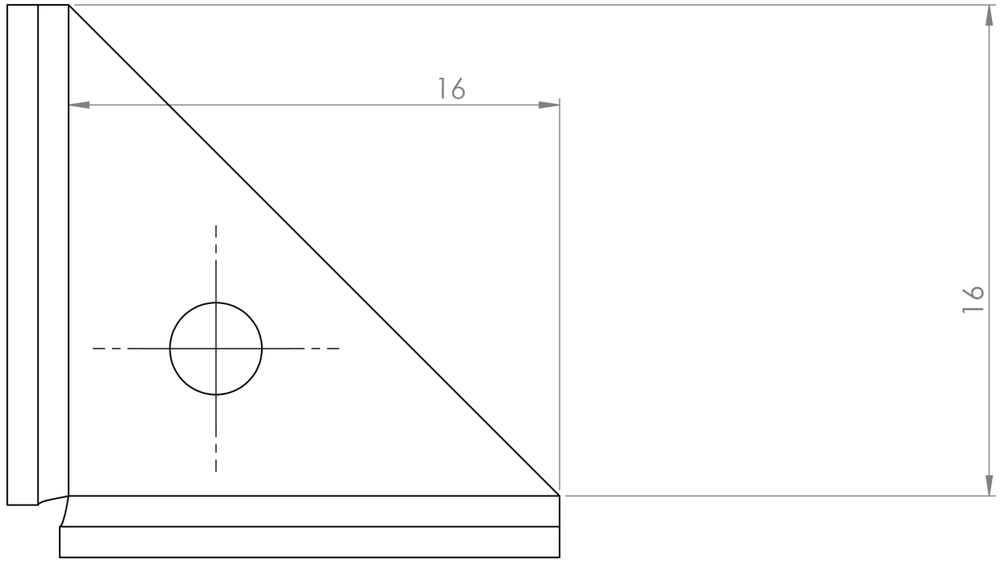

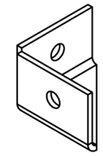

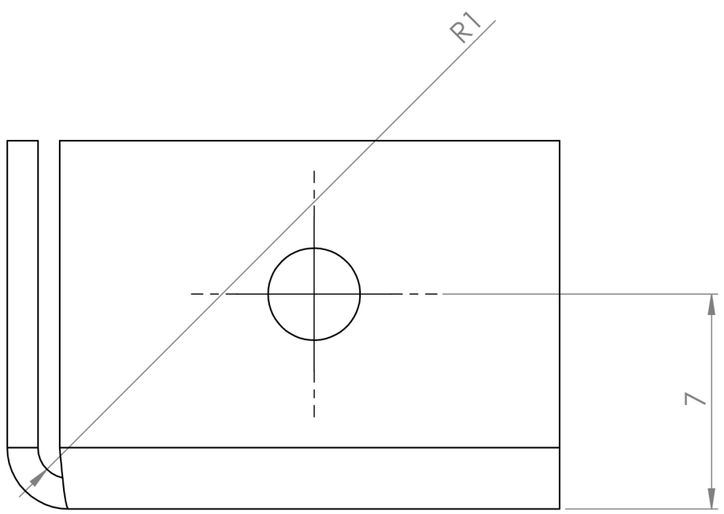

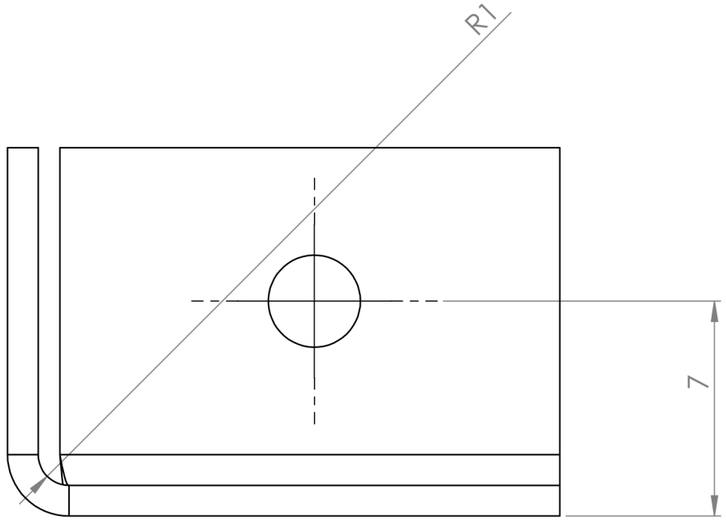

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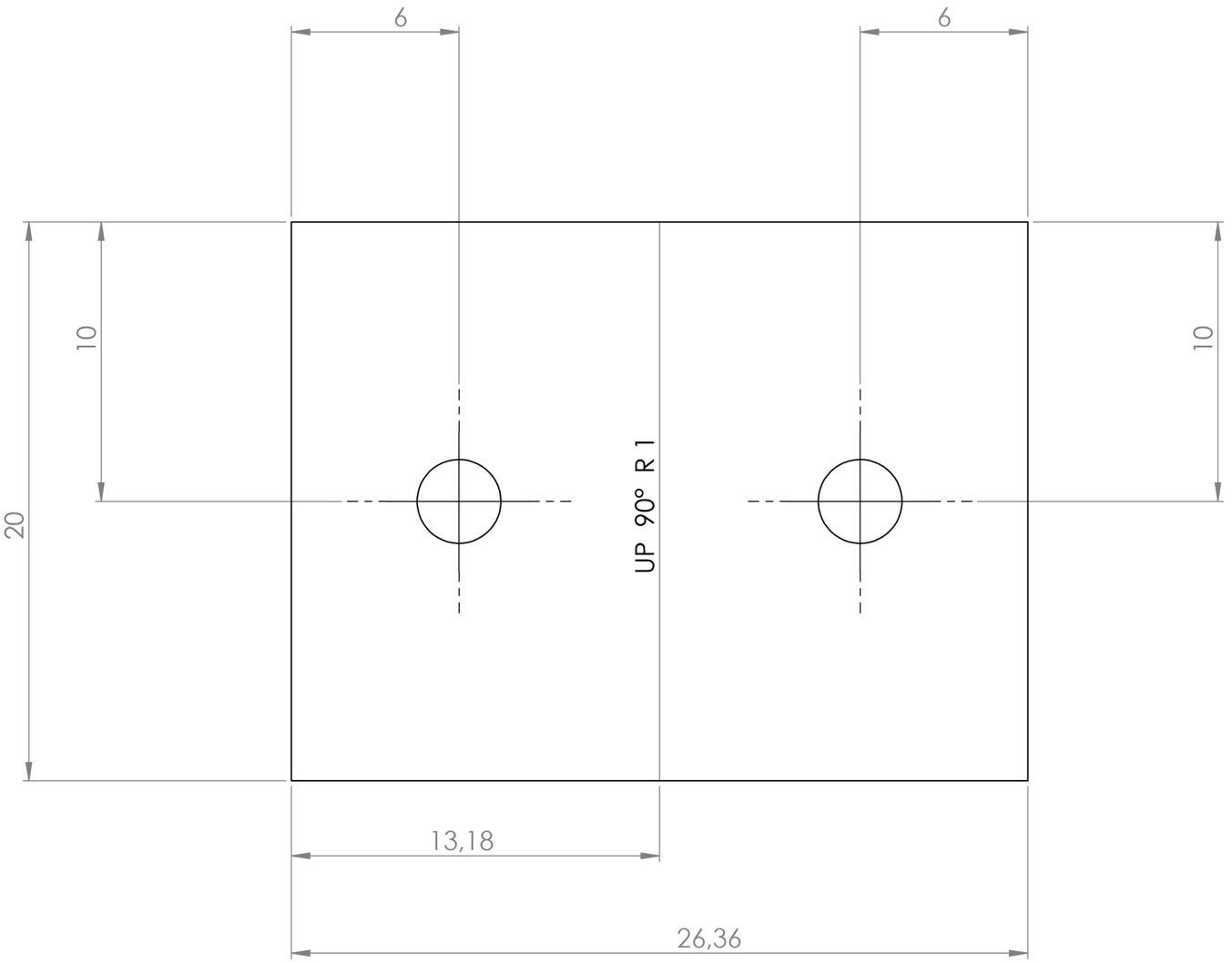

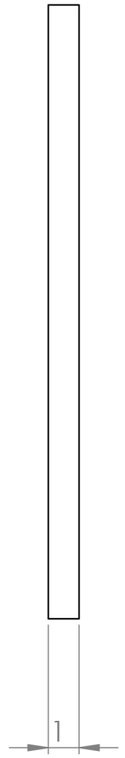

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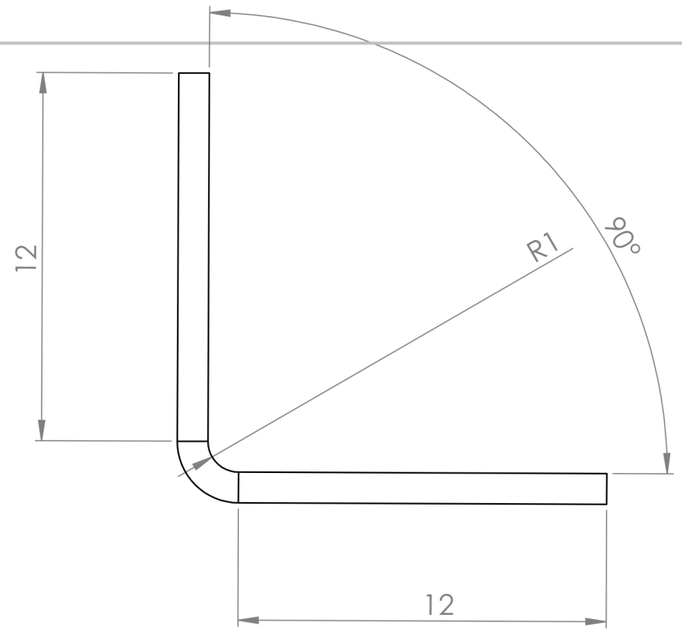

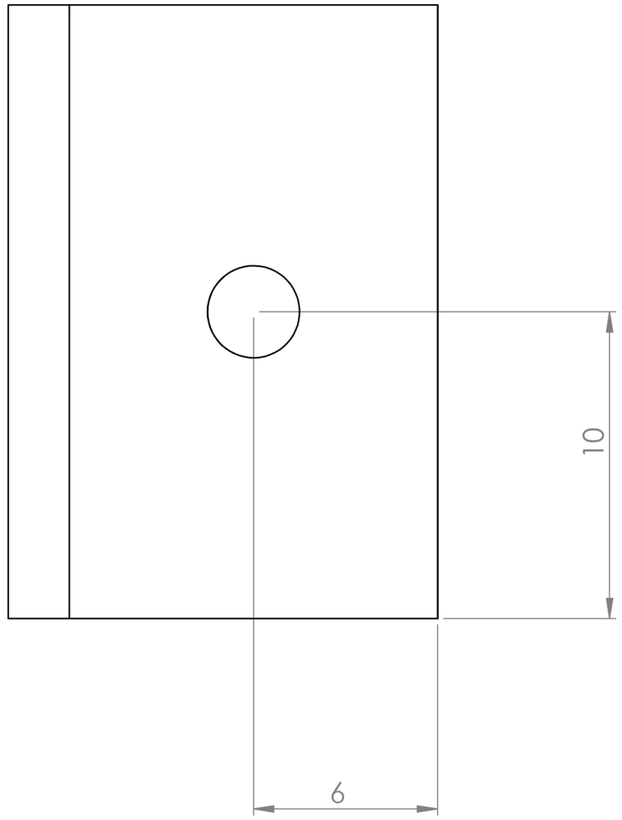

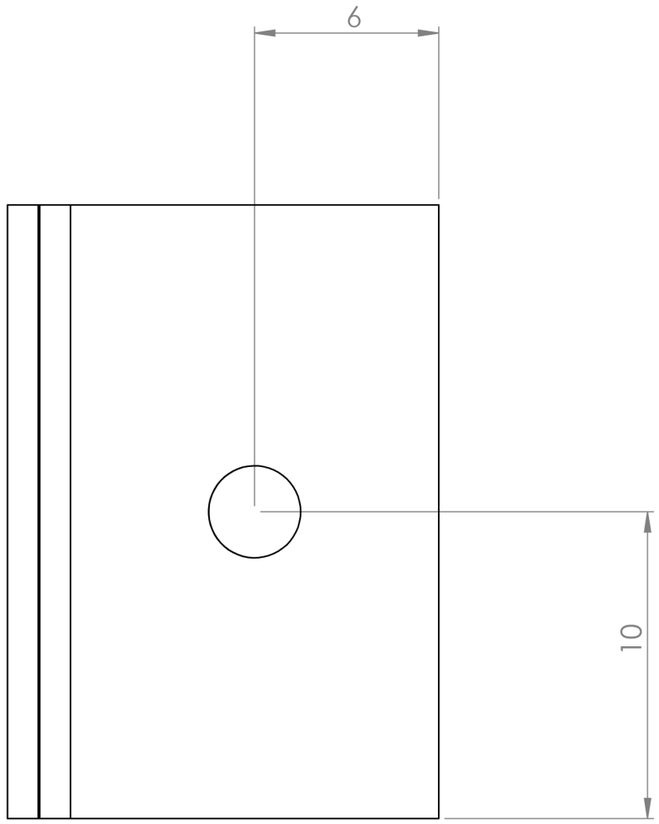

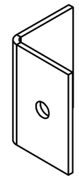

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	NAME	SIGNATURE	DATE				TITLE: plaatje voor bevestiging2
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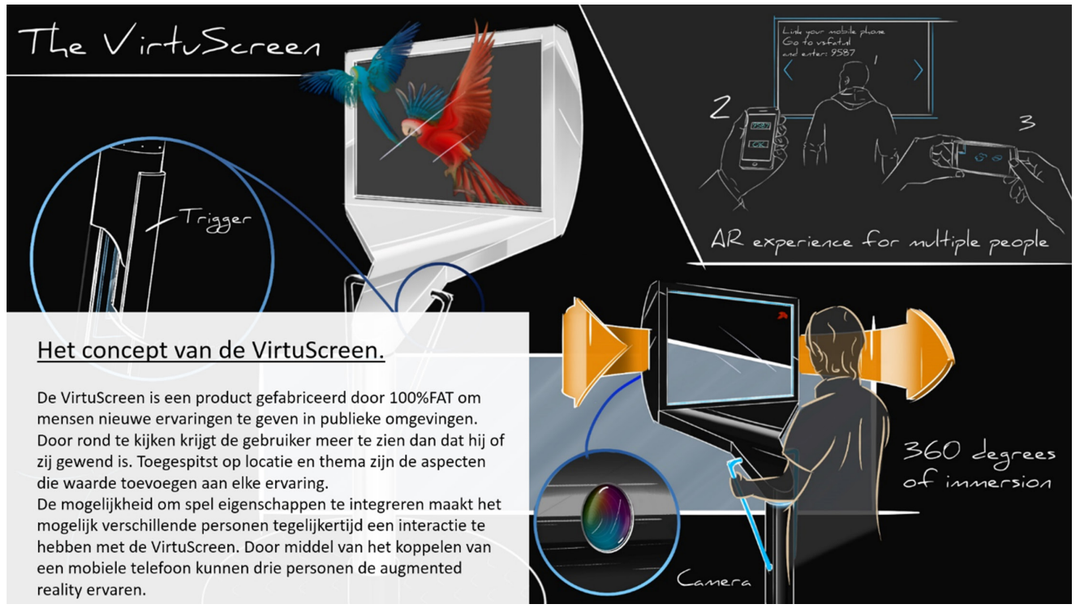
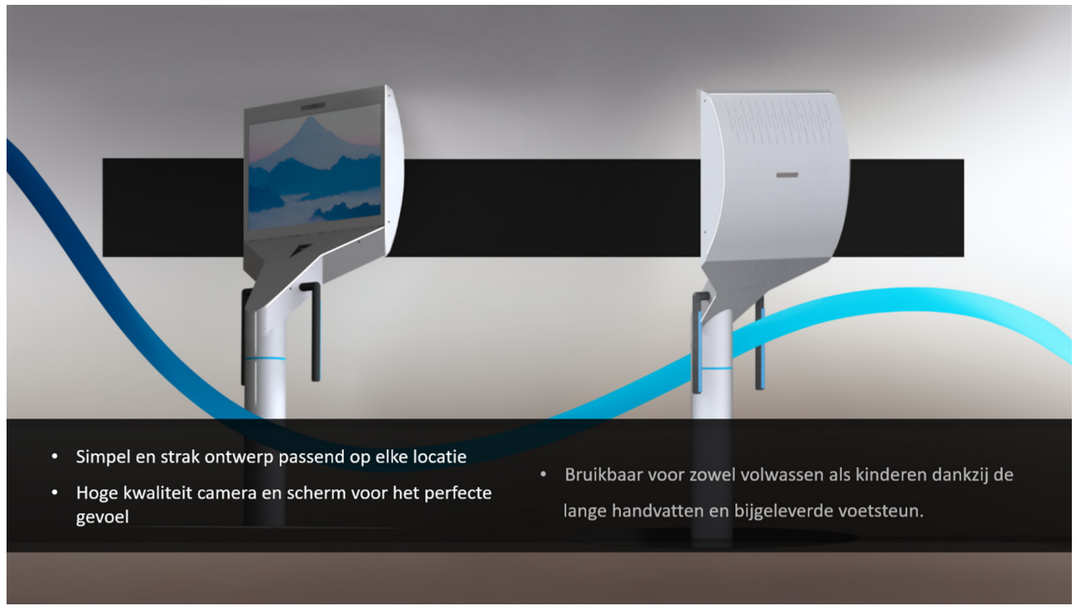
Q.A				MATERIAL:			DWG NO. 20160713-04 A3
				WEIGHT:		SCALE:5:1	SHEET 1 OF 1

A. Appendix

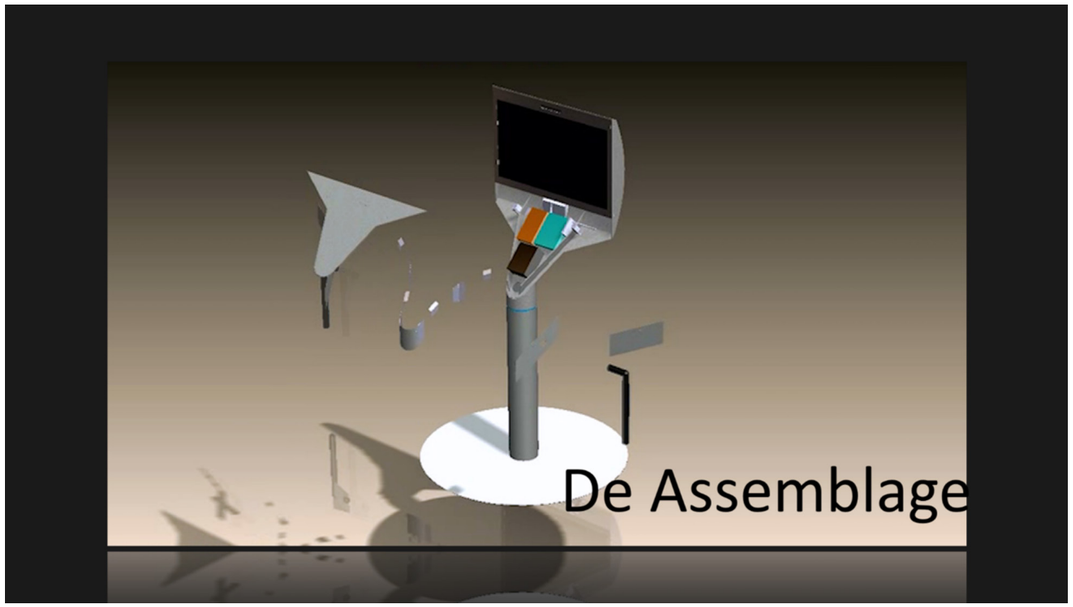
A8 Promotional presentation

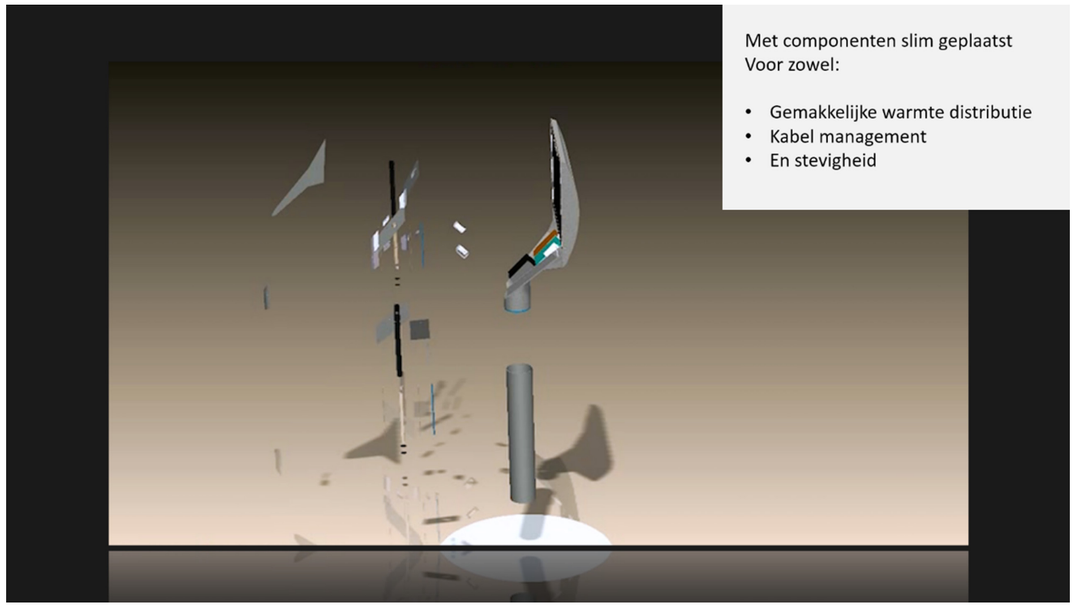
Please note that the actual promotional video uses moving pictures

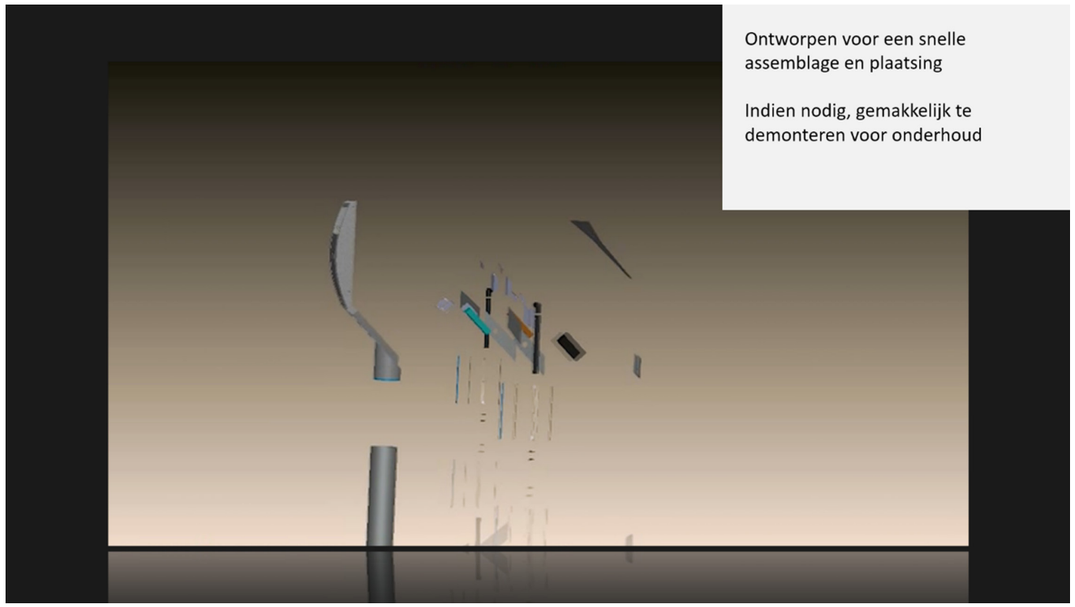


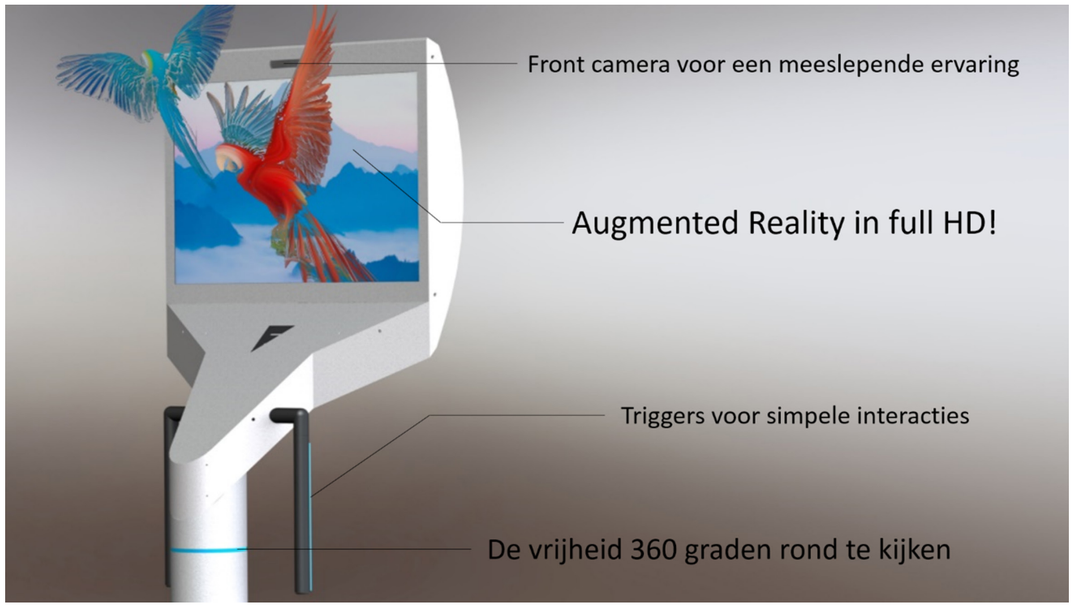


A. Appendix


De Assemblage


Met componenten slim geplaatst
Voor zowel:
• Gemakkelijke warmte distributie
• Kabel management
• En stevigheid


Ontworpen voor een snelle assemblage en plaatsing
Indien nodig, gemakkelijk te demonteren voor onderhoud


Front camera voor een meeslepende ervaring
Augmented Reality in full HD!
Triggers voor simpele interacties
De vrijheid 360 graden rond te kijken

B. Annex

B1 Resume in dutch

Tijdens dit verslag lag de focus op het ontwerpen van de VirtuScreen voor 100%FAT. 100%FAT is een bedrijf dat ideeën van anderen realiseert. Ze bieden concepten aan en realiseren deze om hun klanten tevreden te stellen. Wegens het gebrek aan tijd is het niet mogelijk voor 100%FAT om aan hun eigen ideeën te werken. Eén van deze ideeën is de VirtuScreen. De VirtuScreen zal de opvolger zijn van de VirtuScope (een product dat al eerder gerealiseerd is door 100%FAT).

De VirtuScope is een soort van verrekijker waarmee de gebruiker in staat gesteld word Augmented Reality te zien. Het laat de persoon objecten en beelden die zien die op het moment niet zichtbaar of aanwezig zijn. Dit varieert van rondlopende dinosauriërs in musea tot het veranderen van de gehele realiteit waardoor bijvoorbeeld een omgeving van 100 jaar geleden zichtbaar is. Echter is de VirtuScope niet optimaal. De VirtuScope schiet tekort op het gebied van gebruiksvriendelijkheid en bruikbaarheid voor meerder personen. Dit zorgt er dan ook voor dat mensen snel hun interesse verliezen wanneer ze de VirtuScope gebruiken.

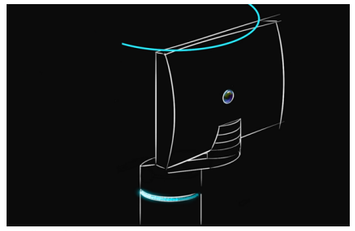
Dit is waarom de onderzoeksvraag voor dit verslag het volgende is:
Wat voor ontwerp voor de VirtuScreen is in staat een Augmented Reality ervaring te creëren dat interessant is voor meerdere personen, zowel wat betreft het fysieke ontwerp (esthetica en ergonomie) als de ervaring zelf? Waarbij het concept van de VirtuScreen uiteindelijk uitgewerkt zal moeten worden in de vorm van technische tekeningen voor constructie en assemblage.

Om tot een antwoord te komen op deze onderzoeksvraag, moesten een aantal deelvragen eerst beantwoord worden. Deze deelvragen zijn:
- Welke eisen en wensen bestaan voor de VirtuScreen?
- Wat zijn de eigenschappen die geïmplementeerd moeten worden in de VirtuScreen?
- Hoe ziet de markt er uit en welke aspecten zijn belangrijk ten opzichte van de ergonomische maten van gebruikers?
- Welke Concepten vormen een verbetering volgens de bepaalde eisen, wensen, eigenschappen en andere aspecten?
- Hoe zal het technische concept er uit zien in zowel model als technische tekeningen?

Deze vragen zijn beantwoord gedurende een aantal belangrijke stappen. Beginnende met het doen van analyses van de context, wat opgevolgd werd door het houden van brainstorm sessies en schets sessies waarbij gezocht werd naar oplossingen. Uiteindelijk werd er gewerkt aan iteraties van fysieke modellen / prototypes waarmee meer inzicht kon worden verschaft in het concept. De resultaten die volgden vanuit dit proces werden vervolgens gebruikt om een ontwerp te maken waarmee technische tekeningen konden worden vervaardigd. Toevoegende aan dit materiaal, is een promotie video gemaakt dat 100%FAT in staat stelt het concept van de VirtuScreen te verkopen aan potentiele kopers.

Het onderzoek dat gedaan is gedurende dit project resulteerde in eisen en wensen voor het product, waarvan de meest belangrijke de onderstaande aspecten zijn (opmerkende dat sommige van deze eisen ontstonden tijdens het testen van de prototypes en tijdens het maken van de schetsen en concepttekeningen):

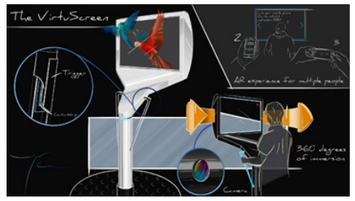
- Op zijn minst drie mensen moeten goed zicht hebben op de VirtuScreen.
- Het product moet interesse wekken bij potentiele gebruikers.
- De draaisnelheid mag niet sneller zijn dan 1 km/u.
- Lange trekkers zijn nodig voor een goede interactie.
- Scherm grootte ligt rond de 45 inch.
- De hoogte van het scherm, ten opzichte van de grond en gemeten vanaf het middelpunt van het scherm, ligt rond de 160 a 150 cm.
- De horizontale afstand tussen het scherm en het middelpunt van de paal ligt rond de 36 cm.



Afbeelding 0.1: Gekozen concept idee

Het gedane onderzoek resulteerde ook in een aantal eigenschappen die geïmplementeerd konden worden in de VirtuScreen. Door gebruik te maken van een morfologisch schema, werden vier concept ideeën gemaakt. Deze ideeën werden samen met 100%FAT geëvalueerd om vervolgens een richting te kiezen voor het uiteindelijke ontwerp. Hier werd gekozen voor het “simpele” idee dat gebruik maakte van een scherm gemonteerd op een paal (Afbeelding 0.1).

Het antwoord op de onderzoeksvraag kwam dichter bij, wat betekende dat onderzoek gedaan moest worden naar de ergonomie van de doelgroep. Een lijst met maten waar de VirtuScreen aan moest voldoen werd gemaakt met behulp van DINED. Deze lijst werd later gebruikt om het 3D model te evalueren.



Afbeelding 0.2: De concept tekening (Bijlage A5)

Door gebruik te maken van tekeningen, brainstorm sessies en iteraties van prototypes, kon een visueel ontwerp vervaardigd worden. Dit ontwerp maakte het mogelijk om samen met 100%FAT een richting te kiezen voor het uiterlijk van de VirtuScreen. Afbeelding 0.2 laat zien dat de VirtuScreen verscheidene aspecten bevat. Deze aspecten zijn: Lange trekkers; een bijkomend voetstuk voor kinderen; een remsysteem; een effect dat net zo werkt als het kijken door een raam; een scherm dat geplaatst is op de lange zijde en de mogelijkheid voor secundaire gebruikers om hun mobiele telefoon te koppelen aan het product. Tezamen creëerde dit een ervaring voor meerdere personen doormiddel van het grote scherm en de functionaliteit om mobiele telefoons te koppelen aan het apparaat.

Het concept (zowel uiterlijk als gebruik) van de VirtuScreen was duidelijk, wat betekende dat een 3D model kon worden gemaakt om vervolgens technische tekeningen van te maken. Dit model hield rekening met verschillende belangrijke aspecten als: ruimte beheer, kabel beheer en constructie. Vijfendertig technische tekeningen zijn gemaakt om te kunnen laten zien hoe de meest belangrijke producten gefabriceerd en geassembleerd moeten worden. Deze technische tekeningen zijn te vinden in Bijlage A7.

Ondanks het feit dat alle deelvragen beantwoord waren, leek het een goed idee om een promotie video / presentatie te maken voor 100%FAT. Deze video kan gebruikt worden om de VirtuScreen te presenteren aan een potentiele koper. De video beschrijft het product en zijn unieke verkoop punten op een interessante wijze, om vervolgens de klant te overtuigen de VirtuScreen te kopen.

B. Annex

Concluderend op wat hiervoor benoemd staat, kan er gezegd worden dat er een VirtuScreen is ontworpen dat voldoet aan de eisen van 100%FAT. De ontworpen VirtuScreen is in staat op verschillende manieren een interessante interactie (gebruik makende van Augmented Reality) aan te gaan met verscheidene personen. De VirtuScreen heeft veel potentie betreft het worden van een leuk en interessant product dat nieuwe ervaringen kan bieden voor zijn gebruikers.

Echter is het wel aan te raden voor 100%FAT om naar de volgende punten te kijken in de toekomst:
- De implementatie van het raam effect (een effect dat een meeslepende ervaring kan bieden).
- De technische tekeningen om indien mogelijk deze te optimaliseren waar nodig.
- Het gebruik van de handvaten met lange trekkers.
- De bevestiging tussen het draaimechanisme dat gebruik maakt van het remsysteem en het bovenste gedeelte van de VirtuScreen.

Reflection Rest

Introduction

These days the world of virtual reality is growing significantly. Due to the fact innovative applications are being made for mobile phones more and more people start to get a feeling for the virtual world. But not only mobile phones are products which use virtual reality. Products like google glass made by GOOGLE and the HoloLens (Microsoft, n.d.) made by Microsoft use virtual reality placed in the real world which is called “augmented reality”. Using a product which uses augmented reality makes users see objects which are not currently there. It is both intriguing and mysterious to be able to look around in the world you know while seeing things you did not expect.

During this essay the VirtuScreen will be reflected on. The VirtuScreen is a product which enables users to see the world around them, but with an extra layer of augmented reality on top of it. Being able to look around 360 degrees it gives the user the freedom to look at anything he or she wants to look at. While most products are static or show objects which are not fitting to the environment, the VirtuScreen shows events and images of things which belong to the area the product is standing in. This way creating an immersive experience for the user. Adding to this, the possibility for other people to link their mobile phones and get the same experience while looking on the screen of their phone.

Since the users look at the “alternated” world through the VirtuScreen, the mediation theory will be used as a framework to reflect on the product. Because the product mediates between the user and the world.

“in many cases the relation between humans and technologies is in fact part of a larger relation, between human beings and their world, in which technologies play a mediating role. What is being designed, then, is not a thing but a human-world relation in which practices and experiences take shape.”

The sentence seen above is what Verbeek (2015) said about the user and the product. This exactly describes what the VirtuScreen embodies. What has been designed during the bachelor assignment (the

VirtuScreen) is not just an object but the relation between the human and the world. Where the human practices certain actions to experience new intriguing and mysterious things.
In order to reflect upon the VirtuScreen, the research question for this report will be:
Is the mediation which arises when looking around with the VirtuScreen desirable according to the requirements of the company?

This question will be answered in two steps. In the first part of this report, the VirtuScreen will be analysed in order to find the mediation which is present when users look around in the augmented reality world. In the second part of this report, the mediation will be evaluated according to the requirements 100%FAT, the company for which the VirtuScreen has been designed, wanted the VirtuScreen to meet. Since there are several different mediations existing between the VirtuScreen and the user, this report will focus on the experience created while looking around an area where augmented reality is in effect.

Analysis

According to Verbeek (2015) there are several lines which are helpful while studying the mediating role of a product. During this report those lines will be used to reflect on the VirtuScreen. Those lines are:
- types of relations
- points of application
- types of influence

Type of relation
The VirtuScreen is an object with which the user is able to look at the world. When the user turns it, together they monitor the different aspects of the environment. Looking through the product as it where a window while turning around its centre together the user becomes one with it. As schematized by Ihde (1990, referenced in Verbeek, 2015) “(human - technology) -> world” the relation could be categorized as an embodiment relation. However, the relation that arises during this interaction could also be seen as the alterity relation “Human -> technology(world)”. This due to the fact the turning interaction exists between the user and the product with the world in the background.

Beside these relations, the product also represents the world in a certain way. By adding a layer of virtual reality the user sees the world in a different way. Instead of seeing things the user would expect, the VirtuScreen shows images of the area from a different period of time (for example how a city centre looked a hundred years ago) or it could show different objects than the objects which should be in that location. This way giving a new perspective / representation of the environment. Which according to Ihde (1990, referenced in Verbeek, 2015) is schematized as “human -> (technology - world)”. Which is a hermeneutic relation.

Giving both an experience of the world and a representation means this product is in a whole different league than products which would be categorized as a hermeneutic or an embodiment relation. Concluding to these arguments the most abundant relation is to be categorized as an augmentation relation. Which according to Verbeek (2015) is a combination of the embodiment relation and the hermeneutic relation.

B. Annex

Point of contact
According to Dorrestijn (n.d.) there are 4 types of contact: “above the head, before the eye, to the hand and behind the back”. The VirtuScreen has several aspects that each have a different point of contact. Since this report focusses on the experience created while looking around an area where augmented reality is in effect, only the point of contact belonging to this aspect will be analysed.

Even though there will be aspects in the GUI (Graphical User Interface) trying to persuade (before the eye) the user to look at certain angles, the act of turning the screen around to look around is a guided gesture (before the eye). Without much thought users are able to recognize the fact the product is able to turn 360 degrees. Standing in front of it taking the handles the user immediately knows how to operate it. Feeling the product is able to turn makes the user want to move it in all directions. Combining this with what is seen on screen the product makes the user curious on what can be seen. However, it is still the users choice to interact with the product the way they want to interact with it. (Norman, 1988) The handles and design show the users what possibilities are available to use the product. According to Norman these action possibilities are called affordances, which help people to recognize how to use a product. These affordances could be seen as guidelines which do leave space for the user to decide how to take them up.

Types of influence
The types of influence are mapped in a 2D space by Tromp et al. (2011). A diagram can be seen in figure 1. The dimensions imply the force and visibility of the influence the product has on the user. Placing the VirtuScreen in this diagram would clarify what kind of influence the product has on its users.

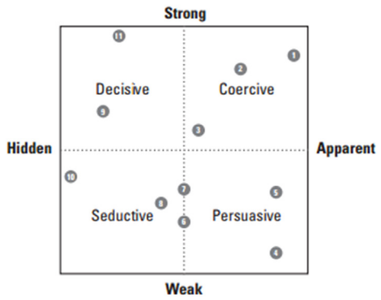


Figure 1: types of influence mapped in 2D space

As said before the VirtuScreen guides the user in a not to apparent way. There are no arrows on screen which tell where to look. The animations shown on screen and the handles which invite people to hold the product subtly tell the user to look around, making them curious on what could be behind them.

The way these nudges are given to the user are not that strong as well. The user is not obligated to look around. The product stands on a location to give people new experiences not to force people and change their behaviour. The user gets the freedom to look around and make his own choices if he or she wants to.

Evaluation

The three dimensions analysed in the analysis describe the mediation of the VirtuScreen. The augmentation relation which exists between human and product guides the user to look around in a subtle way giving the user his or her freedom to look wherever her or she wants to. In order to evaluate this mediation the requirements of 100%FAT will be used, since it is not able to evaluate a product with only the framework of mediation.

100%FAT had many requirements for the VirtuScreen, however only a few of them refer to the experience while looking around.

- The VirtuScreen must communicate to the user how it moves.
- The interaction is to be “smooth” (not apparent) without blinding users of what to do.
- The experience should be interesting and not bore the user.
- The VirtuScreen is to be a product which shows augmented reality

The first two requirements are met with the mediation that arises when there is an interaction, since the VirtuScreen is giving the users nudges on what to do next without being too apparent. These nudges communicate to the user how the VirtuScreen is to be used, while doing this in a smooth seductive kind of manner.

However, even though the VirtuScreen gives the user nudges to look around, they might not be enough to keep the user interested. The nudges like the animations on screen might not be enough for the user to be interested in what is happening behind him or her. Giving more nudges or making them more apparent could solve this problem. However this could have a negative effect on the “smoothness” of the interaction.

Conclusion

The VirtuScreen as it is designed now has many aspects of which the freedom to look around and see new and inspiring things creates new experiences for people. In regard to the requirements mentioned in the evaluation, it can be said that 100%FAT is looking for an augmentation relation between the user and the VirtuScreen where it is important that the VirtuScreen tells the user what the possibilities are in its use. As mentioned in the analysis, the relation which arises between the user and the VirtuScreen is an augmentation relation, which corresponds with the wishes 100%FAT had for it. Requirements like the smoothness of the interaction and the communication about how to use the VirtuScreen are met with the arising mediation between the VirtuScreen and the user thanks to the implemented nudges. Which means the answer for the research question is:

The mediation that arises while looking around is desirable according to these requirements.

However, it is not clear whether or not the experience is interesting enough as it is. Once the product is produced, tests should be done on how apparent the software’s nudges are supposed to be in order to create an experience which is both interesting and “smooth”.

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