TEAM MCFLY

iPole 2014 Design Document

Contents

Contents

Business Summary

The iPole project 2014 was dedicated to the topic “The future of user manuals”. We, the McFly team, took on the task to improve user manuals for Alstom and to help them to speed up their reporting process. For this project, we chose the following mission statement: “The right information at the right time for the right person”. This mission statement guided us through the project and led to the following solutions:

2016 solution:

•Our 2016 solution is based on widely available technologies, namely smart glasses, tablets and cloud computing. This solution supports Alstom in the following aspects:

•The manual provides multimedia content, such as 3D animations, which can be watched on the smart glasses or on the tablet. Moving images are easier to understand than technical descriptions, and they also help to lower language barriers.

•The technicians can add their own notes to the manual and share them with their colleagues.

•By scanning an RFID tag on the machine automatically opens the relevant section in the manual.

•The technician no longer loses time by browsing the manual to find the right section.

•The technician can navigate through the manual by using voice commands (navigation using gestures is also possible).

•The technicians record the measurements for the reporting directly on the tablet. This helps them to save time.

•When recording data for the reports, the system immediately shows the technician if the recorded value is still within the accepted range.
When he encounters a problem he cannot solve with the help of the manual, the technician can all the Support Centre using the glasses. This means that the technician can listen to instructions from the Support Centre agent and has his hands free to carry out the instructions.

Business Summary

2024 solution

Alstom is a very innovative company that always tries to be a step ahead, as we could see for ourselves during our visit to the Alstom factory in Birr. For our 2024 solution, we followed this philosophy and chose the technologies accordingly. The technologies used in our proposed 2024 solution are the Internet of Things (IoT), smart materials and holograms. At the heart of it all is Ally, a small flying robot acting as a personal assistant. We are aware that the chosen technologies still need some development and improvement, but we are convinced that they have a very high potential.

The advantages of this solution are the following:

- IoT automatically notifies the system when a part is broken.

- While the technician takes care of the lock-out and tag-out, Ally prepares the necessary tools. Since these two processes work in parallel, this saves time.

- During the disassembly, Ally can project holograms to show the technicians the different steps.

- Holograms have the advantage that they can be viewed from any angle, i.e. that they are really 3D.

- Ally takes the measurements for the reporting, e.g. by using laser.

- The technician has a smart material sleeve where he can see any data that Ally records. If he thinks something is wrong, he can intervene. It is the technician who signs off the report at the end, so the responsibility lies with him.

- Ally can also issue warnings if the technician is about to do something dangerous, e.g. if he is about to touch a hot part.

- If Ally notices any alternative, more effective processes, she will add them to the manual.

We are convinced that these solutions are a great starting point for Alstom to prove once again that they are an innovative company - not just in terms of their products, but also in terms of their processes.

Our 2016 and 2024 vision videos can be found at: https://www.dropbox.com/sh/mxw0bmrqm1i62ne/AABKvnDet9S2TmpZ6A8Sx6l1a?dl=0

We also have a web based interactive version of our tablet app. This can be found at: http://platzh1rsch.ch/ipole2015/

Physical Kickoff

We all met for the first time at the physical kickoff and began to plan out our project. This section of the document looks at the decisions we have made as a team and how we will work together to tackle this project.

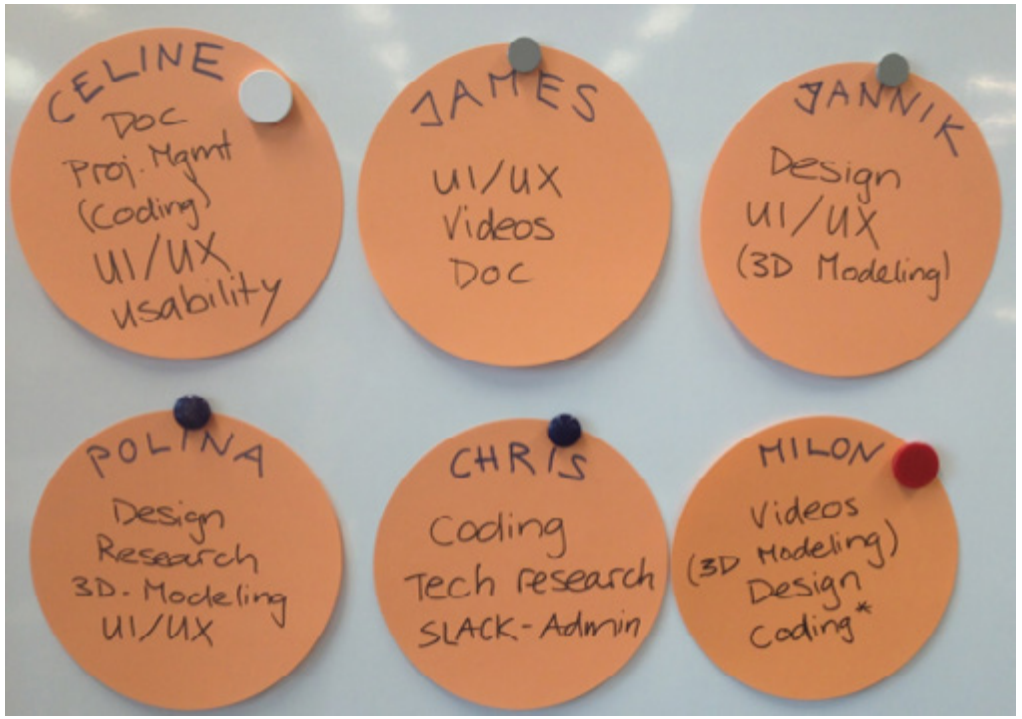
Initial Teamwork

The first thing that we did as a team was to introduce ourselves and talk about our specialties. We were all aware of the face we are all from different backgrounds, on different courses, and also from different countries. Because of this we knew there would be a wide variety of not only skill sets but also design principles.

	UI/UX	Design	Videos	Documentation	Coding	3D Modeling	Research	Usability	Proj. Mgmt
JAMES	X		X	X			x	x	
JANNIK	X	X				(X)			
CHRIS					X		X (Tech)		
POLINA	X	X				X	X		
MILON									
CELINE	X			X	(X)			X	X

We decided to do this activity not only verbally, but also in a more fun way. We each took a piece of card and wrote down our skills. This was the easiest way to get a quick overview of what we all did and therefore who would be best suited to what jobs during the project.

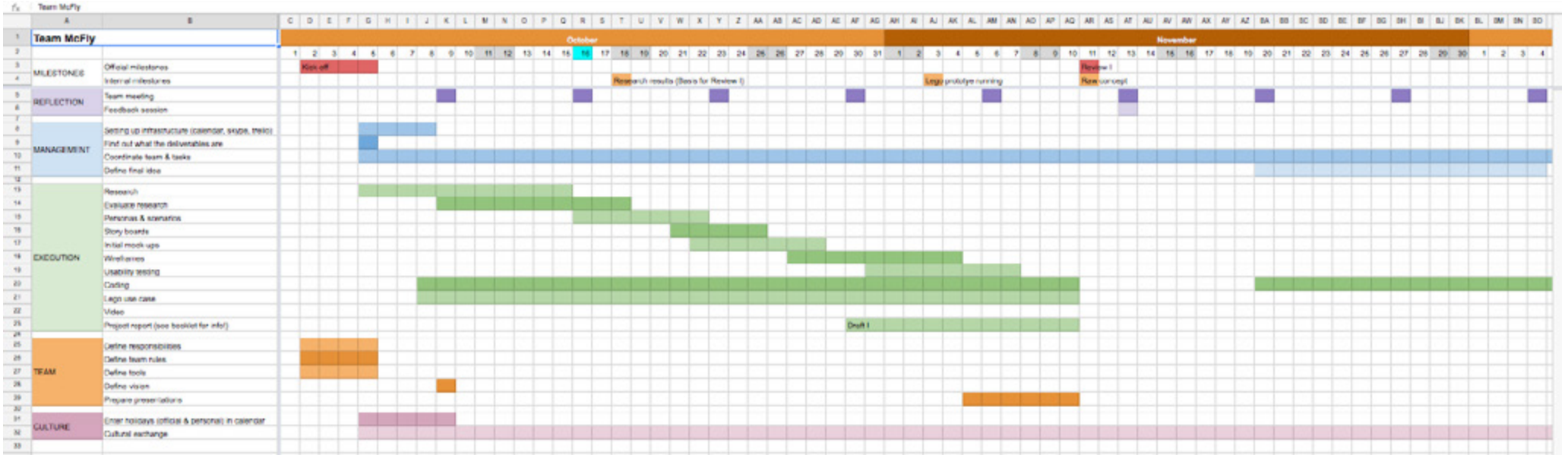
To the right is the outcome of this activity, we also have also displayed our skill sets in a table for better visualisation.



Initial Teamwork

Our next exercise was to figure out as a team what our project time line should look like. This too a lot of time, as we had to figure out what jobs had to be done at what time. This was to make sure we did not fall behind schedule at any point and to make sure we had an overview of what had to be done. We carried out this task by making a large poster and attaching pieces of card to it with the tasks on. We have split up the time line into important sections, marking when the virtual reviews are and what we have to do in the meantime to stay on track.

We have also made a digital copy of this time line for us all to refer to on a regular basis to keep everything running smoothly. This also helped us to determine what had to be completed and what we would present at each peer review.



Team Contact

We spent a lot of time figuring out what would be the best time for us all to hold a video chat. This was an important decision because we all had to be available to talk every week. This was probably the first problem we had encountered as a team, as we are all from different timezones and all have individual commitments that clashed. However we all came up with a plan to meet every Thursday evening at 8pm CET, this was the only time we are all available. We also took this opportunity to note down some general rules for the video calls:

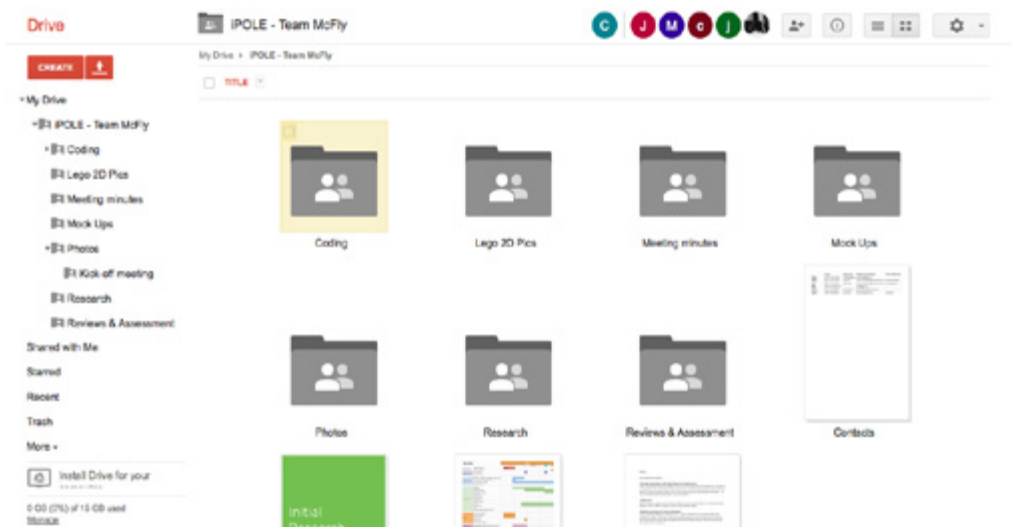
Video conference rules

- Democracy for decision making.
- Don't discuss things for too long. Céline is the moderator and will move the conversation along if a discussion goes on for too long. If Céline is away, Chris is her proxy.
- Only one person talks at a time.
- We use hand signs (e.g. for "like it", "don't like it", "move on", etc.)
- Be ready 5-10 minutes before the call.
- Tell the others if you can't make it.

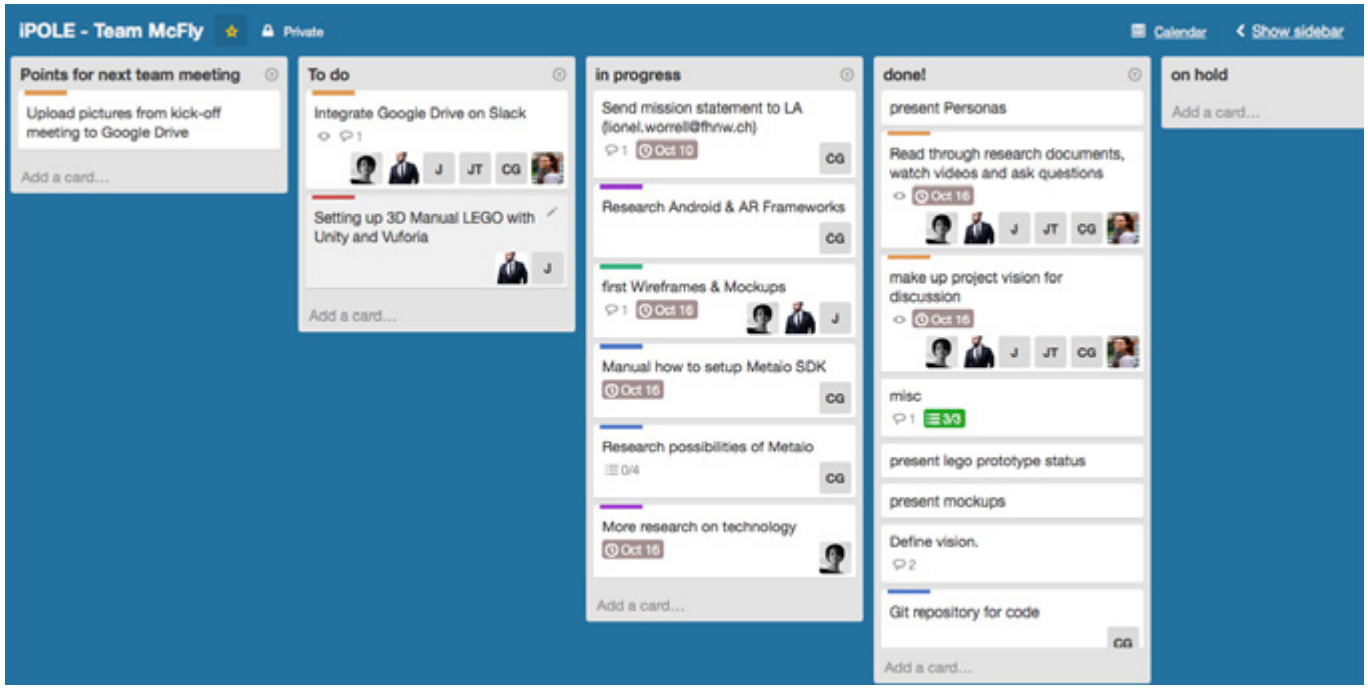
We decided to use Skype to make our video calls, as this seemed to be the easiest option for us all.

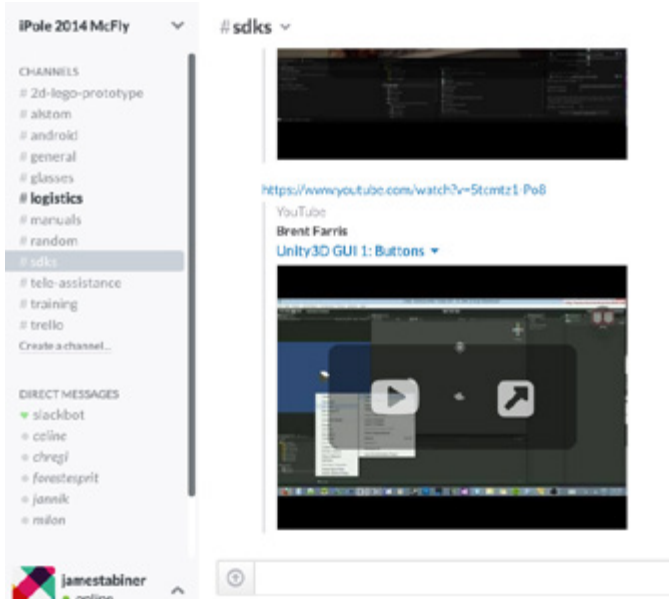
As a team we also took this opportunity to discuss how we would save and share our work. We came to the decision to use a number of programs together to communicate and share our work.

We are primarily using Google Drive to store and upload our work to. This is a great option because it allows us all to edit the same document in real time, so we can discuss things and change them accordingly. We will also keep "meeting minutes" of each video call, documenting what was discussed and the tasks that have to be carried out for the following week.



Team Contact





We are also using Trello as a form of weekly planning. Each time there is a team meeting we delegate tasks and these are put on Trello for everyone to see. This program also lets you see what tasks others are currently working on and what has been completed.

Finally we are also using Slack to tie everything together. Slack allows us all to communicate as a team in the same place. It organizes everything into different sections so two people can converse about UX while other speak separately about the coding. This is a much neater and easier way of working. Slack also allows Google drive integration, so we can upload and view all of our Google documents in this program, again making life much easier and more organised.

Visit to Alstom

We also went on a field trip to learn more about the company Alstom. We all took this opportunity to take personal notes about what they expect and the methods they use. Here are some of the notes that we took:

Process

Permit to work

At Alstom, safety is paramount. That is why for potentially dangerous jobs, they work with so-called "Permits to work". With these permits, they determine the risks for a certain assignment. Alstom wants us to include this "Permit to work" process in our prototype.

There are two types of "Permits to work":
•General Safety Risk Assessment: This is for the safety of the people
•System Safety Risk Assessment: This is for assessing the machine

Lock-out and tag-out system

Furthermore, they work with the "Lock-out and tag-out system". With this system, they can make sure that absolutely nobody will be able to use a part of a system that is under maintenance (and therefore potentially dangerous).
They lock the relevant part of the system and the key to this lock is locked away with the permit to work. Only the operator has the key to the box that contains the key and the permit and he will only open the box once the system has been properly repaired.
In addition to locking the system, they also put a tag on it -
(e.g. "Under maintenance - Do not operate!").

What does Alstom want to achieve?

•They want to replace paper (e.g. the permits and manuals/instructions are still on paper)

•They want to speed up the work (e.g. by using hands-free devices such as Google Glass)

•They want to be able to automatically look up parts (e.g. the smart glasses would automatically recognize the relevant part and display the information for it).

•They want to be able to take pictures and integrate them into the reports.

•They want to be able to multi task (e.g. take a measurement while dictating a report)

•They also consider using AR for training people

•They would love a function that allows them to share information (e.g. "I tried with 50t and with 100t - better go for 120t straight away!") - This would help them to save time

•They are also interesting in analysing the data. (e.g. if they find out that a certain part needs to be replaced frequently, they can look into how they could improve that specific part)

In general, it's all about speeding up processes and being able to work more efficiently. In short: They want to save time and money (and paper).

Visit to Alstom

Replacing vs. repairing

Replacing a part can be much cheaper than replacing it, because it is much faster. Alstom pays up to 100.000 Euros a day if the plant has to be taken off the grid.

Different types of inspections

At Alstom, there are different types of inspections:

Type	Description	Duration
A inspections	Inspections using a boroscope	2-3 days
B inspections		3-4 days
C inspections	Big inspections, everything needs to be replaced	longer

Cranes

Cranes are mostly remote-controlled, i.e. the crane driver can be standing next to the technician.

WiFi

Offices have WiFi; around the machines, WiFi is not often available

There are many unexpected cases. If something unexpected happens, they call the designer/engineer or the Plant Support Center who then helps them. They send e-mails/pictures to communicate the problem. They usually need to go back the office to send the picture.

It would be cool if the designer at the other end of the line could be talking to the engineer directly, i.e. while he is still standing next to the machine so they can tell him to move around the machine so they can see it from the angle they need.

Data centralisation

Data sheet findings are not (yet) centralised (i.e. they cannot be analysed at the moment).

Language

For many technicians, English is not their first language. This is where visuals can help.

EHS

Environmental Health and Safety is an issue (e.g. will people have headaches from wearing the glasses all the time? Will they have deformed ears because the glasses are so heavy?

Knowledge & experience

Loss of knowledge and experience is a big problem for Alstom. Before, people worked for the same company for 30 years, now they change after 5 years. Also, the new technologies makes people more lazy (they no longer have to learn everything, because the information is available and there when they need it).

Knowledge can be stored in a manual, experience cannot.

Processes

Processes are important in a company that big. But sometimes it would also be nice to have some more freedom (e.g. not everyone approaches the same task the same way).

Velocity

Finding the problem fast is important. If it takes too long, the customer loses patience and Alstom loses money (100,000 Euros/day).

Visit to Alstom

Use case for Google Glass

They have tried Google Glass. The use case is as follows: The on-site technician wears Google Glass and uses this device to communicate with the Plant Support Center in Switzerland. The engineer in the Plant Support Center then helps the on-site technician to find/solve the problem.

Predictive maintenance

Alstom is looking into predictive maintenance. For that, they use a system called CMMS (Computer-Managed Maintenance System). The reporting goes into the CMMS. But: The CMMS is only as good as the information that it is being fed.
For big contracts, Alstom installs a system on-site (they can access the systems from Switzerland).

Real-time monitoring

They use real-time monitoring on site already. So if for example there is a lot of vibration, the system issues a warning and if it is not fixed in time, it will automatically shut down.

Acoustic monitoring

Alstom works with ETH on acoustic monitoring. For that, they measure the acoustics. They then compare the sound from day 1 with the sounds from day 2. If it sounds very different, they know that something is wrong. They want to use that acoustic monitoring for the steam valve we work on

These are all important points that we will have to take note of when designing our interface for Alstom.

Project Research

Each team member took on a research topic to look at. We all then presented our findings in the form of a short presentation to the other members. The following pages include the research that was undertaken.

Observations - what manuals are like now

A picture says more than 1000 words
Pictures/screenshot help a lot. They provide context. However, it is also a lot of work to always get the latest screenshot's/graphics, especially if the manual is available in various languages.

Language

The manual must be appropriate for the audience. Example:
*"In patients with severe COPD receiving inhaled glucocorticoids and two classes of long-acting bronchodilators, glucocorticoid withdrawal was non-inferior to continuation with respect to exacerbations but was associated with a slight worsening in lung function and symptoms."*A medical doctor might understand this without any problems, but for the average person, this is not clear. It is very similar with manuals: A very technical description might be fine for someone who has been with the company for 10 years or so, but a newbie might have problems understanding it all.

Clear sentences

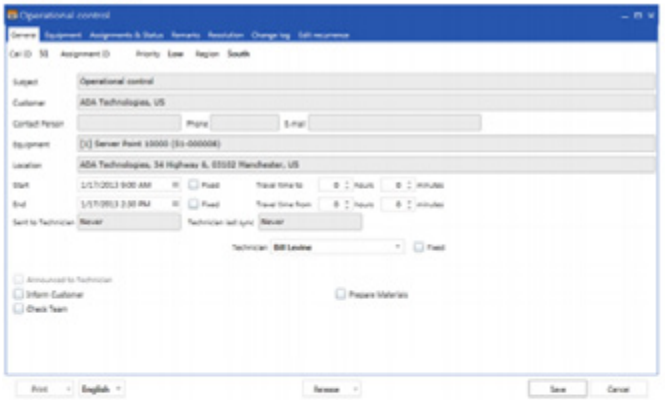
Often, the language used is not clear. For example, many sentences are written in the passive, which leads to problems. One example: "The stem is then inserted into the valve" - Problem: Does it happen automatically or does it mean that I have to insert the stem into the valve?

The manual must be structured in a way that makes sense. There are different ways to do this, for example:

- The manual describes the most important workflows that the software can cover. It then puts the focus on the workflow and guides the user through it. The aim of these manuals is to show the user how something works, so he can then do it himself afterwards.

- The manual describes all the functions of the interface, starting on the left then going to the right (see example below). These manuals are used more for reference.

2.3.2.1.1 General



Call ID	This is the service call code from the ERP system.
Assignment ID	This is the ID of the assignment.
Priority	This indicates the priority of the assignment.
Region	This is the geographical region to which the service call applies.
Subject	This is the short description of the assignment.
Customer	This is the name of the customer.
Contact Person	This is the name of the contact person.
Phone	This is the phone number of the contact person.
E-mail	This is the e-mail address of the contact person.

User Manuals

Finding what you are looking for

In paper manuals, it can be hard to find the information you are looking for. You either rely on the Table of Contents or you browse through the manual, hoping you will find whatever you are looking for.
Digital manuals have the advantage that you can search for a certain term in them, so this is already a big step forward.

Relevant for the project

Provide the right information for the right user at the right time.
During the kick-off “the right information at the right time” was a big topic. I also think that this is the way to go: the required information should be prompted when I need it; I should not have to search for it.
“The right information” is a vague term though. I think “the right information” is not the same for everyone. In a given situation, someone like Walter Umbricht, who has been working for the company for 30 years, will not need the same information as someone who has just finished their apprenticeship. That is why I have added “for the right user” to the above statement.

Amount of information

The amount of information should be just right - not too little, but not too much either. Just give me what I need to solve the task at hand. Don’t give me any background information on the machine I’m working at if that doesn’t help me with the task.

Intelligent manuals

As outlined above, digital manuals have already made things easier.
In a next step, user manuals should be more intelligent, more proactive. Until now, the user has to look for something, and he also has to know what the thing is called that he is looking for (if I looked at that steam valve, I wouldn’t even know what to search for, because I’d have no idea what the different parts were called). Intelligent manuals should do this work for him. That means they should provide the necessary information automatically.

Distraction

What we should also look out for is that the manual itself does not distract the technician from the task at hand. It should be there, but it should be unobtrusive.

Global workforce

We should bear in mind that Alstom has power plants all over the world. Therefore, there will be lots of people whose mother tongue is not the one that is spoken on site.
Maybe the manual will be available in all kinds of languages, maybe it will only be in English because it’s company language - we could maybe contact Alstom to find out more about that.
In any case, the language used in the manual should be simple and clear (no complicated sentences, etc.). Pictures/videos can also help bridging the language gap.

Alstom Workflow

We wanted to understand the process fully that Alstom wants us to use technology for. We looked deeper into what they actually do and the various steps that are taken during the maintenance of a steam valve.

The 3 main sections are:

- Permit to work process
- Work preparation, disassembly / reassembly instruction / inspection
- Reporting

1. Permit to work process

- Work order
Define the work scope & methods

- General Safety Risk Assessment (based on work scope / methods)
Identify risk & define the control measure

- Application to work for system safety risk consideration

- System Safety Risk Assessment (SSRA)
Identify the system hazards & define the control measures

- Isolate System & issue the safety document (based on SSRA result)
System hazards controlled & equipment released for work.

2. Work preparation

- Carry out the work
Execute the work with general safety implemented

- Clearance on completion
System normalized & equipment returned to service

3. Reporting

- Operating data for the part (valve, critical parts)

- Measurements need to be logged

- Pictures are required to show the condition

- Assessments of the parts for further use

- What needs to be replaced based on the condition & what are the replacement parts (identification)

- Are there things that need to be repaired?

- Test results

- Safety at work

- New ideas to make work easier / safer

Smart Glasses Design Principles

We also researched into what we should produce, what our smart glasses application would incorporate and also how it should ultimately be designed. We came up with the following points to define our goal:

Less is More

This is an common seen design principle.
Its easy to add information, but much harder to take them away. Because it requires a true understanding of the user.
It is more important to create a minimalist and usable interface than a flashy
Iron Man-like interface.
Keep it simple: don't confuse the user with too many functions.

People don't like change

If we want to create a usable app, we need to begin to analyse the way people already act and use other devices. If the design is common with something the user already know, it could help them to understand the application.

The two design layers

On the one hand we have the more fixed-layer(2D-head-up display), which is more readable for information. (Straight lines, high contrast to the real world).
On the other hand we have the layer that is more connected to the real world(3D-real-world), which could be more useful to navigate and interact with the application. (Rounded look)

Focus on the Glasses

"People will use smart glasses for a reason. We needed to design a completely hands-free user experience. After all, if you need to swipe and tap with your fingers to interact with your glasses, you might as well use a smart phone or a tablet."

Design for different environments

Transparent displays have a special design challenge, you don't know what is going to be behind them. Some users will be in a sun-filled workplace while others will be in a dark environment.
So the user interface need always a high contrast between the environment.

Sources:

http://www.apx-labs.com/design-principles-for-smart-glasses/

Current Technologies

We looked at what technology was available now for us to work with, we know that we have top create a prototype for 2016 so we looked into what the cutting edge of technology has to offer and how we can implement these technologies into our design.

Epson Glasses

We took a look at the epson glasses website — (http://www.epson.com/cgi-bin/Store/jsp/Landing/moverio-bt-200-smart-glasses.do) to have a look into what they are actually capable of. We have to know what these glasses can do and the technology that will work with them before we can begin to design for them.

- We found that we can use a bluetooth mouse and keyboard with Epson glasses, this could be a possible alternative instead of the small touch pad that is currently attached to the device.
- If you watch a video for a long time the touch pad will warm up and you can`t use it, this is not good from a usability point of view, however if we use a mouse, this should be ok.
- Epson glasses is fine for augmented reality, however not so much for virtual reality. This is because there is only a small portion of the glasses that is used to show information. There is only a small square in the centre of the users vision that is a straight mirror of the users computer screen in real time. This is not a fully immerse experience and the location of the information can sometimes obstruct the users field of view.
- We discovered that it is possible to use an accelerometer (+90° / - 90°) with the glasses. This could be used for navigation issues.
- The glasses use and SD card 64 GB in NTFS format.
- And also that BT-200 can handle 2D and 3D graphics

We also looked at a few articles relating to these technologies:

- http://www.slashgear.com/forget-glass-inside-epsons-scheme-to-be-the-de-facto-smart-glasses-firm-08315882/
- http://www.slashgear.com/epson-moverio-bt-200-review-smashing-glass-23334807/

We have all tested the glasses and came to some of the following conclusions:

- They are low resolution, which is not preferable with todays technology available.
- The glasses are Clunky and quite heavy (you cannot wear them all day) Ideally, they would just be safety glasses with additional functionalities.
- The battery does not last long.
- Control using the manual remote is awkward.
- Wearing the glasses for a long time might make you feel dizzy.
- The camera is currently located at the bottom left. Moving the camera to the middle would have the advantage that the recorded image would not be offset so much from the user's actual view. Another thing that would help, is if the app would not show the image provided by the camera, but only the AR object, but then try to place it correctly. Instead of the camera image, there could be just a transparent / black background and the camera image would be processed in a background process.
- They don't seem to support regular headphones.

Current Technologies

Meta 1 Developer Kit

The Meta 1 glasses are some of the most exciting glasses in development at the moment, they are the only AR glasses that allow two people to view and interact with the same information in space. For example one user could pick up an AR object and the other user would be able to see them doing so and track the movement of the object.

This technology would be interesting to use for our brief if it was possible, as the multiple users could share and edit the same information simultaneously.

Vuzix Glasses

A second pair of glasses that we looked at were the Vuzix eyewear. These glasses seem similar to the epson glasses in the way that they function, however one thing that is interesting about them is the way they have been implemented into the working environment (see image to right). They have been attached to the helmet of the user and do not obstruct the users view in any way, this could be something to look at for our future vision or even for 2016.

Navigation/Control Methods

Leap Motion

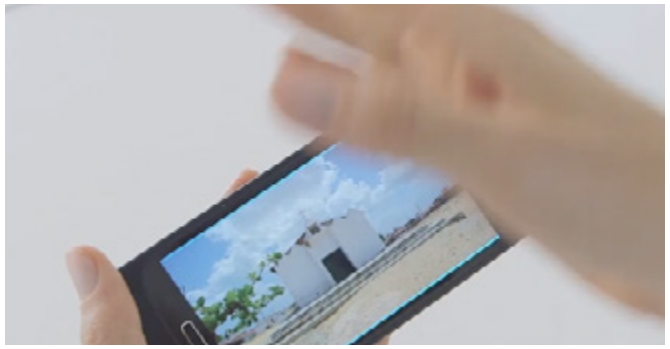
We also looked at the Leap Motion for the possibility of gesture-based controls for our smart glasses. Leap Motion is great for this. It con recognise a number of gestures to allow you to control your computer. The Leap Motion can identify where the user is pointing on the screen to make selections and also can measure the angles between fingers, this allows the user to create “hot keys” from their hands to quickly carry out tasks by just making a sign.

Control VR

“Control VR was designed to be versatile and used with a variety of operating systems and platforms. The development kit comes with more than 10 free applications for the PC as well as an open source SDK for developers to create the applications of the future with Oculus VR, Google Glass, Unity, Unreal, Autodesk software and even the Parrot AR Drone!”. This technology uses gesture based controls, without the use of cameras, which means that it will be less likely for the camera to pick up a mistake. However the user will be wearing the gloves whilst working and so it still may trigger some things and also if the user is wearing gloves whilst working, this could be a safety problem!

Current Technologies

Ultrasound



There are also existing examples of ultrasound being used to interact with technologies. This again uses gestures and so it would be much easier for the user to interact with, however instead of a video camera it is sound, meaning that the user can make the gestures anywhere and they would still be recognised.
This technology is great, however it has been mentioned that the user may accidentally trigger something with hand movements because of the work they will be doing on the steam turbine.

Samsung keyboard interface

We looked at possibilities for documenting information. One of the technologies that came up was this virtual keyboard from Samsung. This allows the user to bind certain letters to sections of their fingers and allows the user to type by looking at the letters you wish to use. This could be useful for our brief, however it also depends on how advanced and how fast this technology is.

Sources:

•Meta glasses - https://www.spaceglasses.com/
•Vuzix - http://www.vuzix.com/
•Leap Motion - https://apps.leapmotion.com/apps/bettertouchtool/osx
•Control VR - https://www.kickstarter.com/projects/controlvr/control-vr-motion-capture-for-vr-animation-and-mor
•Ultrasound - http://vimeo.com/108101901
•Keyboard - http://24gadget.ru/1161057217-virtualnaya-klaviatura-osnovannaya-na-tehnologii-dopolnennoy-realnosti-3-foto.html (ru)

Future Technologies

We live in a world today where it is impossible to predict where technology is going, we no longer an tell what will be possible in 20 years time, as technology is moving so quickly, the possibilities are huge. Years ago, researchers believed we would have flying cars by the year 2,000, yet we may never actually reach this goal.
Although we can not predict these new technologies and say for sure, we can have an educated guess as to where the technology may head.

Navigation/Control Methods

Navigation and the controlling of information is an essential part of any system, and in the case of a digital user manual it is even more so, as the user has to be able to control the information on screen and navigate through instructions. In the present day, there is some innovative control methods that work to some extent. Voice recognition technology already is pretty advanced, however it could be better. Also there is gesture based camera controls, so the camera could potentially pick up the users hand movements to navigate. However in the future, we could have even more amazing ways to navigate.

Brain-wave Technology

One idea concerning this is the use of brain-wave technology, this is currently being developed and it currently allows the user to do small things, such as turn a switch on and off by thinking certain thoughts. But in the future this could be expanded into a fully functional way of controlling an interface, where the user can simply think what they want to do and the glasses would display the correct information. This would allow the user to navigate through a user manual and possibly even dictate text through though, which could save a lot of time and errors, as the noisy environment limits the use of todays voice recognition technology.

Future Technologies

Smart Technology

A second possibility for future technology could be a “smart system”. This is again currently being tested and developed by major technology companies in the context of smart homes. The idea being that you come home and your home knows everything you want. What TV channel you want on, what meal you want for tea. It will even know how you are feeling and will change music and decor in the house to cheer you up. This could be implemented into a smart user manual in some smart glasses. The technology could possibly be so advanced that it knows what parts you are unsure of because of how others have reacted. It will adjust the level of help automatically and make suggestions for parts you may be unsure of.

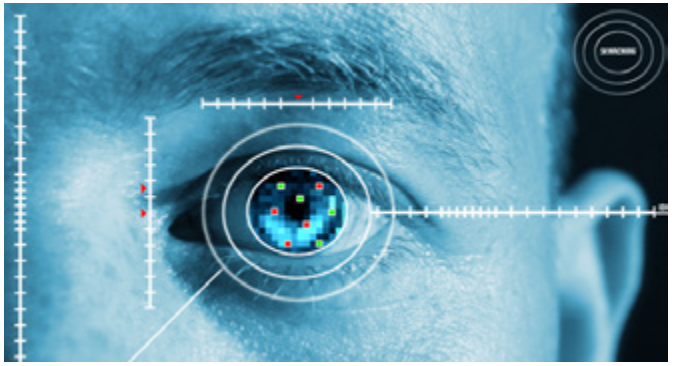
Human-Computer Integration

Merging humans with computers is something that is not currently any where near completion, however it may be available in the year 2024. This would involve there being some sort of touch interface on the users arm, this may be projected or built in. In the context of our project, this could be used as a second screen for the user, allowing them to type, take notes and view extra information at a quick glance. If developed further, this technology could even replace smart glasses altogether. Also this technology could be possibly integrated with the previous I have mentioned to create huge possibilities.

Future Technologies

Advanced Eye Tracking

Eye tracking is currently a technology that is used a lot. It has even been integrated into some mobile phones to allow the user to scroll through images and text. However, this technology has not yet been developed and used for wearable technology such as smart glasses. This technology could be very helpful for our brief, as it would remove the need for voice control. Voice control could be a problem for this brief because of the noisy environment that workers will be in.



Other

Internet of Things

The internet of things is the theory that in the future, everything that we own will be digitally connected in some way, similarly to the previous mention of “Smart Technologies”, all of the products will know the users feelings and movements. The Internet of things however, refers to the communication between the digital products. This will be especially helpful when it comes to the documentation and recording of information that Alstom expect us to achieve. Once an image is taken it will automatically be sent and inserted into a document, the user will then be able to speak a sentence and this too will be added in as text next to the image or wherever necessary.

Android & AR Frameworks

To find out what would be the best program to use we also carried out some background research on the different typed of AR frameworks and looked into their possibilities.

Android

Android is a linux-based operating system for mobile devices created by Google. The first Android devices entered the market in October 2008. Since then the system gained a lot of popularity. More than a billion phones and tablets around the world are running on Android, which makes it the most popular mobile operating system.
The latest software version is Android 5.0 (Lollipop), which brings a new design, better synchronisation across devices, multiuser support as well as integrated support for watches, TVs and cars.

•Android Wear

In March 2014, Google announced Android Wear, which is a version of Android designed for smartwatches and other wearables. Android wear devices can be paired with your Android Smartphone via an Android Wear app over bluetooth. To install the Android Wear app, your device has to run at least Android 4.3. Since Apple just announced their Apple Watch as well, there will definitely be a lot of interesting stuff happening in this domain.

AR Frameworks

The idea of augmented reality already appeared in 1901 in “The master key”, a book by the well known author L. Frank Baum who also wrote “The wizard of Oz”. Since then, this topic was discussed by lots of different people, but it was only in the late 90ies when there were the first attempts to create applications and frameworks for this matter. We will try to evaluate the existing frameworks as well as their pro and contras.

•Metaio

Metaio is a privately held Augmented Reality company that develops software technology and provides augmented reality solutions. Headquartered in Munich, Germany, with subsidiaries in San Francisco, California, New York City, New York and Dallas, Texas, metaio provides a software development kit (SDK) for programming PC, web, mobile and custom offline augmented reality applications. Additionally, Metaio is the creator of Junaio, a free mobile AR browser available for Android and iOS devices.

Android & AR Frameworks

•Metaio Creator

Metaio creator is a tool to easily create simple tracking and AR combinations. The tool is free of charge with some limitations (only 2 trackables and 2 3D models). It is possible to upload the so-called “channels” to the Metaio Cloud for use in the Junaio app. One can also export the created channel to Unity or Eclipse for further modification. More info: http://www.metaio.com/creator/

•Metaio SDK

The metaio Software Development Kit (SDK) is the framework that is also used to power the metaio creator. It allows programmers to easily use metais object and image recognition algorithms, as well as their 3D API.
The SDK is available for every well known mobile operating system.

Some numbers from the Metaio website.

•AREL (Augmented Reality Experience Language)

Metaio has its own programming language to use for their SDK, which allows you to write apps in Javascript, HTML and CSS. This could be really interesting in regards to designing the glasses interface.

https://dev.metaio.com/arel/overview/

•Junaio Browser

It’s possible to create channels for the very popular AR browser “junaio browser”.

•Wikitude

The austrian company Wikitude was one of the first to develop a AR browser and publish it free of charge in 2008. Their app, the wiktude world browser, uses the location data of the device to display interesting information to the users based on their location.

Android & AR Frameworks

•Wikitude Studio

Like Metaio, Wikitude is also providing a very easy to use tool to quickly create AR content that can then be added to the wikitude world browser database or can be used for individual apps.

•Wikitude SDK

Wikitude is also offering an SDK to create Augmented reality apps. Other than metaio, they do not only provide tracking based on images, but also on location. Their SDK is available for many development environments like Android, iOs, Smart Glasses, Phonegap, Titanium or Xamarin.

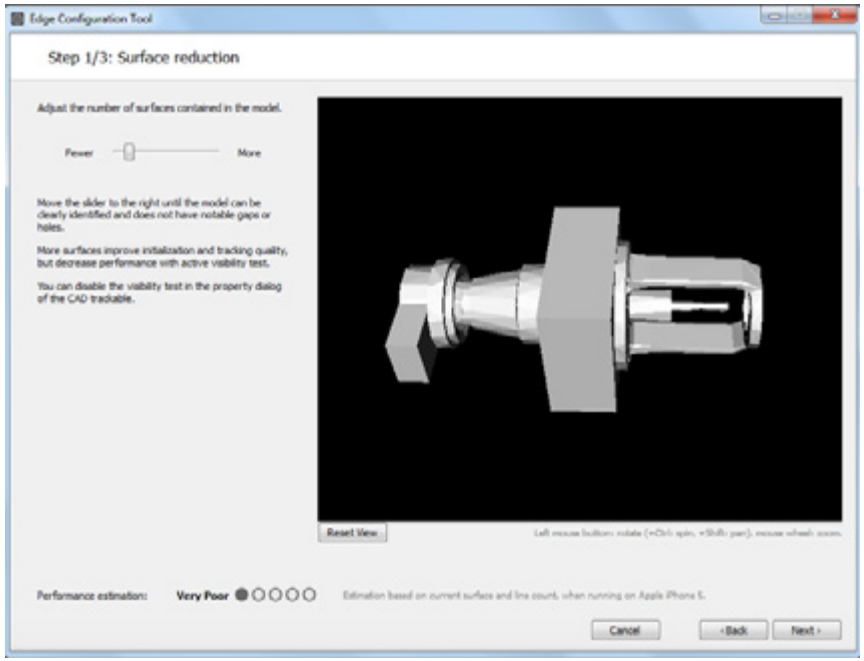
Conclusion

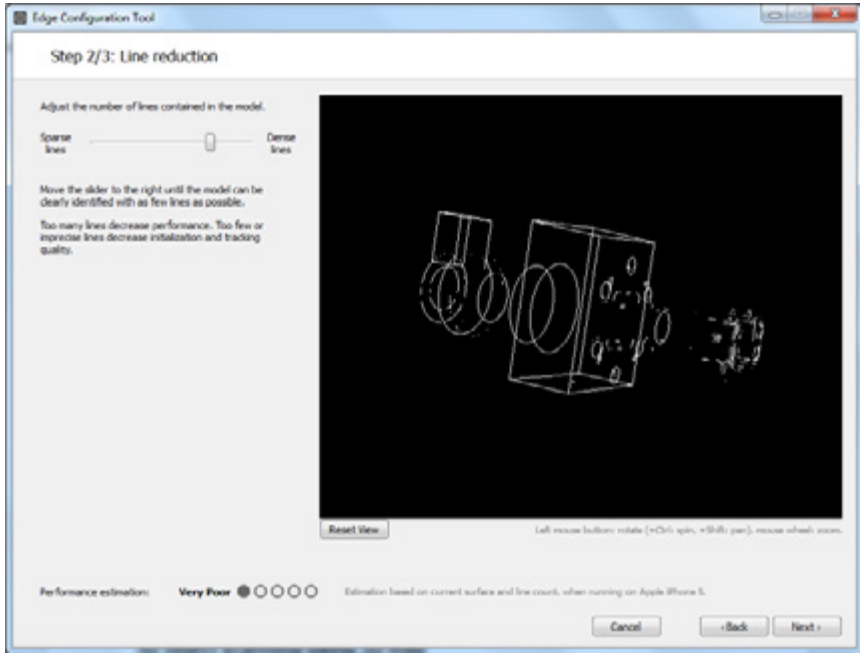
I think the best solution to use would be the Metaio SDK. Most of the other teams will also be using this technology and therefore it will be easier to exchange knowledge and solve eventual problems. We could even do simple prototypes using Metaio creator without writing one line of code. Also with the possibilities of AREL, everyone that knows Javascript, Html, Css and a bit of XML should be able to contribute to the development and design of the prototype.

Sources

http://developer.android.com/index.html
http://developer.android.com/training/index.html
http://socialcompare.com/en/comparison/augmented-reality-sdks
http://www.t-immersion.com/
http://www.xloudia.com/
http://www.metaio.com/
http://www.wikitude.com/
http://www.wikitude.com/products/eyewear/epson-augmented-reality-sdk/
http://www.epson.com/cgi-bin/Store/jsp/Landing/moverio-bt-200-smart-glasses.do

3D Object Scanning





Our idea after Review 1 was to extend our lego prototype by 3D object recognition and exchange the model with the steam turbine. There are two different approaches for this: one is using the 3D model itself as a trackable, the other one is to create a 3D map of the physical object (the steam valve model we received on the kickoff meeting) with a smartphone using the Metaio toolkit.

3D object scanning using 3D model

The first way to do 3D object scanning that we tried, is to provide a 3D model as a trackable. After loading the steam valve model as a trackable, we can adjust the detail level we want to use.

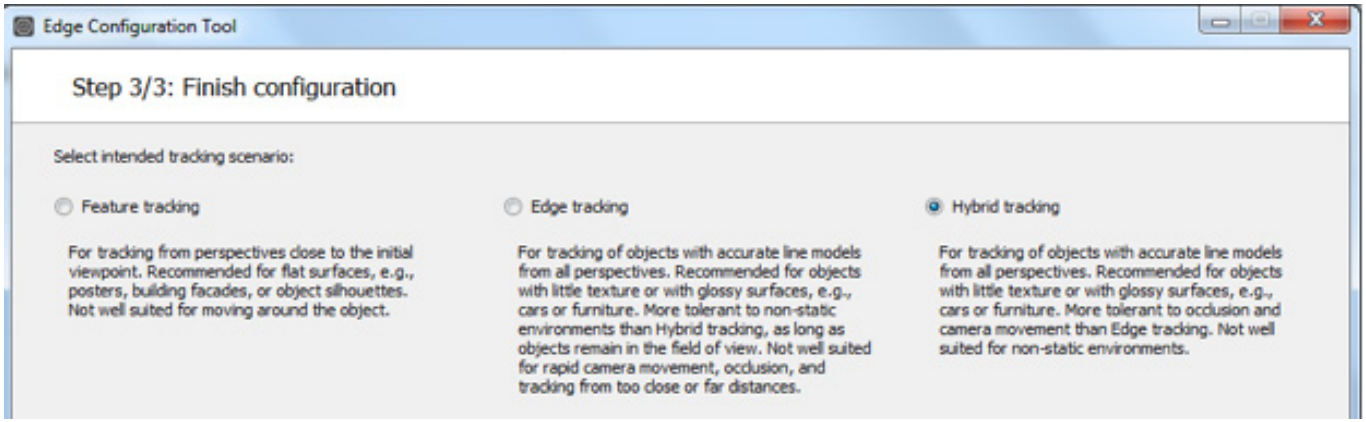
Left top: The steam valve model in the 3D model tracking assistant.

Then we need to choose the line detail level:

Left bottom: Visualisation of the line reduction in the 3D model tracking assistant.

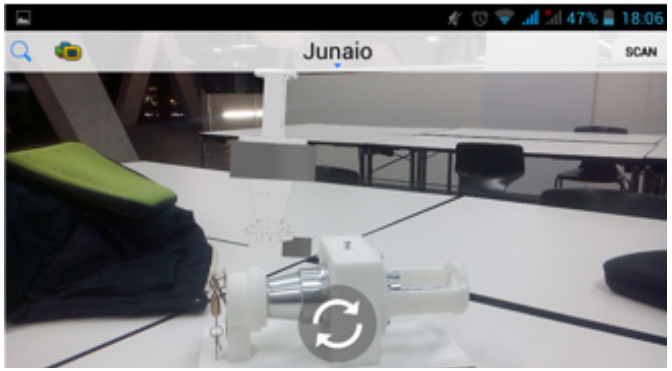
3D Object Scanning

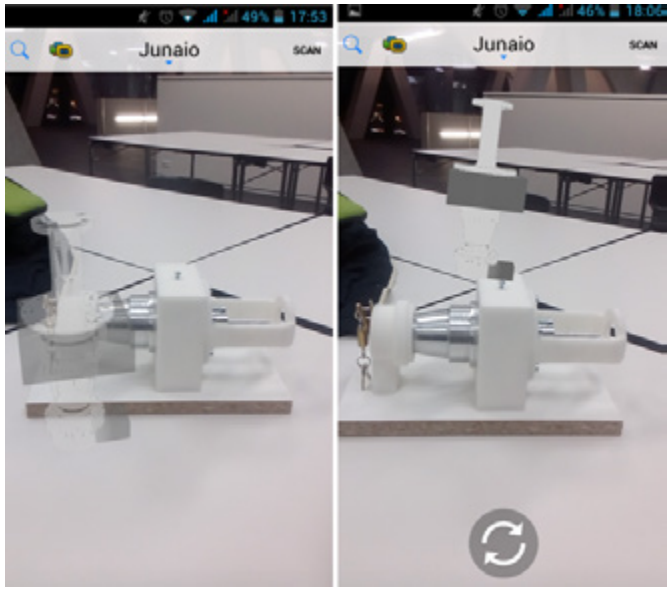
Finally, we had to define the tracking scenario, as seen from the screen shot below:



The dialog to choose a tracking scenario

After defining the trackable, we add the 3D object to display - again the steam valve model - and export it as a channel to metaio cloud. The result is not overwhelming:





Screenshots of end result in Junaio using 3D model tracking

3D Object Scanning

Conclusion

In conclusion to the 3D object scanning in Metaio, 3D object scanning using a 3D model looks promising while setting it up in Metaio creator, because you can overlay the trackable directly and 1:1 with the 3D model. But when it comes to real life application, you can see that it is not that easy. The 3D model gets placed just anywhere around the object, but not nearly overlays it.

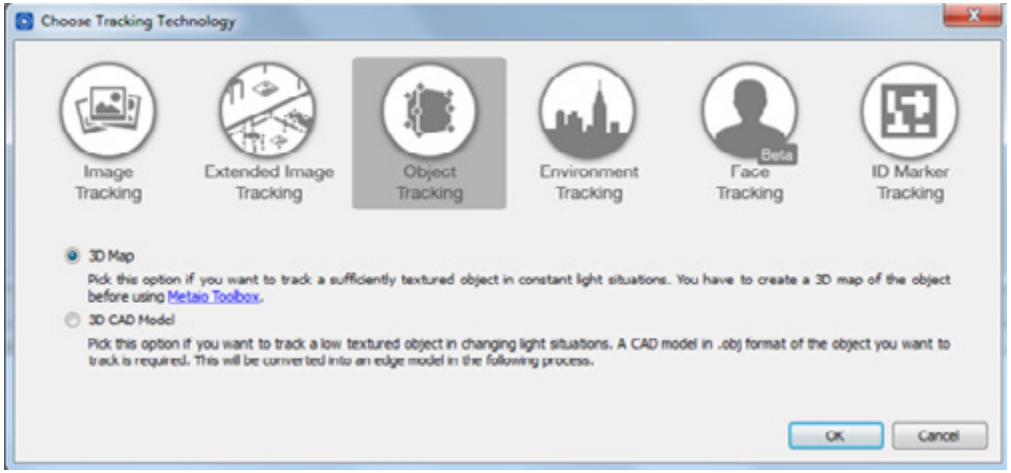
3D object scanning using 3D map

Another possibility is to create a 3D map of the steam turbine model, using the Metaio Toolkit app, and use that as a trackable.

Generating 3D map using the Metaio Toolkit app for Android.

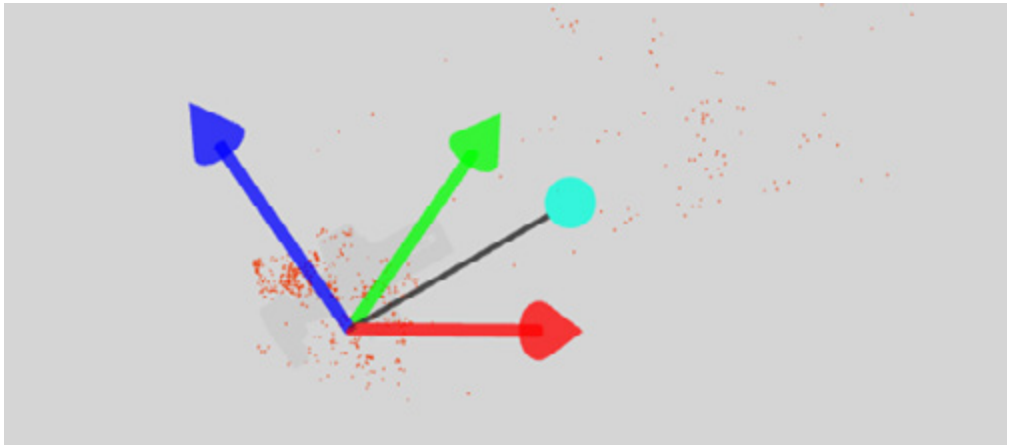
3D Object Scanning

We can then export the created map from the app and import it into the Metaio Creator as a target.



Creating a trackable in Metaio Creator

As a next step, we import the steam turbine model and place it in the 3D map. This is quite tricky, as we don't see the captured images, only the marker points of it:



This is how the 3D map is displayed in Metaio creator, one can also see the 3D model that would be shown when the 3D map is found by the camera (in grey)

3D Object Scanning

We can then export this as a channel to the metaio cloud, and open it with the Junaio app. However the results we get are not very good:

Screenshots of the end result with 3D map based tracking

The 3D model is placed differently depending on the angle you look at the model. Also it flickers quite a lot, as if it may lose track of the tracker.

Conclusion

Although 3D object recognition with SLAM sounds like fun, it really is not. You can not yet choose what exactly in the view of the camera the object is that you want to map, so it just scans everything in the viewport. This means you would need a completely neutral background for the scanning. Also the display of the 3D model based on the 3D map is very unstable.

Future Vision Videos

We have also looked into the videos that have been produced by large corporations for their future visions. These videos have been produced for a company 2020 vision. They have been completed to a high standard including mock-ups and graphics to illustrate what the company aims to achieve by the year 202. Looking at these videos will come in useful because it shows us their prediction of future technologies and how they expect to use them. This is similar to what we will be doing for our future concept video.

Coca-cola Video

Available here: http://www.coca-colacompany.com/investors/videos-from-cage-presentation

Microsoft Video

Available here: http://osxdaily.com/2011/10/27/microsofts-vision-of-the-future-everything-is-touch-video/

These videos provide a clear vision and will inspire us to create something similar. Both to advertise out 2016 product and more importantly for the future.

User Research

The next step was to undertake some user research. We began this by creating some user pesonas to give us all an overview of the people who we would be designing for. We need to know what product will work for them and how skilled they are with technology.

We have also created some customer journey maps for both the current workers of Alstom and also for the predicted future users of our product.

Mario Kleiner

"I'm confident, but nobody is perfect."

Gender:
- Male

Age:
- 22yrs

Job Occupation:
- Trainee

Nationality:
- Swiss

Bio:

Mario is a recent graduate at Alstom. He has been trained by the company over the past few years and so is fairly confident with the task at hand. He has been working in the training facility for a number of years now alongside other students and likes the team aspect of working in Alstom. For all he is confident, he does not have a lot of experience when it comes to steam turbines, he has taken apart many during training exercises but is a little apprehensive with doing the job for real.

Mario's life revolves around technology, his phone is constantly getting notifications and he has no problems with learning new things concerning technology.

User Needs:

Mario needs a system that will prompt him at the correct time and give him the information that he wants, exactly when he needs it. He also would like a way to be able to take notes quicker, as he hates having to write up reports and send emails every time!

Technology Skills

Task Confidence

Level of Expertise

Thomas Braun

"I just don't have time for documenting every little detail"

Gender:
- Male

Age:
- 41yrs

Job Occupation:
- Engineer

Nationality:
- German

Bio:

Thomas is an engineer that is regularly hired by Alstom to come in and service the steam turbines. He lives just a few hours away in Germany but has to travel regularly in order to complete the jobs he is given. At the age of 41, Thomas has plenty of experience of steam turbine valves, having serviced many during his career so far. He knows that it can be a lengthly process, especially if everyone doesn't work quickly and efficiently together.

Thomas is one of the older generation desperately trying to fit in with the "young ones" with technology. He owns an iPhone4 however struggles when it comes to anything more complex.

User Needs:

Thomas needs to have s system in place where he can keep in contact easily with the other workers he is with. Also he wants to be able to make sure everyone is safe on the job, as he tends to take a paternalistic role during work activities.

Technology Skills

Task Confidence

Level of Expertise

Jürg Sutter

"I have no idea how to work the gadgets these days"

Gender:
- Male

Age:
- 56yrs

Job Occupation:
- Engineer

Nationality:
- Swiss

Bio:

Jürg is highly thought of by his team members when it comes to work, he is a skilled specialist in the field of turbines. He can be seen as a little bit of a control freak and tends to boss people about in the workplace. He doesn't mean to but he knows he is speaking from experience and it will all be passed down to the people he is working with.

Jürg is a self confessed technophobe. He struggles to operate his TV never mind a fancy smart phone. He likes to try new technologies but rarely finds anything usable for him.

User Needs:

Jürg needs a simple to use interface that he can easily understand and learn about from others. He wants to be able to speak clearly to the others, as at the moment he struggles to hear in the loud environment.

Technology Skills

Task Confidence

Level of Expertise

John Boyd

"Communication is the issue when you are 30ft up in the air"

Gender:
- Male

Age:
- 33yrs

Job Occupation:
- Crane Operator

Nationality:
- English

Bio:

John is a laid back and calm crane driver, he is regularly hired and dispatched by Alstom to aid in the dismantling of steam turbines. Have a new born child, John is used to multitasking, however he does find this difficult in a noisy environment. He and his team mates need to rely on hand gestures and an old walkie-talkie to allow him to operate the crane efficiently. He has to be in constant communication with those on the ground, especially when moving large parts of the turbine, as anyone could be seriously hurt, or a part could be damaged.

John loves technology, his father has worked in a design company and so he has always been around the latest tech.

User Needs:

John needs a system that will aid his team mates on the ground, but allow them to have hands free contact, and possibly even a way for them to show him what is happening down there in more detail. He thinks this would be a fantastic way to work and will stop any minor mistakes before they occur.

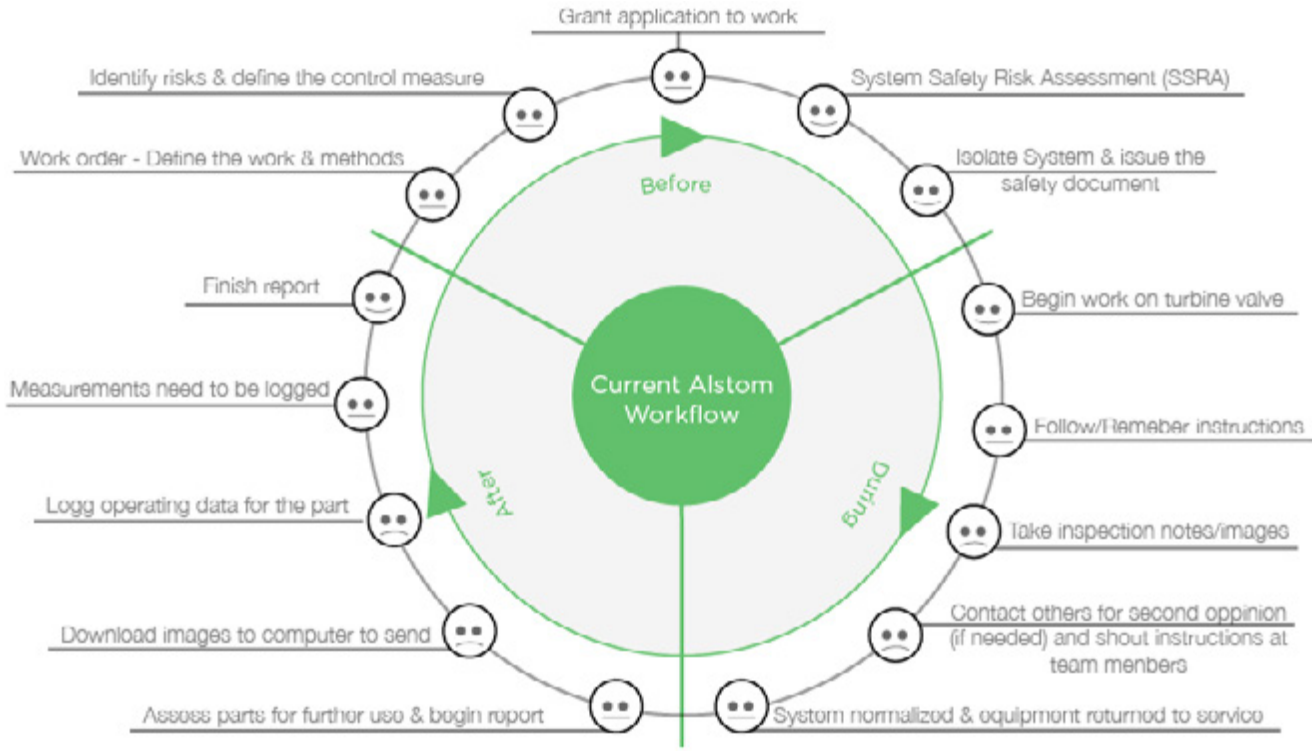
Technology Skills

Task Confidence

Level of Expertise

Current Alstom Workflow

Below is a customer journey map for the current workers at Alstom. This shows the different stages in the process of servicing a steam turbine valve and the workers feelings towards each stage.



As you can see from the diagram above, the current Alstom process is lengthly, especially with the need for documenting after the job has finished. This also extends the time period of the job because the worker has to stay to complete the documentation before sending it.

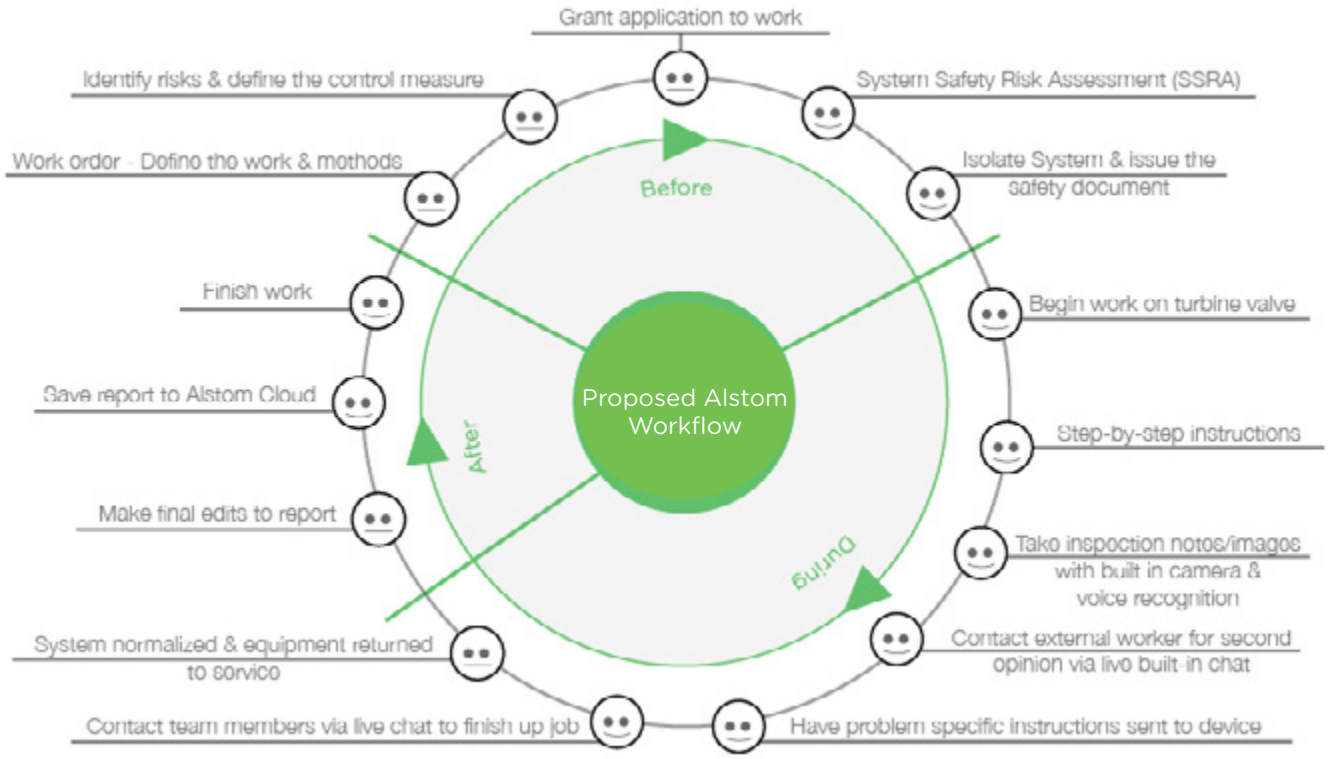
Furthermore, the documentation could be completed alongside the task. The worker could dictate the problems that arise and take images with the camera glasses.

This can be automatically compiled and inserted into a document to save the need for lengthly documentation after the job has been finished!

Also the communication is something that could be improved. Currently the worker has to put their tools down and ring someone off-site for extra information, this could be improved by having built in web chat with an external specialist.

Proposed Workflow

Below is a potential customer journey map for the Alstom workers using our solution to the brief. This again outlines the various sections and how the user feels at each stage.

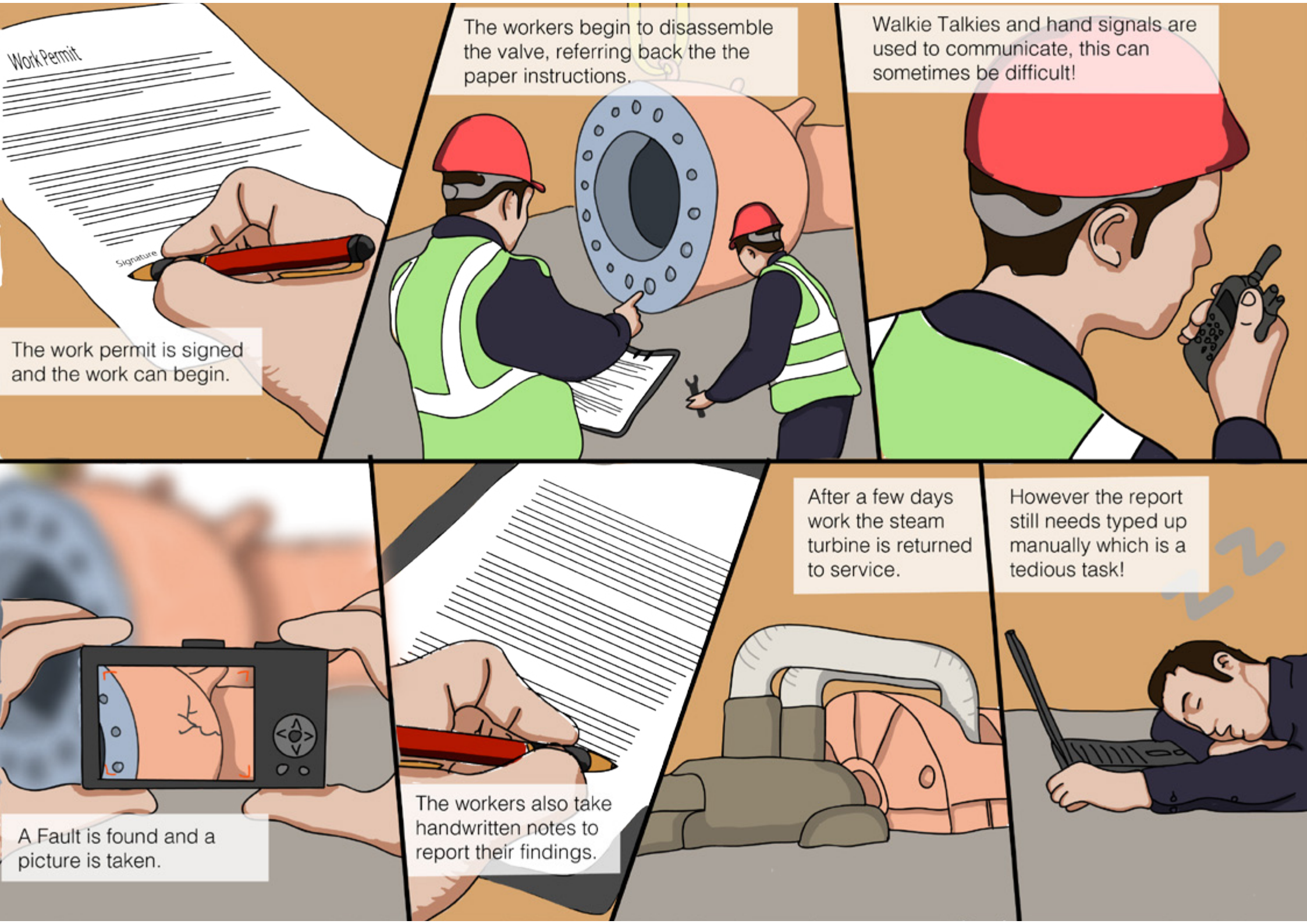


As you can see from the diagram above, the before stage of the cycle will stay mostly the same, the user will still have to go through all of the relevant safety procedures before beginning the task of servicing the steam valve.

The during stage of the process has a few more points, but this is mainly due to the integration of reporting into the actual work process, this will greatly reduce work hours, as the worker will be able to do two tasks at once, without losing concentration on the job.

Also there are the additions of easier contact with team members and other staff. If there is a problem and the worker needs to be put in contact with someone else, then this will be seamless and easy, triggered with a voice command.

The use of instructions is also a great improvement, instead of following a paper guide or remembering the instructions the worker will be provided with step-by-step instructions to aid them.


Work Permit
Signature
The work permit is signed and the work can begin.
The workers begin to disassemble the valve, referring back the the paper instructions.
Walkie Talkies and hand signals are used to communicate, this can sometimes be difficult!
A Fault is found and a picture is taken.
The workers also take handwritten notes to report their findings.
After a few days work the steam turbine is returned to service.
However the report still needs typed up manually which is a tedious task!

2016 System Diagram

We have drawn up these two system diagrams for 2016 to give an overall idea of how the user will connect with the glasses, the reporting system and also with a secondary member of staff, stationed elsewhere to aid with any queries.

The Diagram to the left shows how everything would link up if we were to only use a pair of smart glasses for everything. The user would use the glasses, which would be able to connect to another member of staff and the company's cloud, and therefore the user would have access to the reporting systems, which would enable them to write reports.

This second diagram is essentially the same but with the addition of a tablet, everything would connect together to create a user friendly system that will work quickly and efficiently. We have decided to potentially add in a tablet into the system because this would be the best way to solve the problems that Alstom have set. We believe that the glasses can be used to show helpful animations and images, whilst the tablet will come in as a helpful second device that will display extra information and allowing more efficient reporting and communication for the user. Each user would have a pair of glasses and a tablet to ensure that each worker can access the information relevant to them, when they need it most.

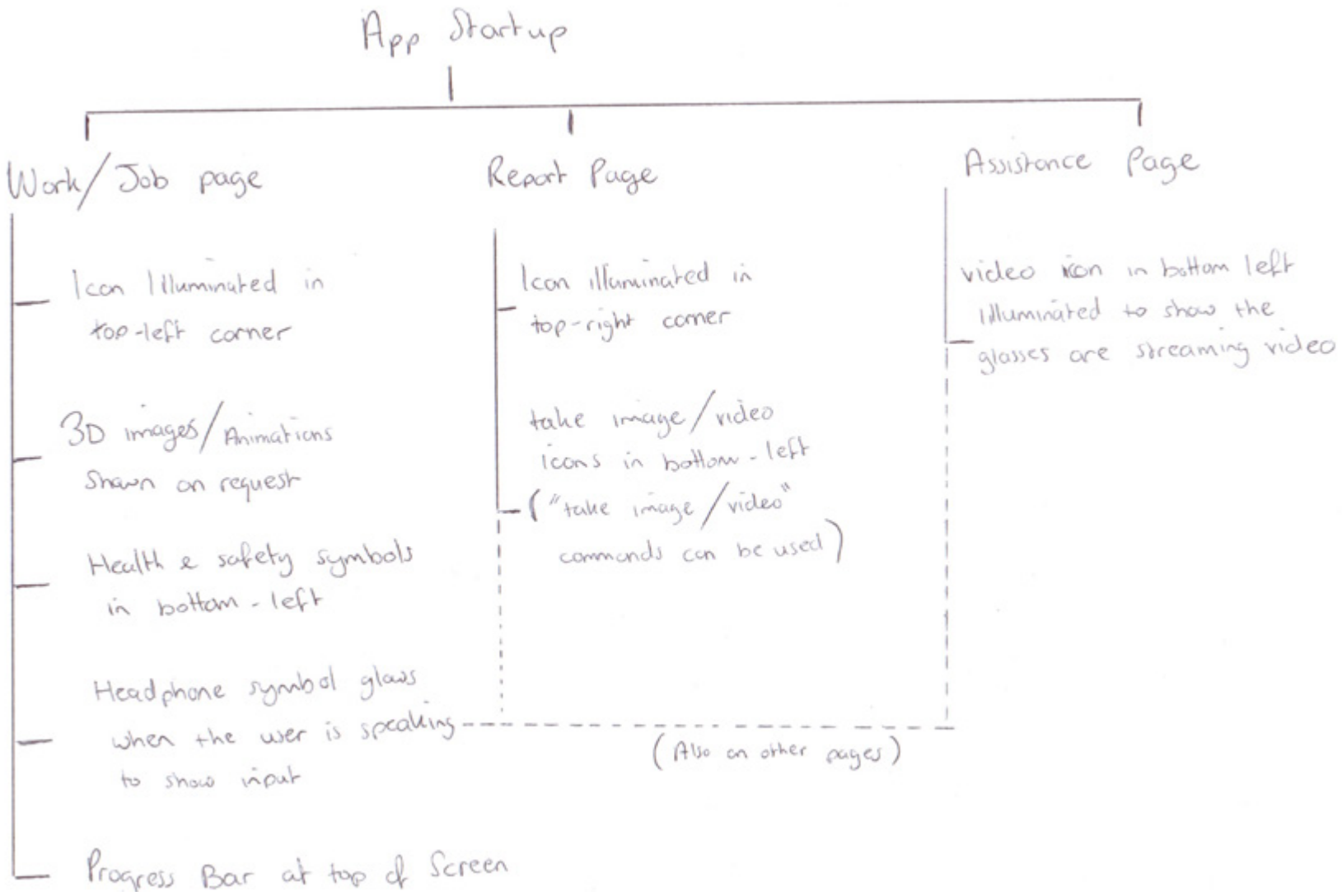
2016 Design Develpment

Now that we have all of our research conducted and know where this project should lead, we can now start the process of designing the user interface and getting feedback from both peers and users in order to make our project a success.

Glasses App Architecture

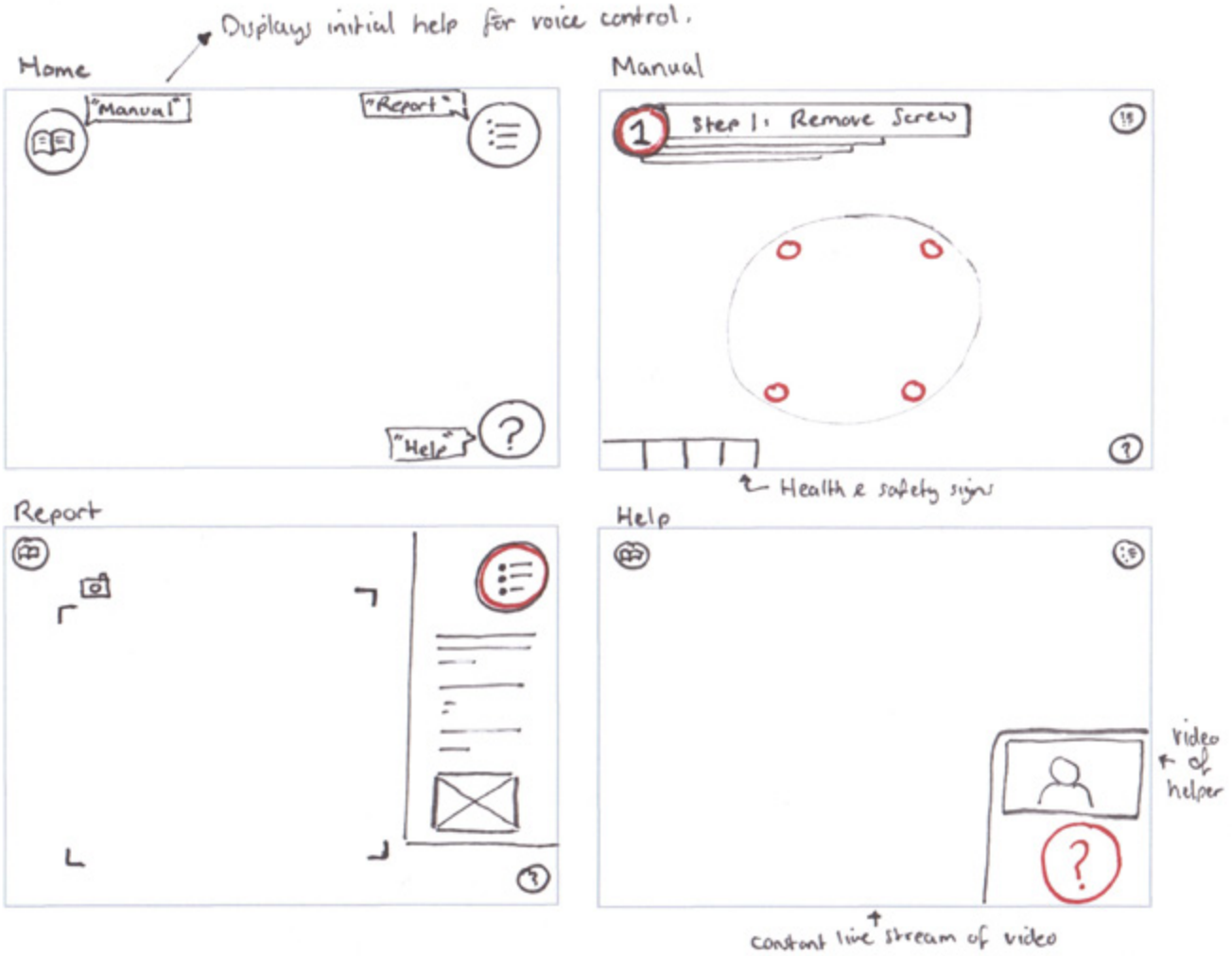
To begin with, we started looking at the system architecture for the glasses interface. This would help us to know what information needed to be shown on what pages.

Our interface will consist of 3 main pages that will be easy to navigate and will all include relevant information.



Glasses Wireframes

To begin with we wanted to get some initial ideas down, so a few initial wire-frames were created. We then planned to give feedback on these designs and produce more and more iterations until we were all happy with an out-come and we could progress from there.



Wireframe #1

This wireframe was the first idea for the navigation of the glasses. We have kept these designs sim-ple with 3 main sections in separate corners. This is to keep them out of the users line of sight and to not cause and distractions. Depending on what “mode” the user is in, the relevant symbol will be larger and a different colour to allow the user to always know what is active.

The job mode (top right) will have the step title and a small description underneath. This will also include 3d images or animations of the step to aid the user.

Report mode (bottom left) will enable the user to take images and create a report in the glasses. This will pop out at the side and allow the user to input information through voice recognition.

The assistance mode will allow the user to send a live video stream or images to an external helper and receive help in the form of images and vid-eos.

Glasses Wireframes

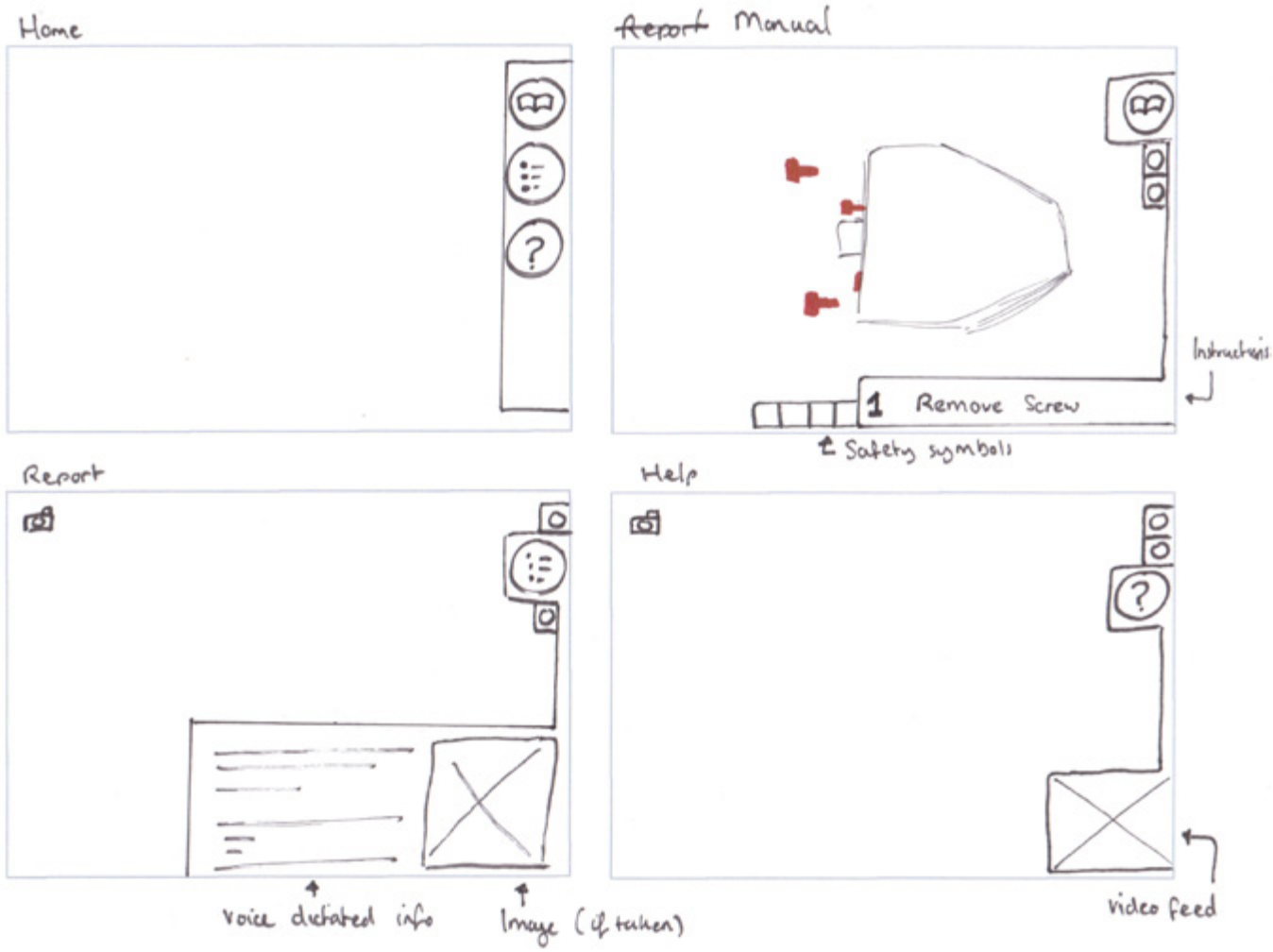
Wireframe #2

This wireframe makes use of the navigation on the right hand side of the glasses interface. The icons will be hidden and then appear when the user says a trigger phrase.

The Job mode will perform in the same way as the previous design but with a different layout. The text will appear at the bottom of the screen, along with some health and safety symbols that will notify the user of any potential risks.

Report mode will again allow the user to compile a report in the glasses interface. We have placed this in the bottom right to make it interfere with the users real world work as much as possible.

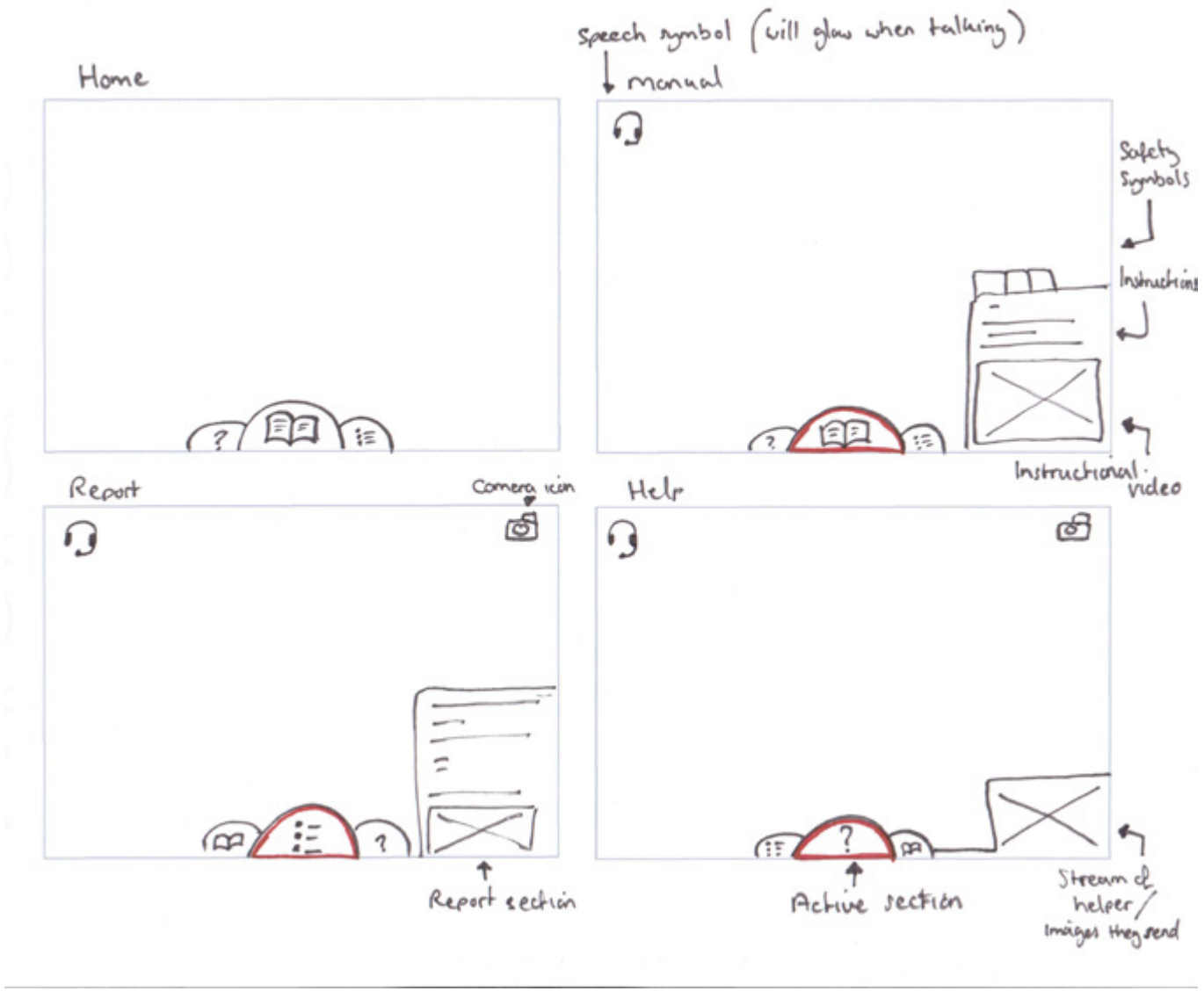
Finally the assistance mode will provide a small image or video in the bottom fight of any help that has been sent across from the external technician.



Glasses Wireframes

Wireframe #3

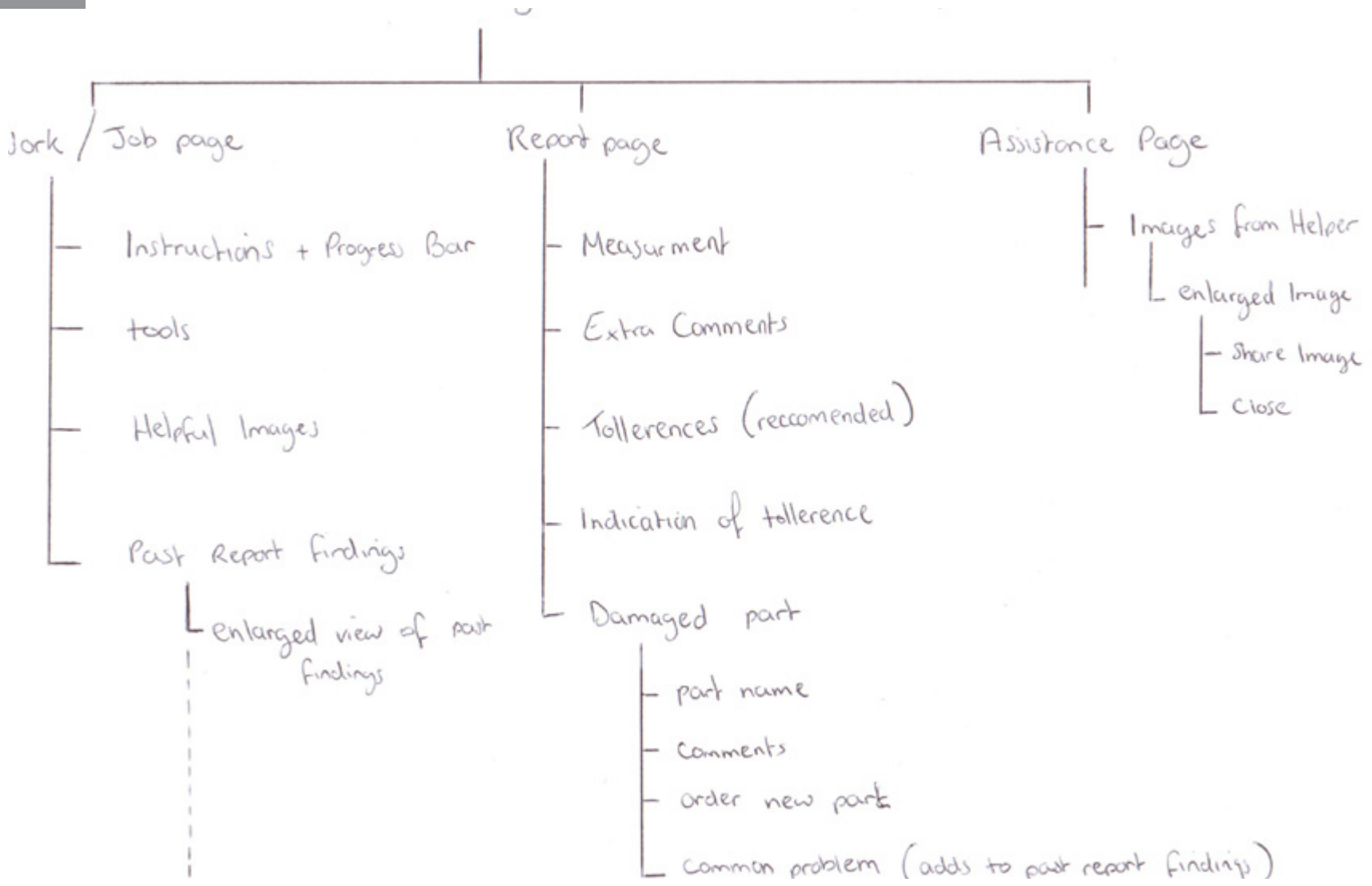
This is our third idea for the layout of the glasses. This time we have looked at having the navigation at the bottom of the screen. These ideas are essentially the same as the previous but in a different layout. The main addition in this wireframe is the Speech symbol that has been inserted. This will be a small symbol that will glow when the user is talking to their colleagues. This will greatly improve interaction, as the user will be able to tell if the device is listening to them or not. This will work through a push to talk system where the user will have to hold a button, probably on the side of the glasses, to activate the microphone to talk to colleagues.



Tablet App Architecture

Because at this stage we were thinking about implementing a tablet into our designs, we started to look into a possible system architecture for this. We looked into what should be on each page and how these pages would link together.

To the right is the system architecture that we came up with:

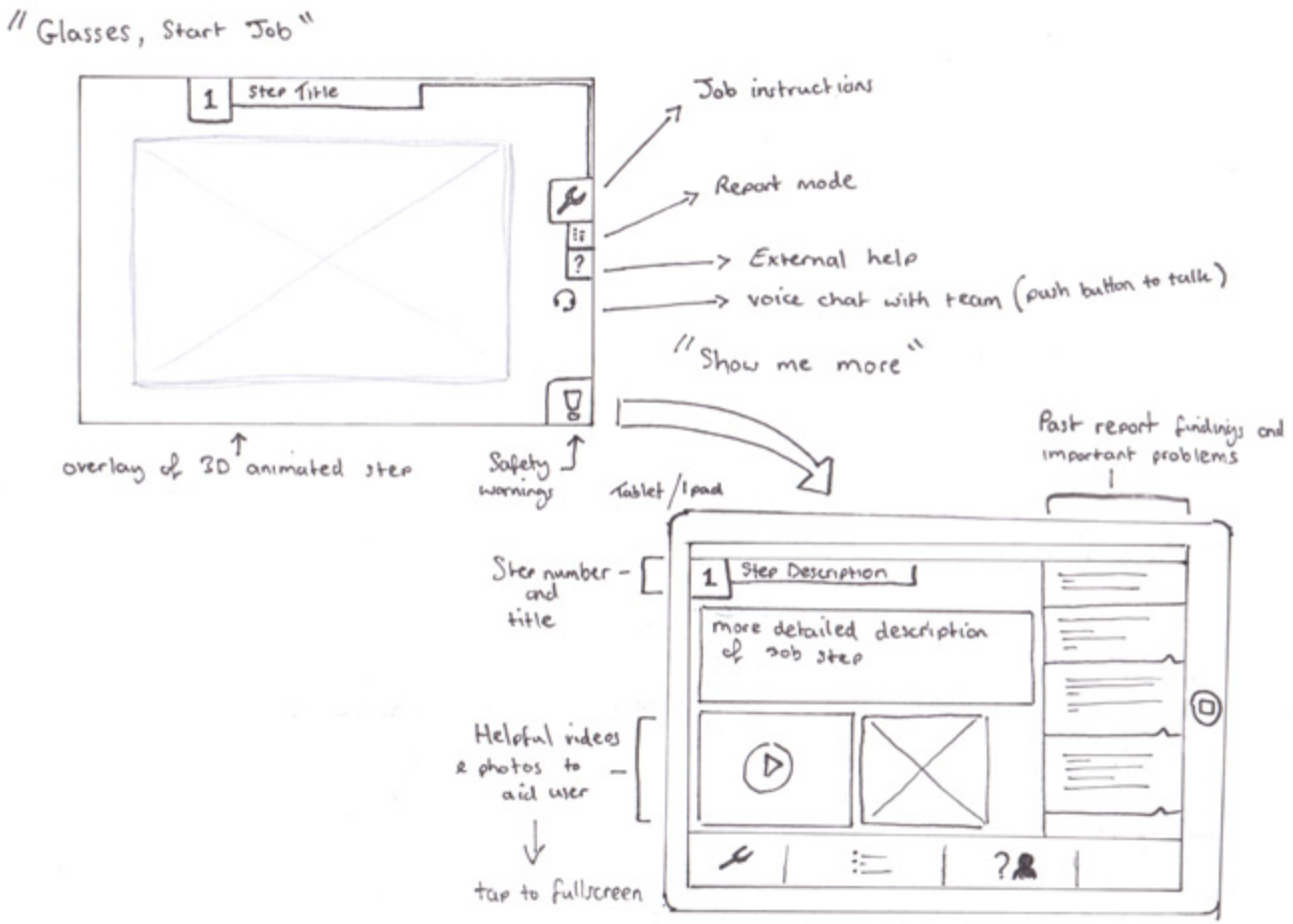


Glasses & Tablet Wireframes

Wireframes with inclusion of tablet.

As we were looking at adding a tablet into our solution, we drew out some initial wireframes to look at what we could potentially display on the tablet and how the two devices could work together. We used a slightly different design for the glasses interface, however it is similar to the previous design #2.

For the tablet interface on the job mode, there will be a more detailed description of the task at hand, this is so if the technician wants some extra help, they can request this to be shown on the tablet. This would be done through a voice command of something along the lines of “show me more”. This would then activate the tablet and bring up the extra information. The tablet would also include some helpful images and videos that the user can look at to help them complete the task. Another addition would be past report findings on the tablet. These would be the important points that have been previously found, this could potentially help solve a problem quickly if it has happened before, without the need to contact someone else.

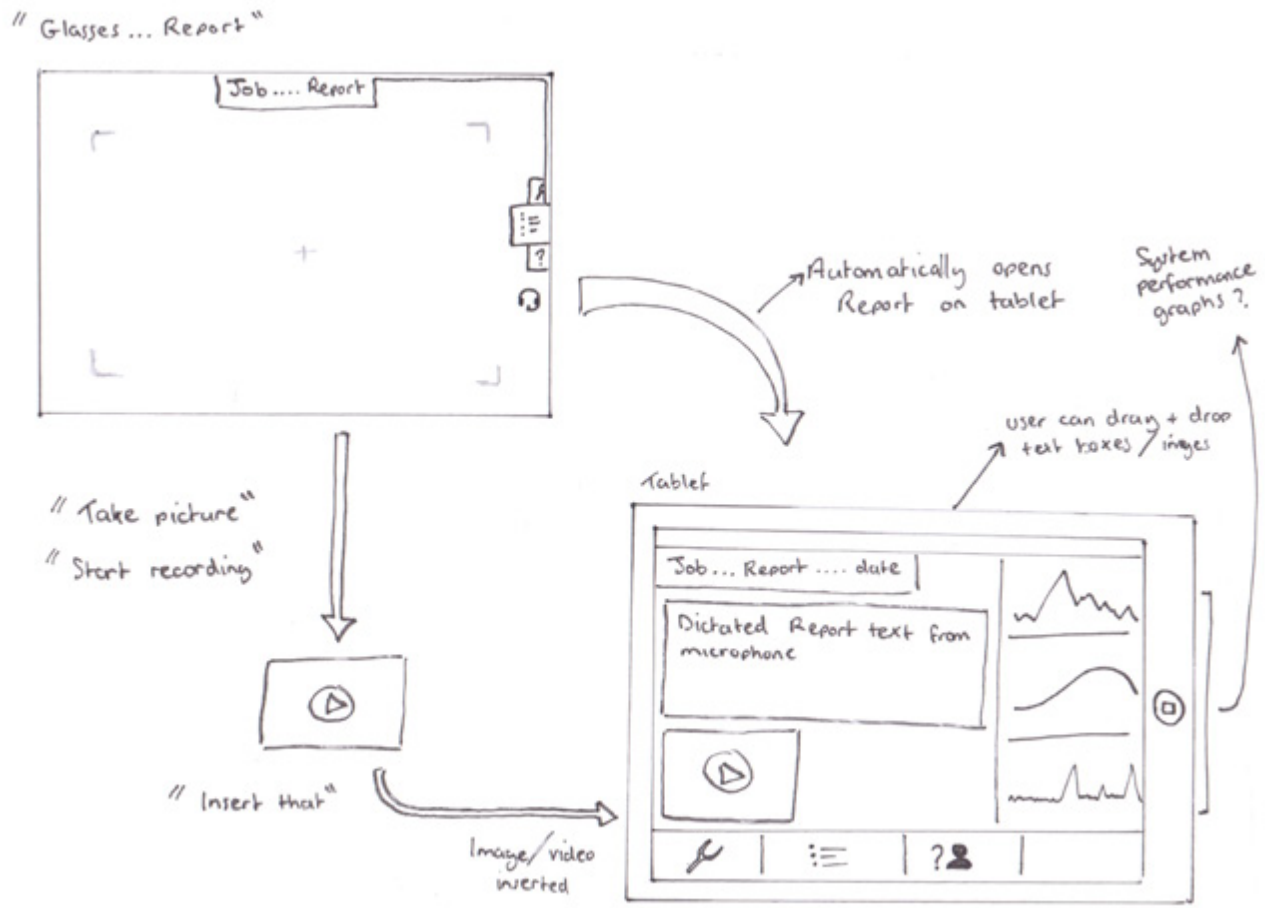


Glasses & Tablet Wireframes

Wireframes with inclusion of tablet.

When the user activates report mode on the glasses, this will automatically open the report on the users tablet. This will allow the glasses interface to be much clearer, as all of the information will be on the tablet. The voice recognition on the glasses will allow the user to hands free report their findings and they will be typed out on the tablet. We have also considered how the user would take images and insert them. This too would be done by voice commands such as “take image” and then “insert that” which will insert the image into the report on the tablet.

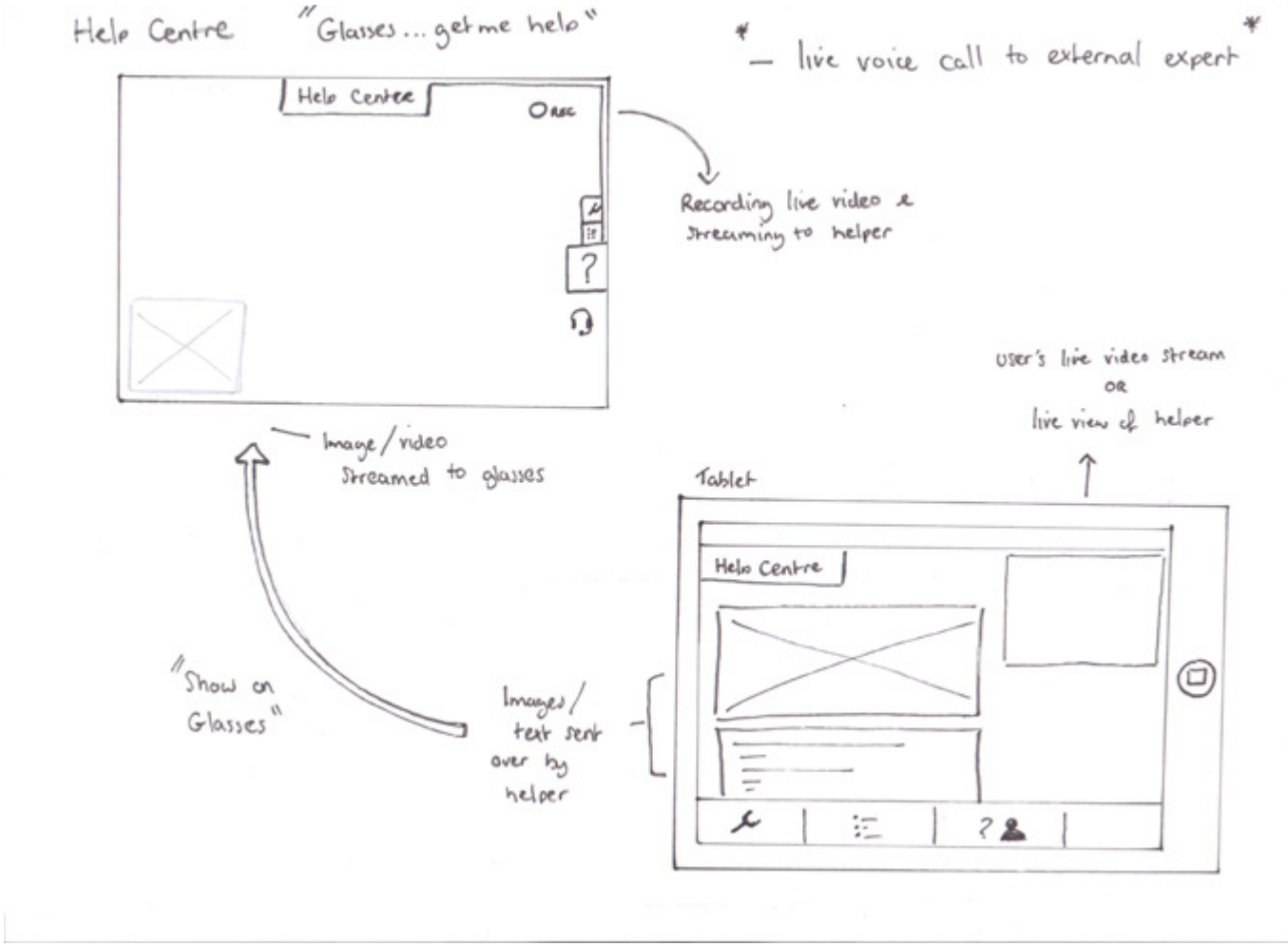
Also we have thought about displaying useful information to the user on the tablet. This would be graphs and charts of the system operating data since the last service. This will allow the user to look at the data and see how the system has been performing, and weather there is anything that can be done to improve performance.



Glasses & Tablet Wireframes

Wireframes with inclusion of tablet.

Finally for the assistance mode, the tablet will display any helpful images or videos that the external helper will send across to the user. The user can then say “show on glasses” which will open a small window on the glasses displaying this information. This will allow the user to concentrate on the job whilst being able to refer to some extra help in the glasses.



Wireframe Feedback

Wireframe feedback points.

We all discussed the wireframe ides over Skype and decided on the following points:

- Design #1 was most popular (with icons in the corners). This was because the design was the simplest to navigate and allowed the user to constantly see what "mode" they are in. We all especially liked the way in which the icons were larger and in colour when in use.
- Have no text displayed on the glasses, only icons. This is mainly because text is very hard to read and understand when on the glasses, unless it is against a high contrast background, and even then this will take up more space on the glasses. All of the text can be taken away and only imagery used, which will save space. This can be solved by voice instructions, so there will be previously recorded instructions that will be played at the start of every task. Everyone also liked the use of the tablet to display information and the "show me more" command that gives the user the option of more information if they need it.
- Any images/videos displayed in the corners of the glasses will be too small so we should keep this on the tablet, maybe make the images on the tablet expandable, so the user can click on them to make them larger or in full screen.
- The icon that lets the user know they are talking to the team will be helpful, as it will allow the user to know when they are talking to the glasses or the other workers, so we should incorporate this into our revised designs.

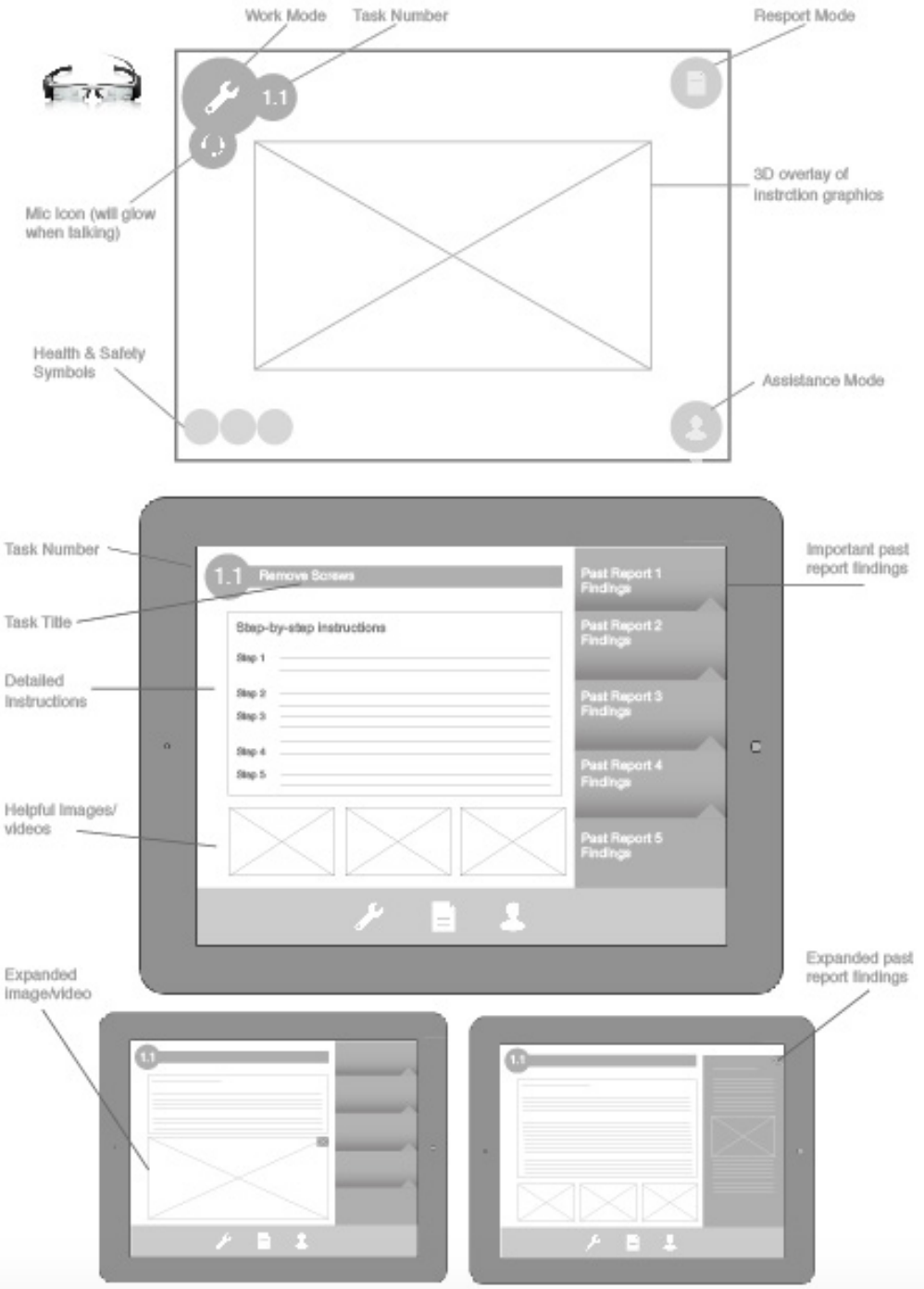
We have taken these points into account and began to draw up some neater wireframes using Adobe InDesign. These designs are on the next pages and are mostly self explanatory.

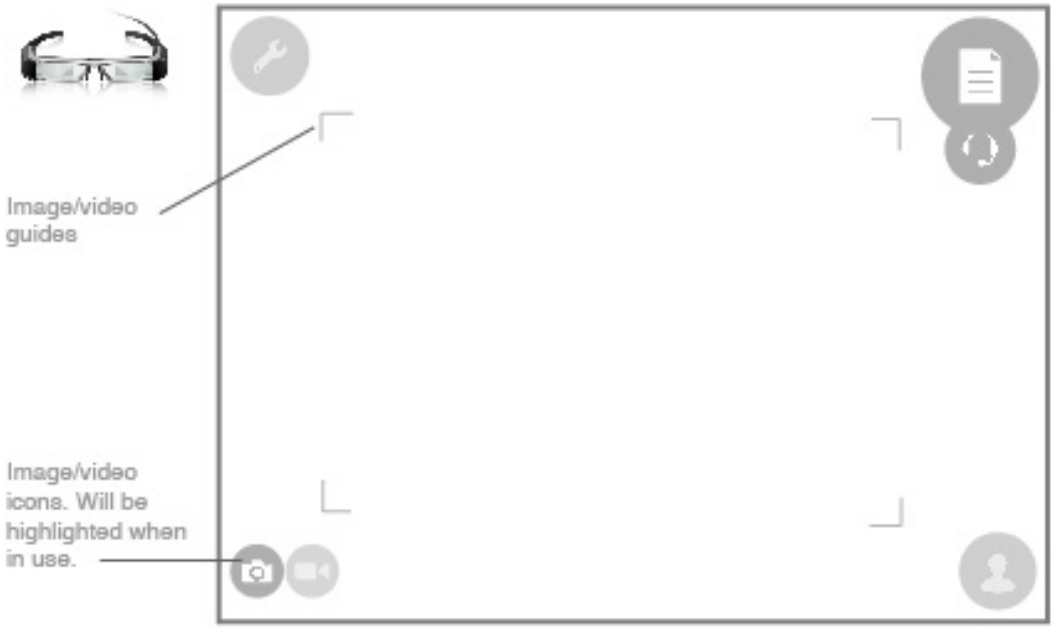
High-fidelity Wireframes

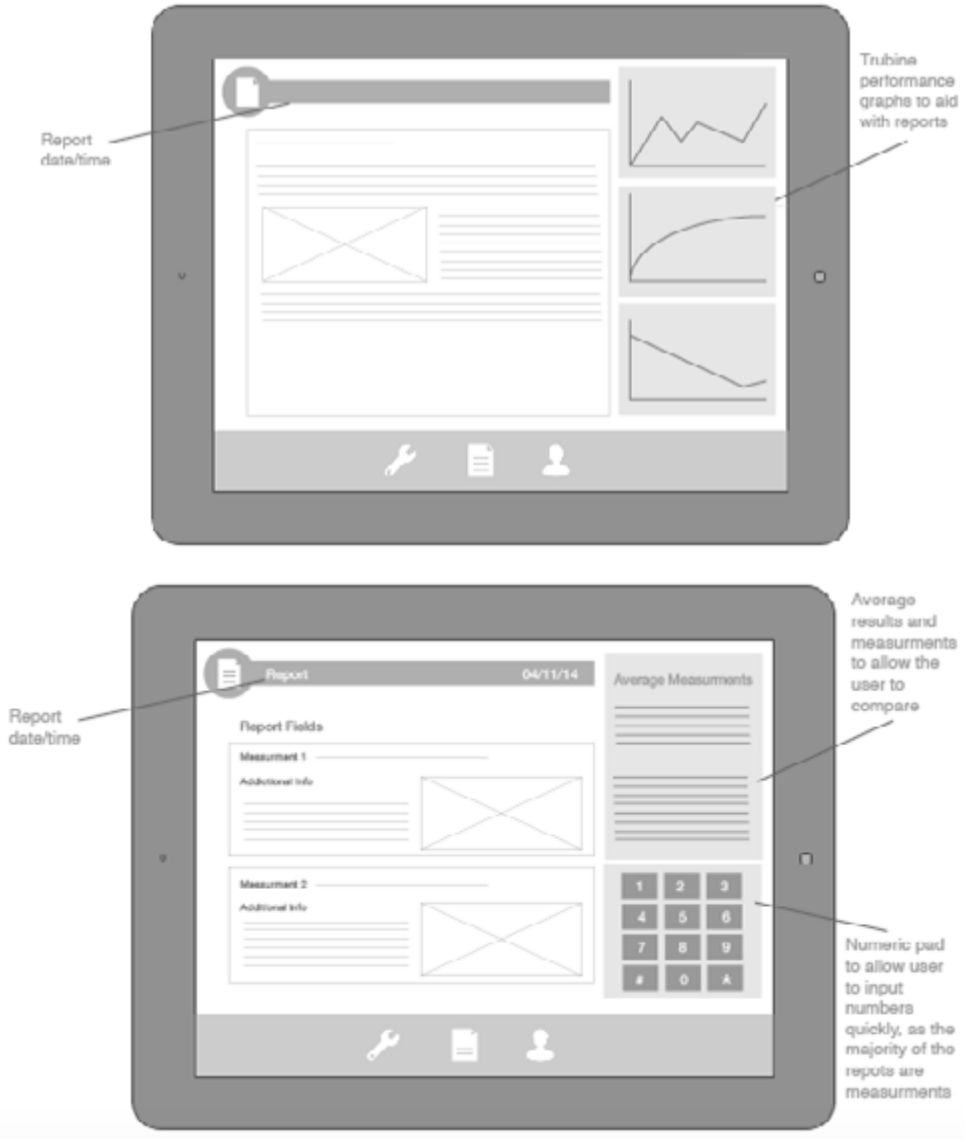
After reviewing the feedback from the initial wire-frames, we then moved onto developing the tablet interface on Adobe Illustrator.

The following pages show these interface designs and are annotated with extra information showing the main functionalities and uses for each section of the interface.

The image to the right shows the glasses interface for the “Job” section and also the corresponding screen on the tablet app. The Glasses will display the step number and any safety symbols that relate to that stage of the task. The tablet will show text-based instructions, along with helpful images, and any past report findings that past users have inputted.





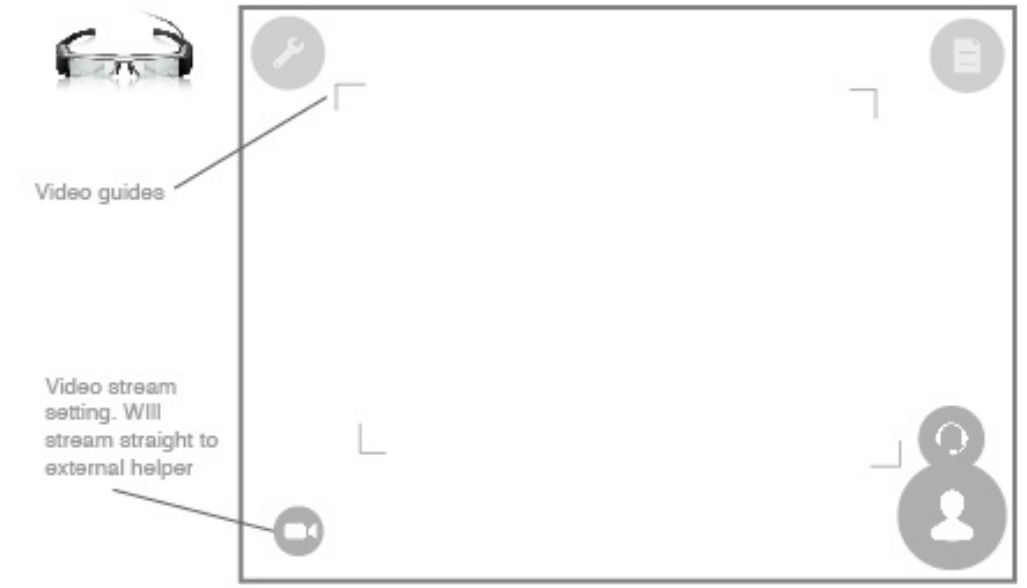


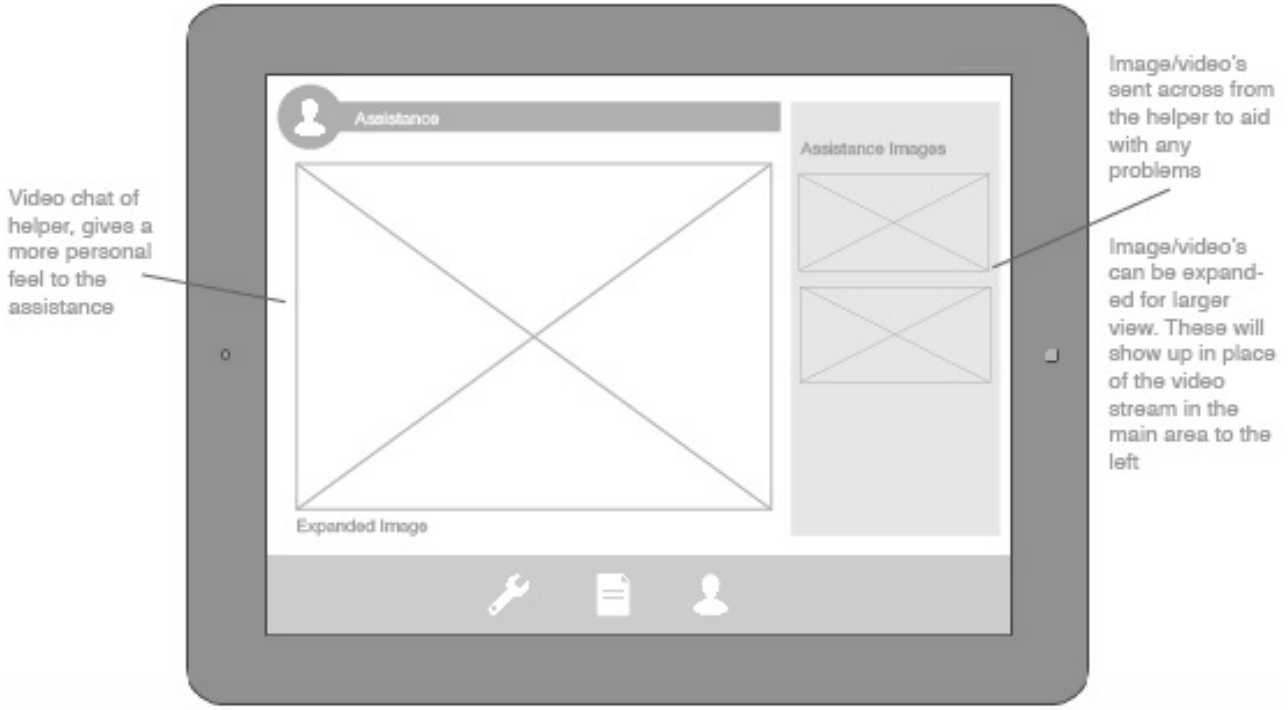
The original plan for the tablet during reporting was to show the operating data of the turbine since the last service, this would aid the engineer to see how the turbine has been performing and write the reports accordingly. These graphs would be shown on the right of the tablet.

However after some feedback, we decided to change this. We thought that the best way to use this space would be to provide average results or recommended results for measurements. This way the engineer can compare their findings and note down if everything is correct. We also decided to add in a numeric pad to allow the user to input numbers quickly, as voice recognition does not seem to recognise numbers too well.

This final section shows the “Report” section of the interface. This is where the user will be in contact with the support centre. The support centre will see a live stream from the users glasses so they can explain a problem. The worker in the support centre can then send over any relevant helpful images to aid the worker in completing their task.

The user would then be able to view these attachments and share them with their team mates.



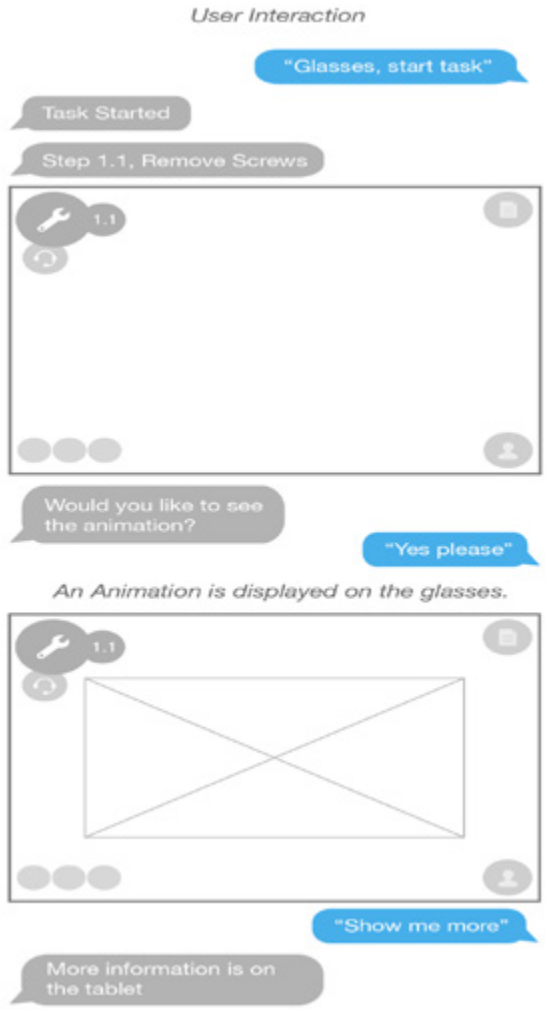


Interaction Workflow

To aid with understanding the relationship between the glasses and tablet app, we have created a possible ‘conversation” between the two. The glasses will talk to the user and understand commands given to it.

This will allow the user to work hands free and also allow them to have as much information as they need available to them. Every users experience with these devices will differ, as everyone has different levels of expertise and knowledge.

(Conversation continues over 2 pages)



The glasses will ask report related questions so the user completes the report as they work.

Is there any wear on the screws?

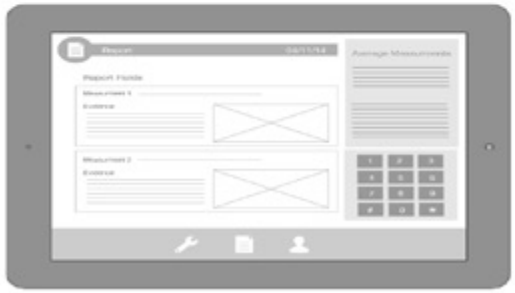
"Yes"

"Take Image"

Image Taken

"Insert that"

Image Inserted



As the glasses asks questions, the report page will start to fill. The user can also manually go to report mode via a voice command and insert more information.

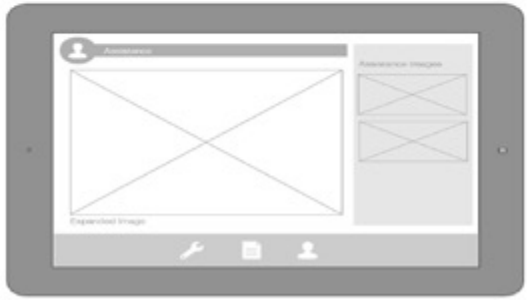
"Glasses, get assistance"

Calling help center

Connection established

The user is now streaming video to an external expert.

After conversing with the external helper, the user has extra images and information to help, displayed on the tablet.



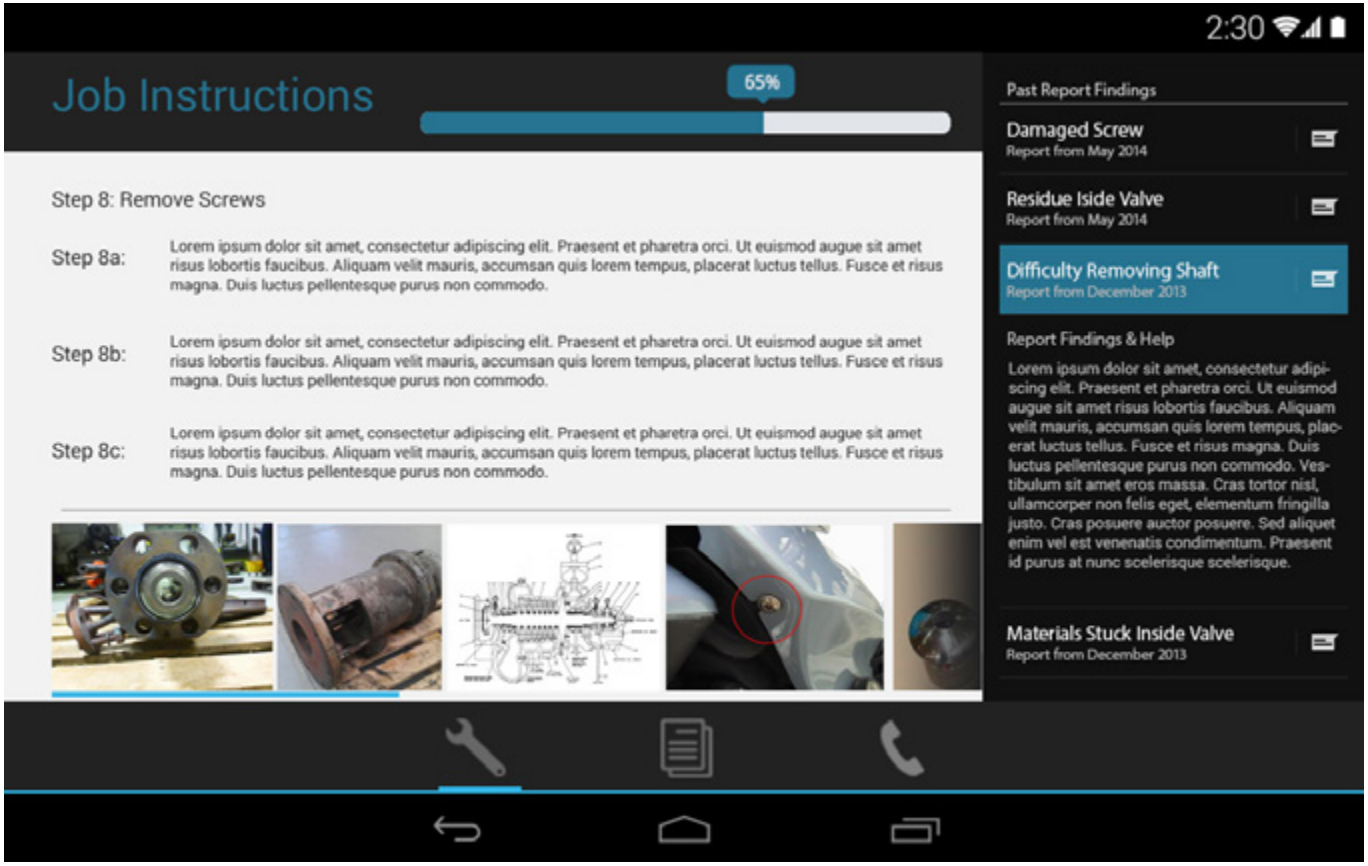
"Glasses, back to task"

"Next step"

The next step is started and the process will repeat.

1st Tablet Mockup

We decided to first mock up the tablet interface. This was because the glasses interface is fairly simple and we wanted to pay special attention to the content on the tablet and how this will provide a more detailed and enhanced version of the glasses interface. The main use of the tablet is to provide extra information, in a different way, due to various limitations with the smart glasses we are using.



The first screen that we looked at was the job instructions section of the app. This page includes a progress bar at the top of the page as a visual indication of how close to completion the overall task is.

Below that in the main content area is the current step that the user is on. This will be supplied in a series of steps in text. This is because text cant be displayed well on the smart glasses, and so incorporating text into the tablet app will be a great help to the user.

In the “past report findings” this will help the user because it could provide an answer to a problem without the need of contacting external specialists.

Below the instructions we have the helpful images. This is a section of images that have been sent to the users in the past, or images taken by other workers that relate to the step they are on. This is how our user manuals will grow, this is user generated content that will be helpful to the users situation.

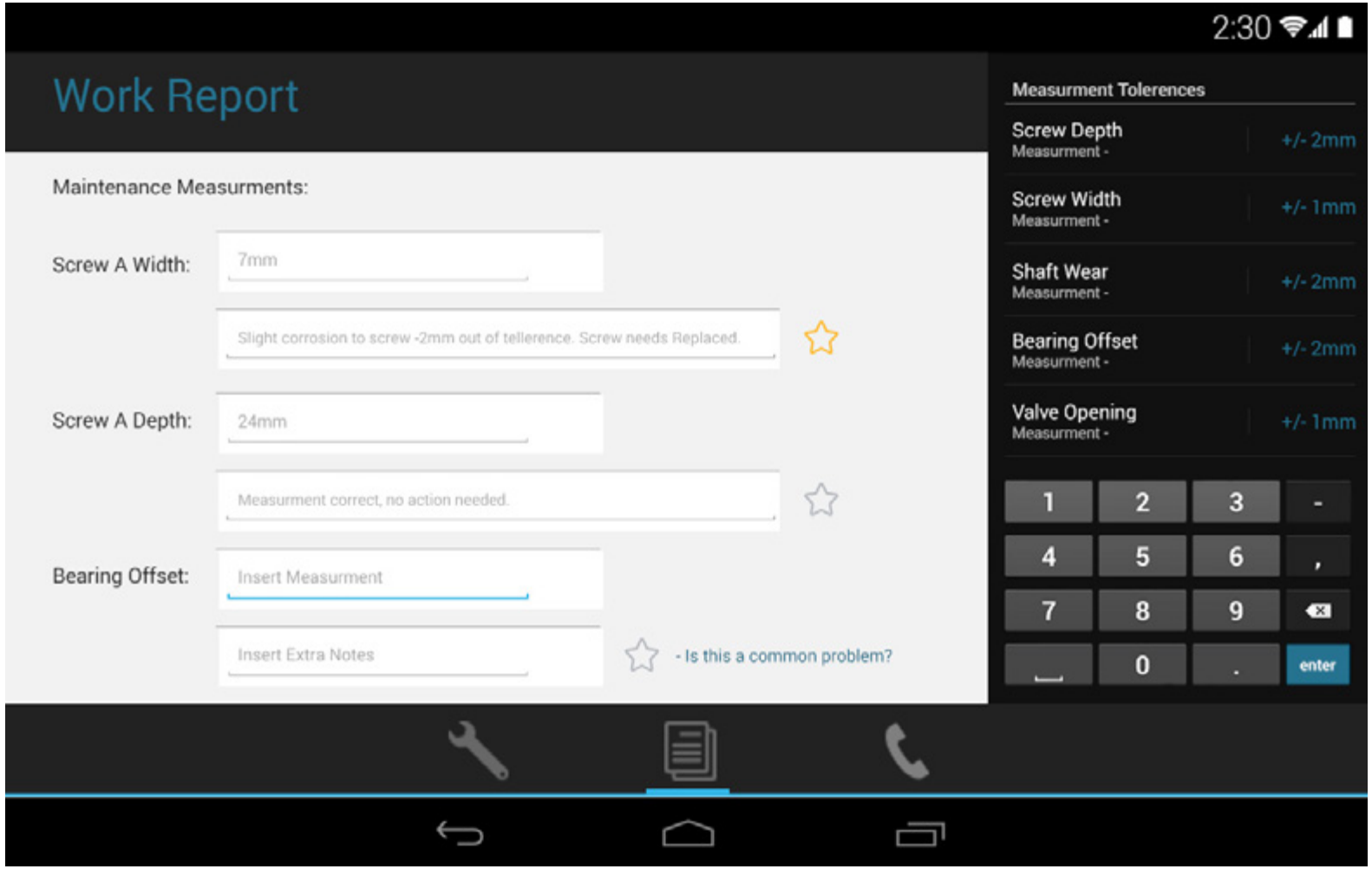
On the right there is the “past report findings” This section will be again user generated. When filling in the report, the user will be able to select various points that are a common problem, and these points will then appear in future job manuals

1st Tablet Mockup

The second page for our ipad app is the Work Report page. This is where the user fills in the measurements taken during reporting and also points out any other problems. There is a text field for measurements and also extra comments. These extra comments can be “starred” (as mentioned on the previous page) and will then appear in the “past report findings” on the Job page.

Also on the right of the page there is a section displaying the measurement tolerances. This will be helpful for the user to refer to when taking measurements to make sure that they know the measurements are correct.

We have also inserted a numeric pad in the bottom of this section to allow the user to easily input numbers, as speech recognition is not the best with large numbers and measurements.



1st Tablet Mockup

Finally is the job assistance screen for the tablet app. This is the section in which the user will be able to call an external helper and request information to be sent to them over the wifi network. The users glasses will stream video straight to the external helper so that they can understand the current problem and send information accordingly.

The main attachments will appear in a list on the right hand side of the page, the user can then select these attachments and view them in more detail.

There is also the option to share the images with colleges on this page, so that if one member of the team gets a helpful images, they can then send this to the other workers they are with to help them to understand the solution better.

1st Mockup Feedback

Mockup Feedback points.

We all discussed the mockups ides over Skype and decided on the following points:

- The main feedback points for all pages mainly concerned the navigation, the current style is not in keeping with android guidelines and so this will have to be changed. Also for the instructions it was recommended that we add in some “previous/next” buttons to allow the user to manually move back or forwards.

- The main feedback for the “report” page was to change the “star” icon, this is mainly because this is usually associated with something being good, and not a common problem. Also the measurement fields should be shortened, this is because the user may think they need to input more information because of the size of the text field. Finally it was recommended to remove “enter” from the numeric pad and replace this with a symbol just to aid with non-English users and to reduce confusion. All of these points will be taken into consideration when we take a second look at the design of this app.

- It was pointed out that on every page, the text seems to be too small for a tablet, this will need to be examined and improved in the next iterations. This application is being designed for a 10inch tablet and so we will have to ensure everything is correct.

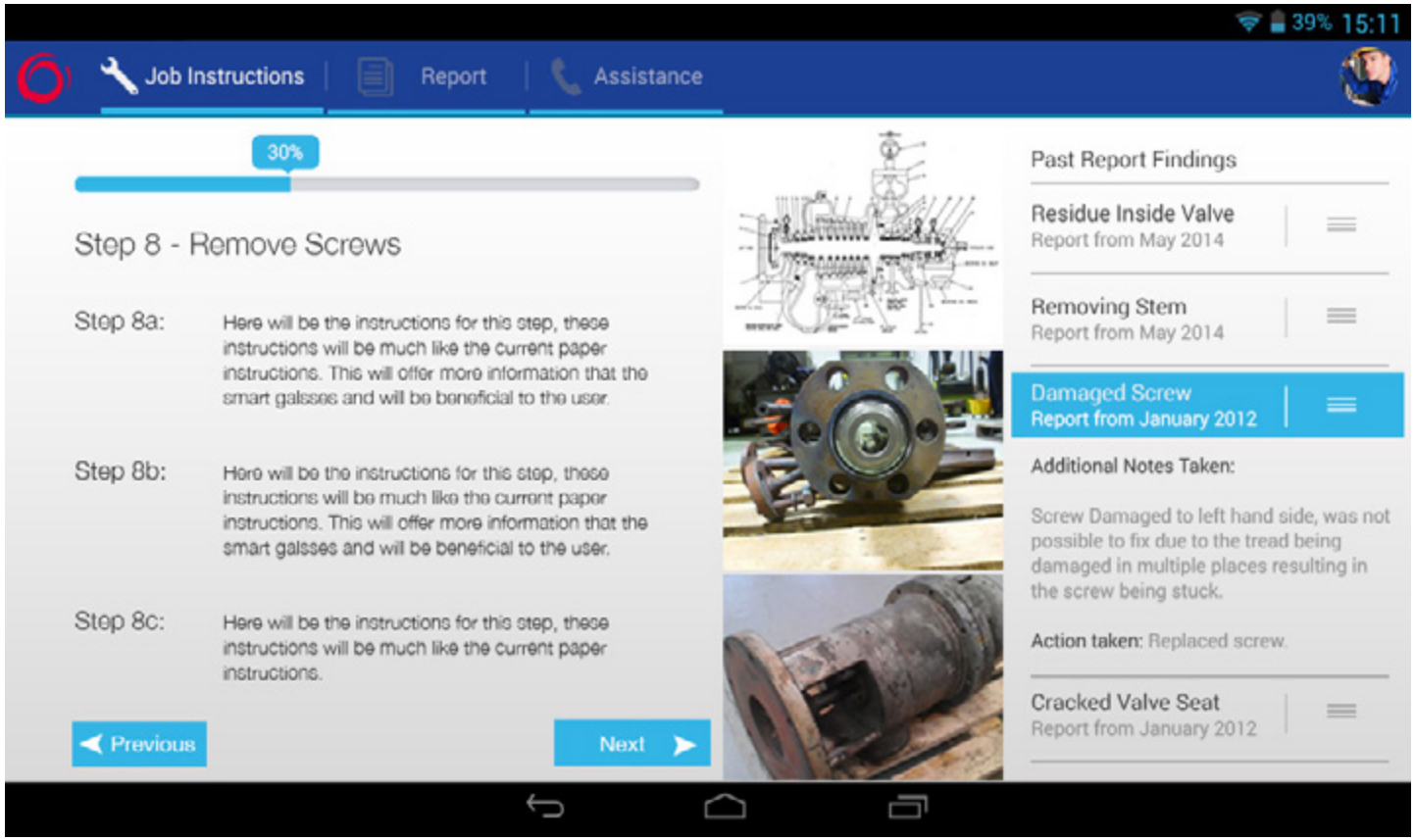
2nd Tablet Mockup

It became apparent to us that we would need to design a log-in page for the worker, each worker would have their own identification number and a password to gain access into the app.

With the new designs we wanted to try our best to follow the given feedback in order to make the app as functional as possible.

One main thought concerning the aesthetics of the app was the overall look. Some of us though it looked too dark and it didn't really follow any of the company colours and design - something that we should have taken into account earlier. To make amends for this, we have used a colour pallet of blues and silvers to follow Alstom's brand colours.

2nd Tablet Mockup

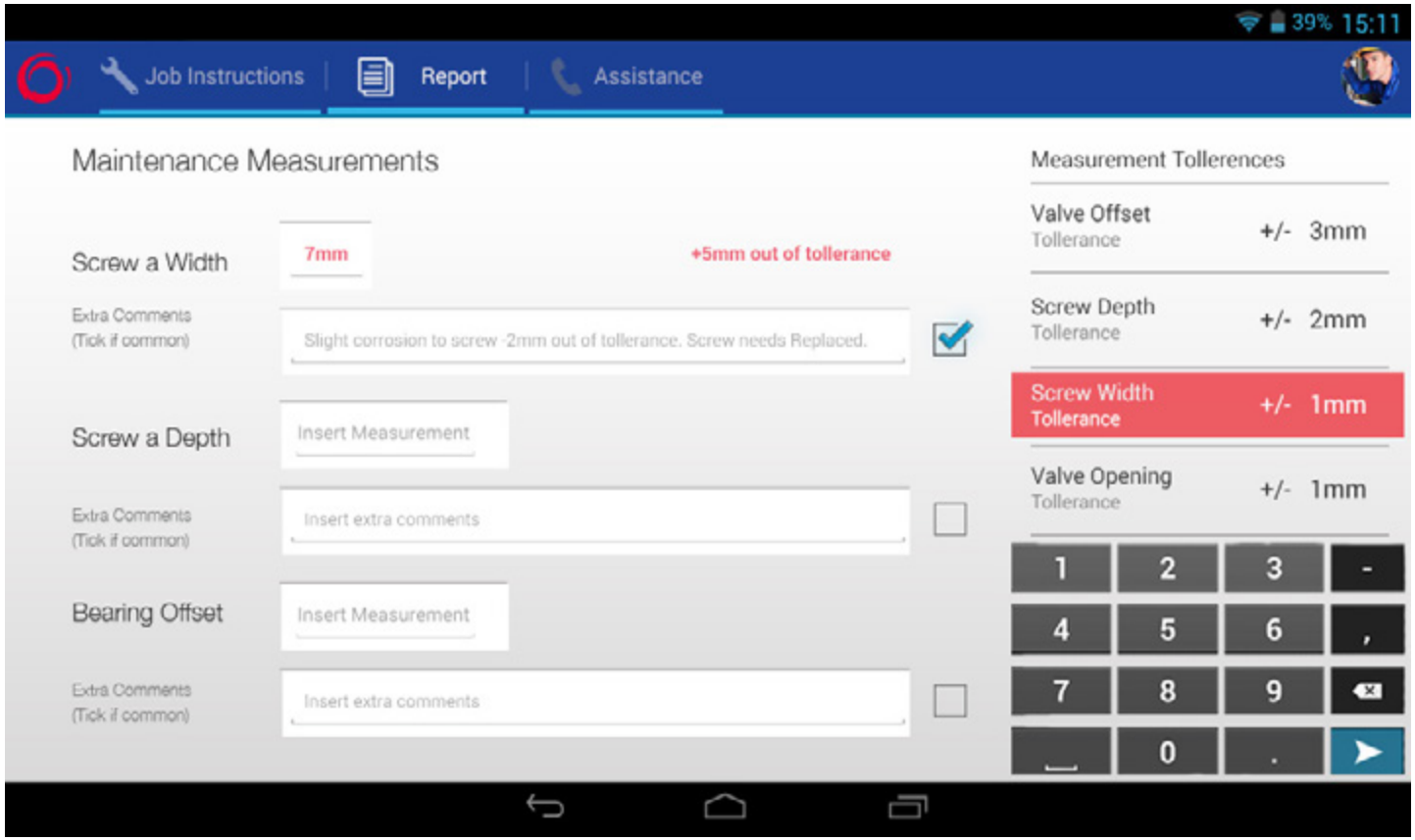


Here is the second iteration of the “job” screen. As you can see there have been some large changes to this page. The main change is the addition of the navigation at the top of the page. The navigation has been changed to follow Android guidelines. There is now a tabbed system at the top for navigation to allow the user to navigate easily through the app. This also frees up more screen space, before, there was a lot of space taken up by the chunky buttons at the bottom.

We have also added in some navigation buttons onto the instructions, this will allow the user to switch between instructions if they do not want to use the voice control that will be available.

The layout of the images has also changed, with the being displayed down the right. The user will be able to click on these images and view them in more detail.

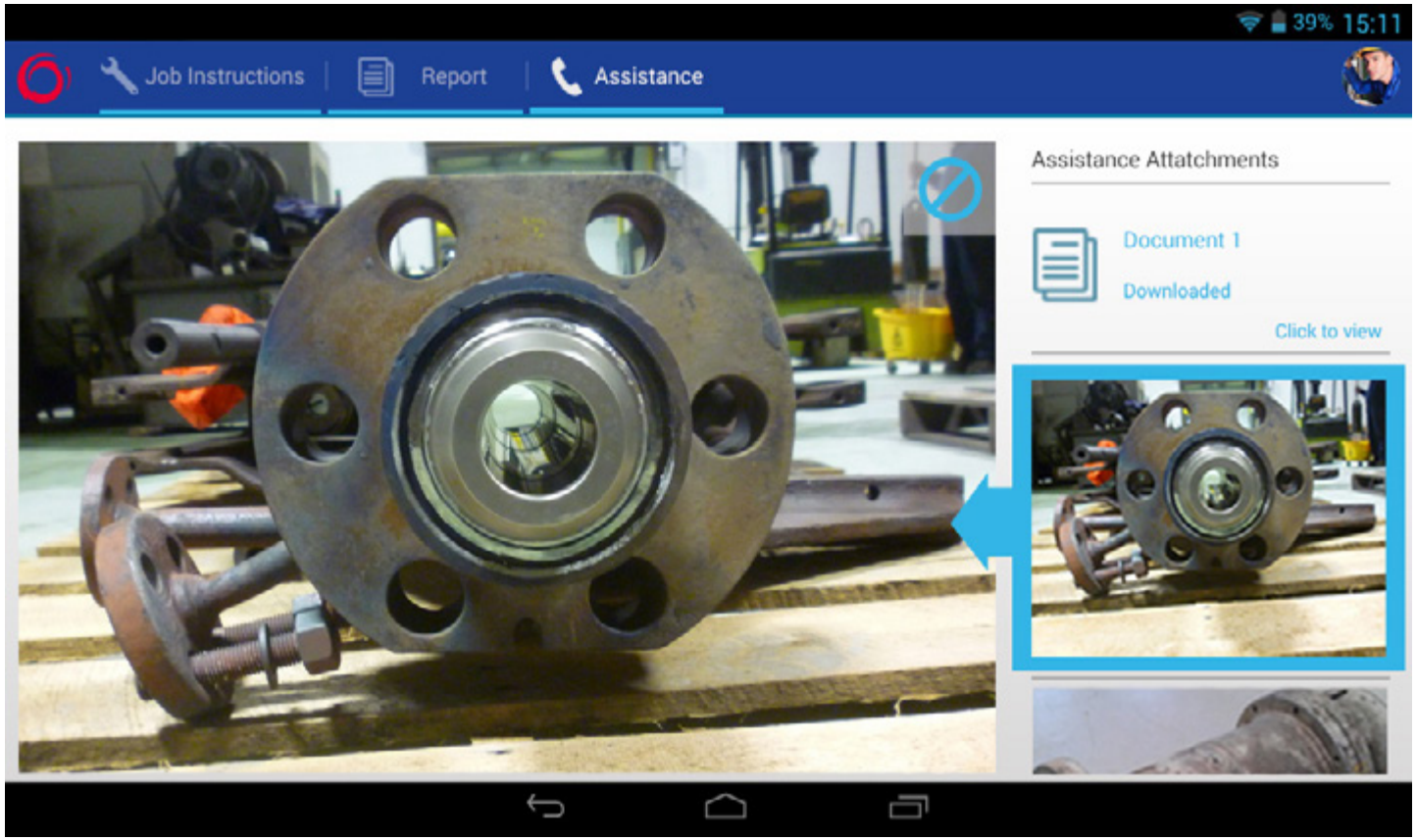
2nd Tablet Mockup



We have also taken a second look at the report screen to iron out any problems. It has been difficult to keep in the idea of a growing manual whilst also making it easy to report certain measurements. To do this we have included a field for a measurement, a field for extra comments and also we have changed the star to a tick box to state if it is a common problem. If something is common then it will be displayed on the “job” page in the right-hand column. This allows the manuals to grow with comments from workers that are both helpful and relevant.

We have kept the tolerances on the right side of this page, however we have added in an extra detail. That being a traffic-light system to notify the worker if the measurement they have taken is within tolerance. Red being not in tolerance, amber being on the border. The corresponding section will light up with a warning message to alert the worker.

2nd Tablet Mockup



Finally we have the assistance page for the tablet app. Not too much has changed on this page apart from aesthetic changes. The assistant will still be able to share images with the worker. These will appear on the right. The worker will ten be able to click on these images and view them in more detail, and also share them with other workers.

It is also worth noting the addition of part of the Alstom logo in the top left corner of the page, this is just a small detail to relate the app back to Alstom. Also we have added in a small avatar in the top right just as an indicator of who is using the app. The user will be able to click on this to reveal the option to log out of the app.

2nd Mockup Feedback

Mockup Feedback points.

We all discussed the mockups ides over Skype and decided on the following points:

- Most of the points were positive for this iteration of the app. There has been a definite improvement to the look of the app and some of the functionality has been improved.

- Small details such as buttons and icons could be changed to make the app follow a more 'flat' look, however the app must still be user friendly.

- The Report page still needs to be improved, at the moment it is still a little confusing.

- Also we should remove the numeric pad on the report page and make it only appear when the user is inputting numbers. There is no need for it to be there all the time.

- We should add in an icon to show the glasses are paired with the tablet.

- Also an icon to allow the user to activate voice commands.

- We should also add in the actual instructions from the manual Alstom have gave us. At the moment we have useless information that has no context!

- Also we should think about the tools the worker will use. These are in the instructions so imagery will be helpful for this.

3rd Tablet Mockup

There was not much feedback to take in to account when it came to the login page for the app. We decided to just look at the aesthetics in a little more detail. We had a look at the current visual identity for Alstom and decided to include the detail at the bottom of the page because of this. This shape is on all of their promotional material, and also the signage around their factories.

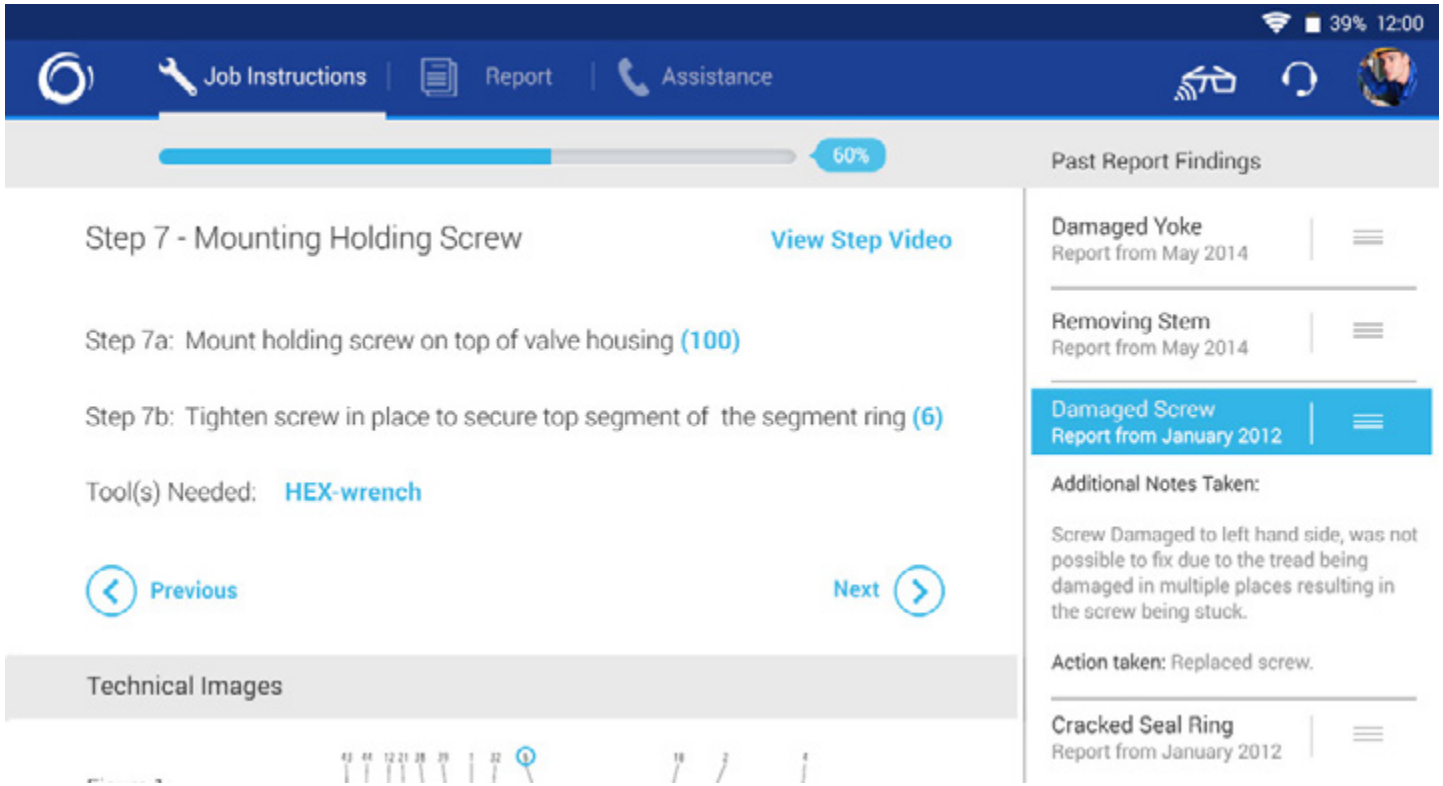
We also added in a low opacity version of the “O” from the logo just as an extra detail in the background.

3rd Tablet Mockup

We have also added in this extra page to allow the user to connect the tablet to the glasses they are wearing. This screen will appear after login and will display a list of all nearby glasses that are available to connect. Once the user selects their glasses, a notification will be sent to them to connect the two. Once the user accepts this then the two will be able to work together.

This screen also gives the user the ability to only use the tablet if they want. The tablet is more than capable of showing the user what to do on its own. This puts the user in control of the information they will receive.

3rd Tablet Mockup

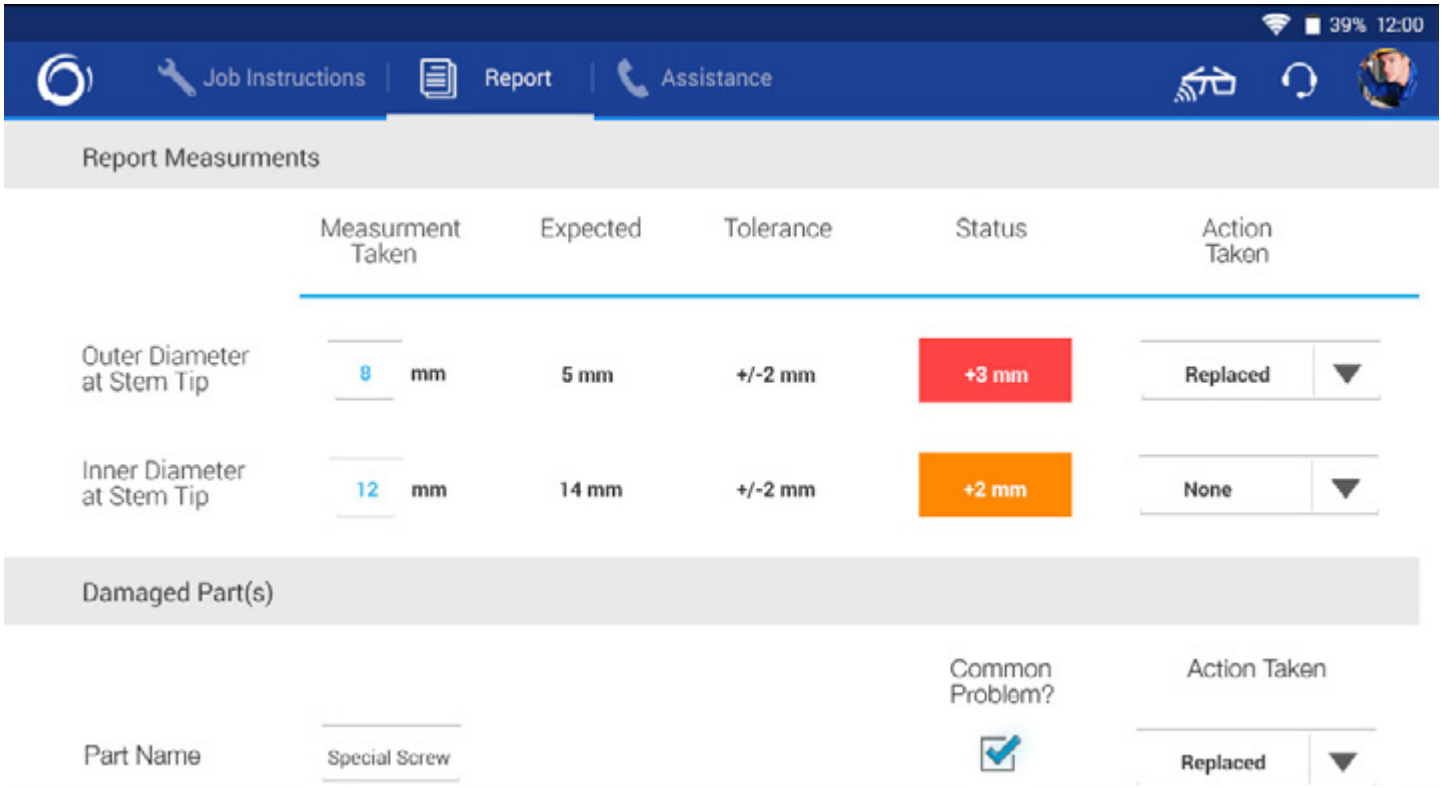


The Job page has had a few more improvements. We have re-thought the use of space on this page, as we thought 3 columns was too much in the previous designs. We had never thought of the page as a scrollable area and had tried to squeeze everything into one small section. However we have now changed this, making the page be scrollable so the user can have a closer look at any images that come with the instructions. We have also inputted the instructions that we were given from Alstom to make the manual have some context.

In the manual, all of the steps have numbers alongside them. These numbers relate to certain parts of a technical drawing that is supplied. We have placed these technical drawings further down the page, along with the tool that is required for that step and the animation video we have created for the disassembly. Also the numbers are highlighted in blue, which indicates to the user they can be pressed. If the user selects a number, the page will automatically scroll down the relevant image.

The look of the previous and next buttons has also been improved to look more simple.

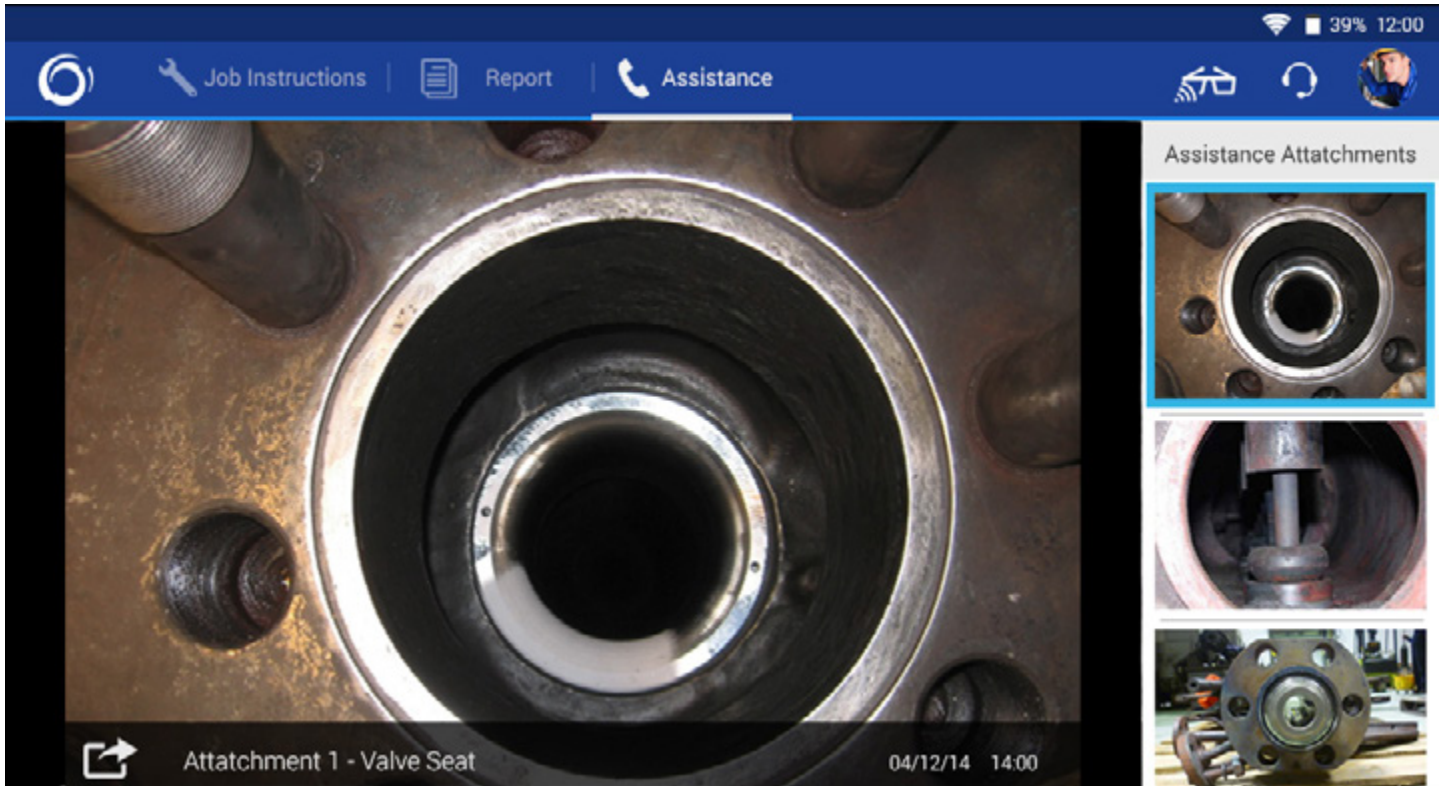
3rd Tablet Mockup



The layout of the Report page has been completely changed. We have looked at the instructions from Alstom and inputted the measurements that need to be taken. We have added in fields for the measurement, the expected measurement, the tolerance and also the status of the measurement. This is similar to the previous designs but it is now much more user friendly and easier to understand. We have also added in the Action Taken field, which allows the user to state weather they have replaced a part or not.

We have also added in a Damaged Part form that the user can fill in if there are any other parts that are damaged. This is a much better way of allowing the manuals to grow, if there is any part damaged, they can state which part, add notes and state the action taken.

3rd Tablet Mockup



Again we have kept the Assistance screen fairly simple. However we have changed a few things. We have made the right column smaller, as these are really just thumbnails. This allows for a larger selected image that the user can see in a lot more detail. We have also added in a bottom bar that states some information about the image and also an ability to share the image. When selected a list of the co-workers will appear and allow the user to share an image.

We have also taken into account other points for improvement by adding in an icon to display if the glasses have been paired with the tablet, and also an icon to allow the user to select if they wish to use voice controls.

Glasses Interface

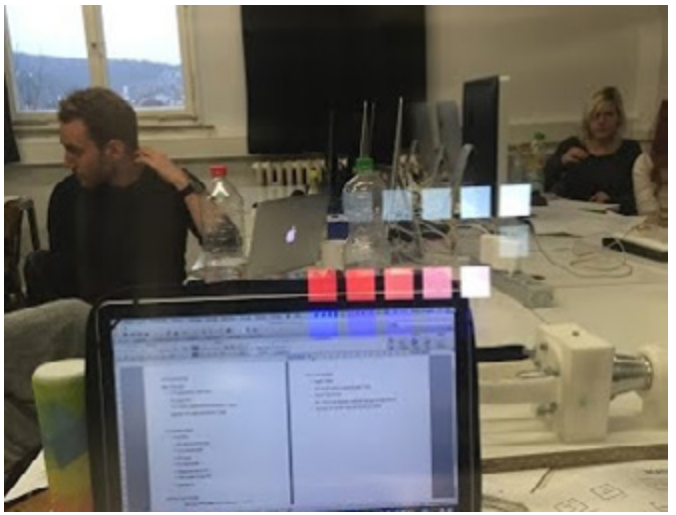
Further Glasses Research

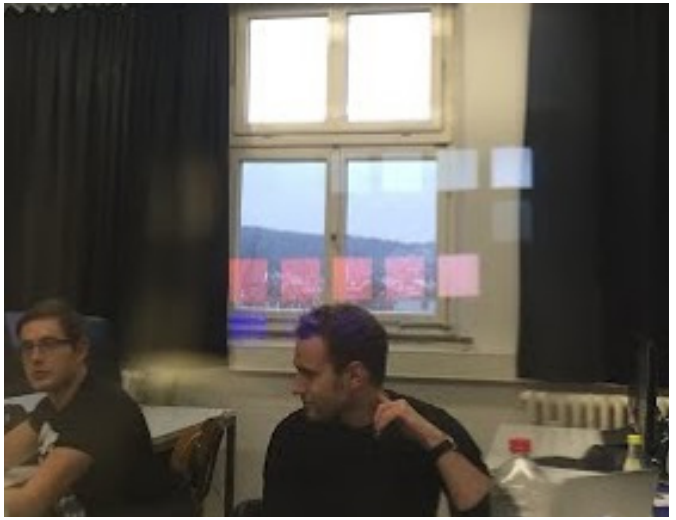
The feedback from the glasses wireframes was all positive and so we decided to take forward the current wireframes that we have created. However, we wanted to ensure that our interface was as easy to use as possible. To make sure of this, we conducted some extra research into the colours that could be displayed on the glasses, we anted to know what worked and what didn't.

To the right is some of the findings from this exercise. We established that white was the clearest colour to use, especially on a blank background. Also red and blue seemed to produce some clarity.

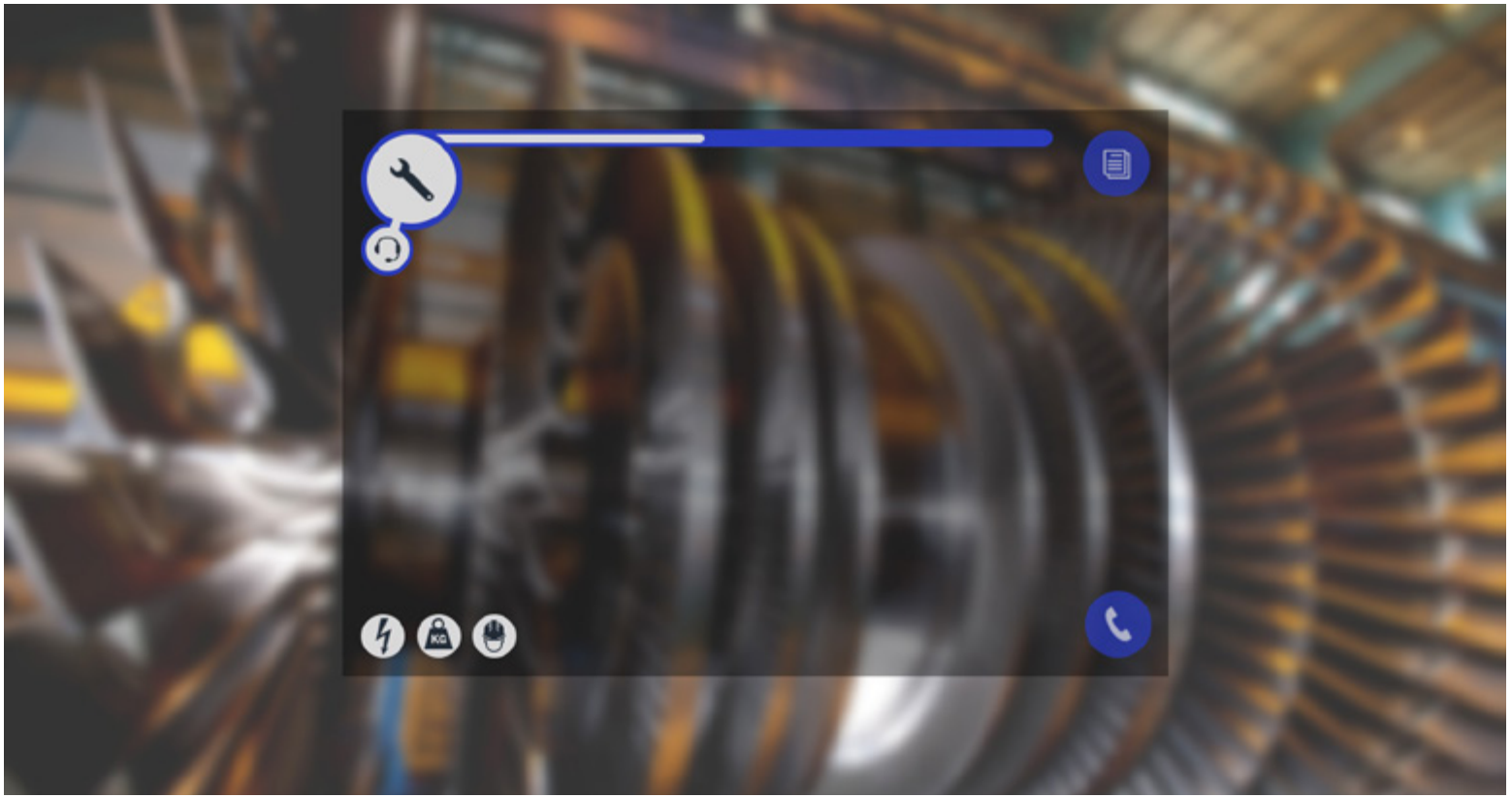
To conduce with this research, we decided to use white to display the 'active' state of the glasses and anything that needed to be clear. We decided to use blue as a secondary colour to use for the inactive icons and information that was less important.

On the following pages are the final mockups for the interface, displayed as the user would see them through the glasses.





Glasses Interface

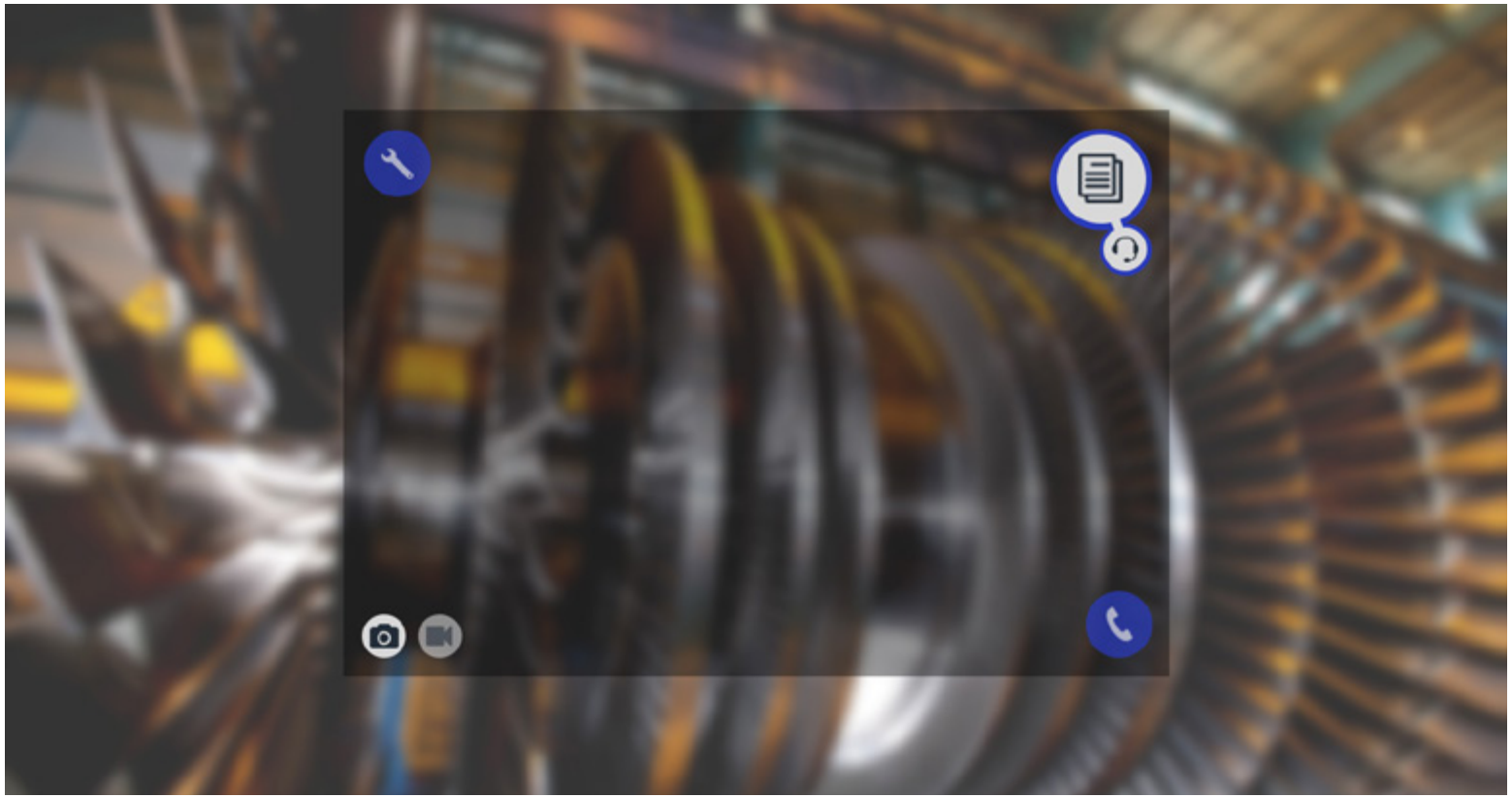


Here is the glasses interface for the Job section. We have made a few improvements to the wire-frames. The main one being we have removed the step number. This is because it gives no indication of progress. To solve this we have included a progress bar. This will match up the progress bar on the tablet interface to allow the worker to know how far along they are and how much more work they have to do.

In the bottom right we also have some safety icons. These will change depending on the step.

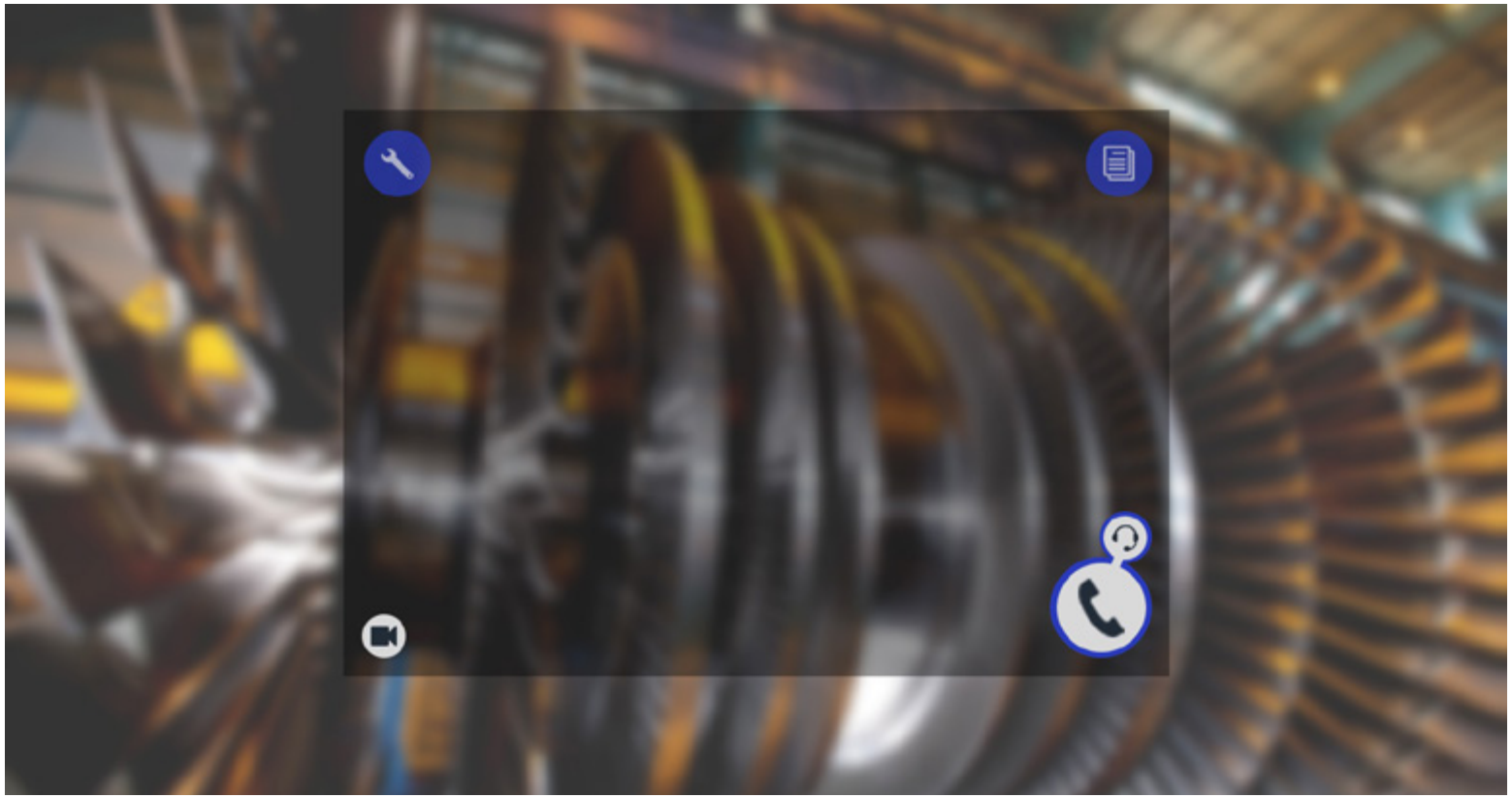
This page will also display the 3D renders of the machine disassembly to aid the user. These animations will appear in the middle of the users view. The user will be able to show or hide these through voice commands.

Glasses Interface



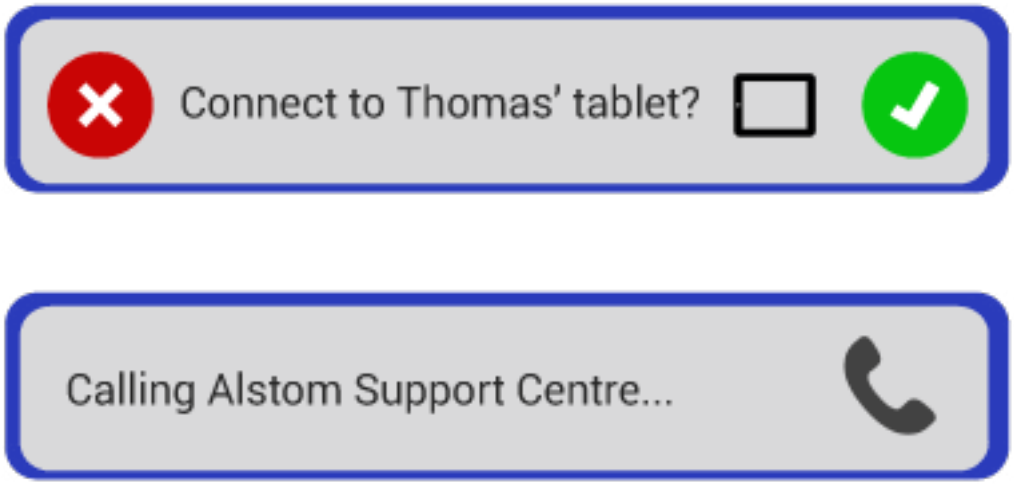
Second we have the report section of the interface. This page will allow the worker to take any images or videos to insert into the report. This page is mostly clear in the middle to allow the user to see through the glasses interface to concentrate on the report that will be displayed on the tablet.

Glasses Interface



Finally we have the assistance page. This page will be mostly blank, but will show the user that they are streaming video to the support centre. This will be shown by the icon in the bottom left glowing to show it is active.

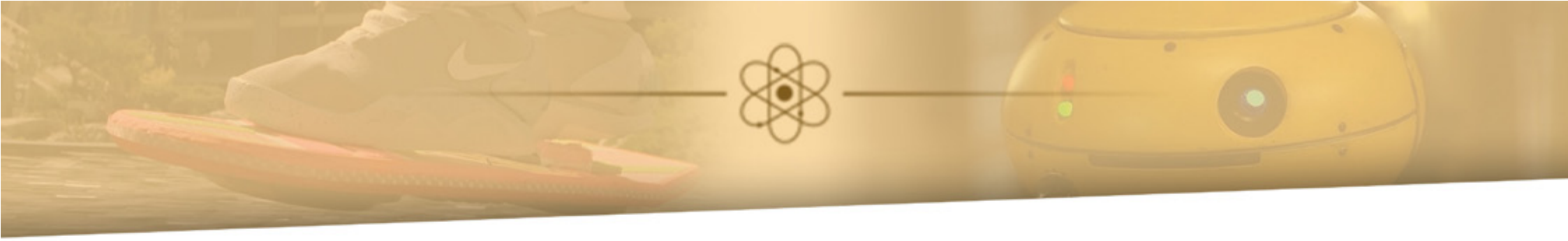
3rd Tablet Mockup



We have also created these two pop-up notifications for the glasses interface. These will be triggered when the user attempts to connect the glasses to the table and when they call the support centre.

The connect notification will allow the user to say “accept”/”yes” or “decline”/”no” to connect the glasses or not.

The calling notification will be displayed when the user is calling the support centre. This will only be displayed for a short period of time whilst the call is actually connecting.



2016 Prototype Creation

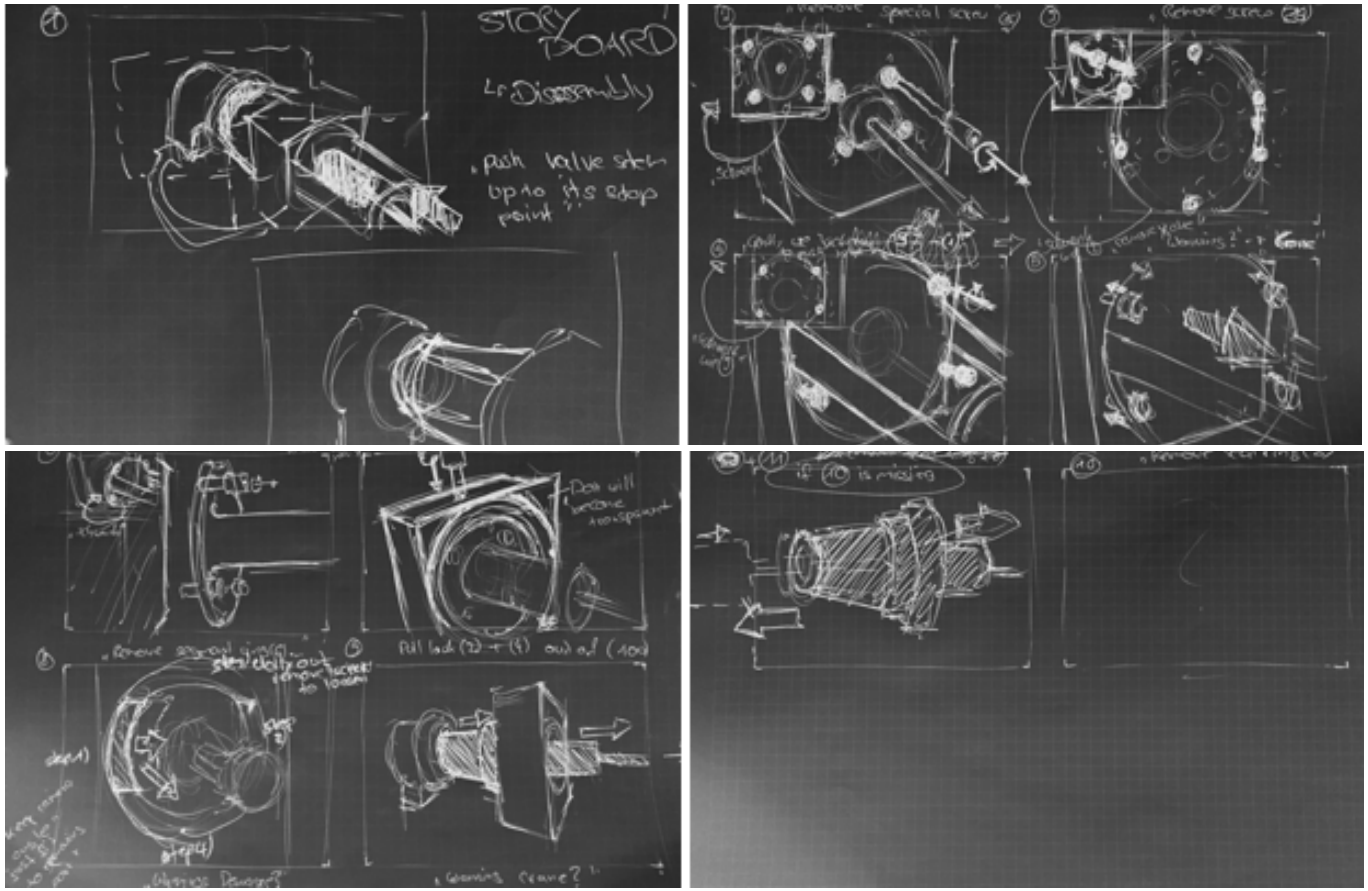
Once we had created out final designs for both the tablet and glasses interfaces, it was time to start creating interactive prototypes to showcase our work. We have decided to create a semi-functional glasses interface and also a tablet interface mockup.

Disassembly Animation Creation

As you will be able to see from our interface designs, we have also created a 3D disassembly animation video. This is to aid the worker with any steps that they may be unsure of. They will be able to request to see the animation and it will show them the job step-by-step with detailed animations.

We first drew out a storyboard for the disassembly animation (below) this was used to create the final animation.

We created the animation for the whole disassembly, however we will only show parts of this in our prototype.



Disassembly Animation Creation

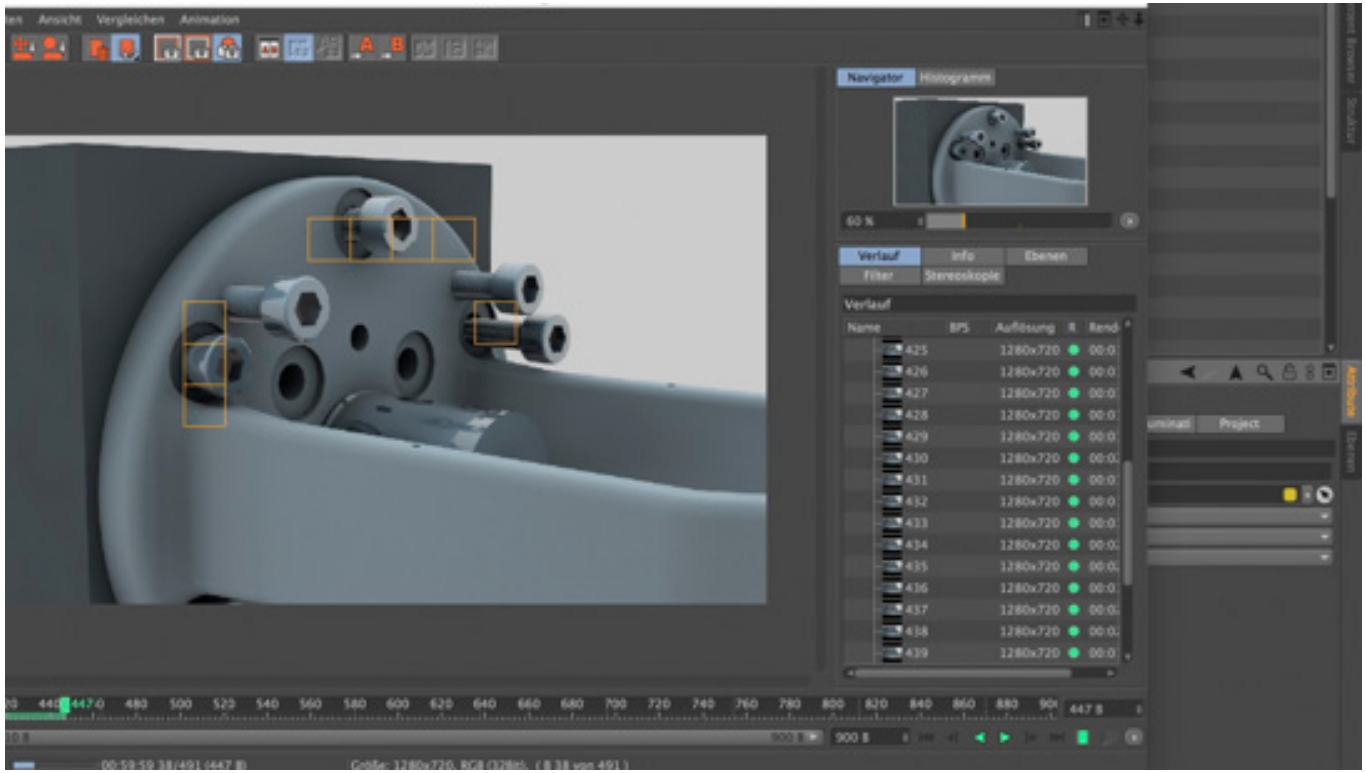
Once the storyboard was complete we could then begin to create the animation. We created the 3D model of the valve and imported this into Cinema 4D so that the model could be animated.

After that we inserted the lighting around the model and created the camera movements to pan around the model to show it from various angles to allow the user to understand the step fully.

After that the parts were animated, for example the screws, to show the step in more detail and to give an accurate visual representation.

Finally we cut the animation up into separate parts for use within the user manual.

Below: Cinema 4D in use



Tablet Prototype

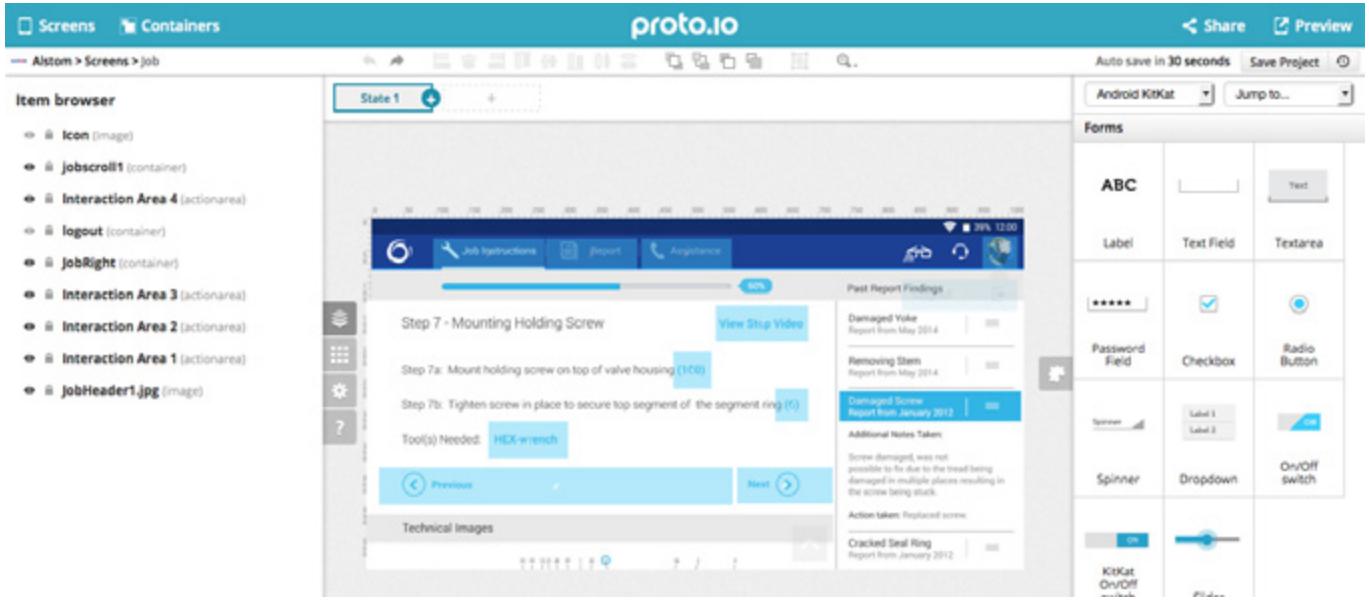
We began creating the tablet prototype in a program called Proto.io. This is a fairly new application that allows the user to create interactive app mockups for demonstration and user testing purposes. It also allows you to download an accompanying android or IOS app for you to showcase the interfaces on an actual tablet or smart phone. This was perfect for our project.

Proto.io has a pretty simple learning curve and so it was not too difficult to learn as we created the prototype. It mainly functions on setting out the main screens for the application. Within each screen you can place certain containers. These containers can be edited to be interactive, such as scrollable and they can also be shown or hidden on demand through simple commands. For example “If button X is pressed then show container Y”. This allows the prototyping to be a fairly quick process, but the final product is fully functional and impressive if you put the time and effort in.

We have made sure to include everything needed in this interactive prototype to allow the user full freedom of the app when testing. It allows the user to navigate through the app from the login screen, to connecting the glasses, to the job instructions, report section and also the assistance screen.

Below is a screen shot of the job instructions page. All of the blue squares on the page are interaction areas, to allow the user to tap, scroll or swipe to allow the user to interact as if it was a fully function application.

On the left of the screen shot you can see the list of items that there are on the screen. This screen has a number of containers placed on it to allow the screen content to change when a certain button is pressed.

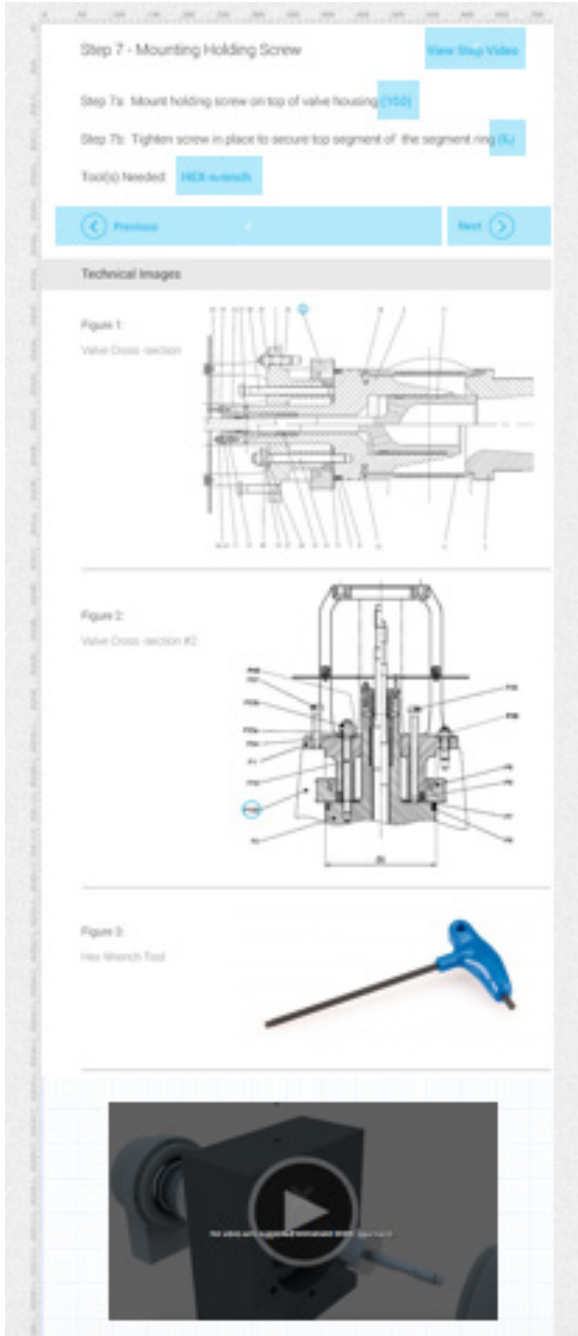


Tablet Prototype

To the right is an example of a container on this page. This container includes the detailed step instructions and also other information, such as the cross-section diagrams of the valve, the tools needed for that step and also the video that we have created. This container is scrollable to allow the user to look through the assets and look at them if needed. The interaction areas at the top are also there to aid user interaction. If the user presses on one of the blue words, the container will automatically scroll down to that section. So if they click “view step video” it will scroll down to the video and allow the user to view it. We have also added in the actual video into this prototype so everything works. However, this brings us to one of the limitations of Proto.io. For all it is a fantastic platform for designing prototypes, the videos take a long time to load, even on a fast WiFi network. We have found that there is no fix for this and other groups have mentioned similar problems. The file sizes of these videos are very small (4mb) yet the app cannot load them very quick. This is a shame but the user can still get a good idea of how the application works and how it could be used in a working environment.

We have also included a web-based version of this prototype. This can be found at:
http://platzh1rsch.ch/ipole2015/
The video does not play but the rest of the app should be fully functional.

proto.io



Glasses Prototype

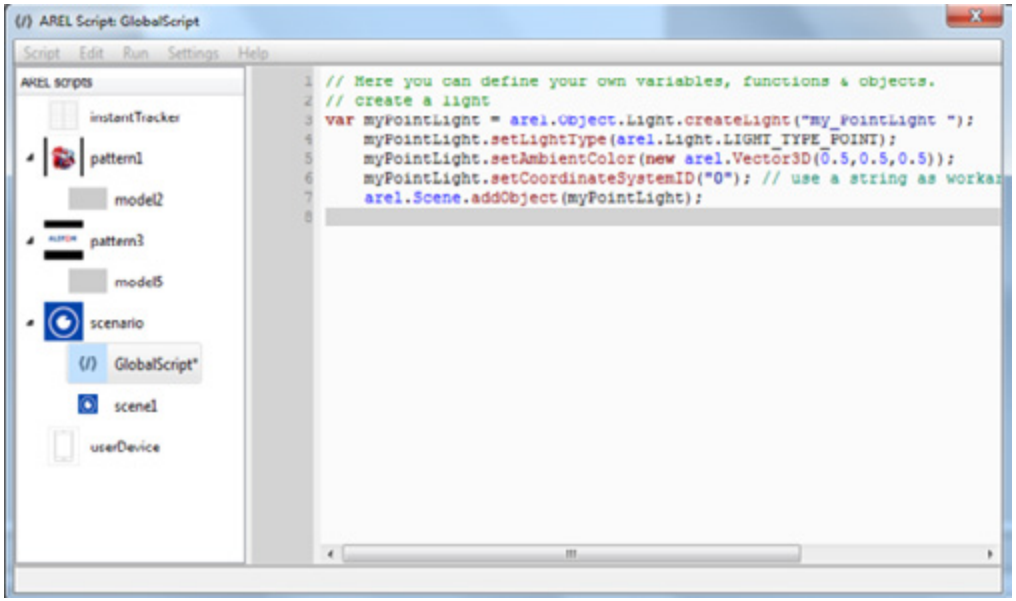
On the following pages are the steps that we have taken to create the Glasses Prototype. All code snippets are shown in Blue Text

Create Trackable / 3D Model in Metaio Creator:

First of we simply create a new project in Metaio creator. We use the Alstom logo as an image trackable and a 3D model of the steam turbine as the AR object to display.

Add lighting

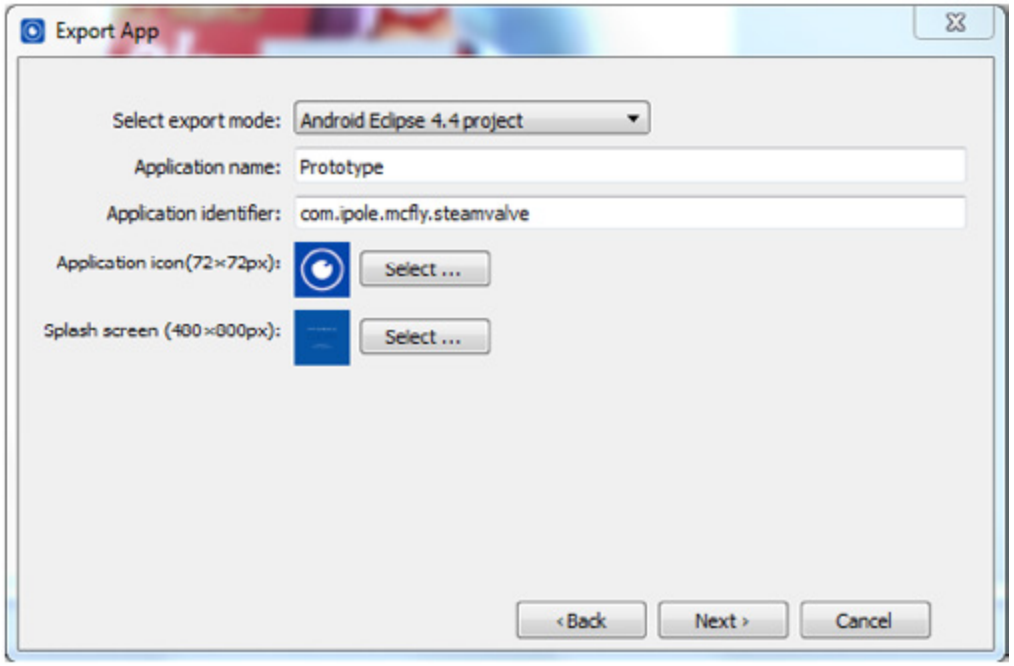
Because Metaio creator does not apply any lighting to 3D models by default, we have to do that ourselves using Metaio's ArelJS.



AREL Script to add light sources to the scene

Export to App for Eclipse

Now we want to export our scenario to Eclipse, to get more possibilities to interact with the android system. We can do that via Export App > SDK App > Android Eclipse project.



Export assistant of Metaio Creator

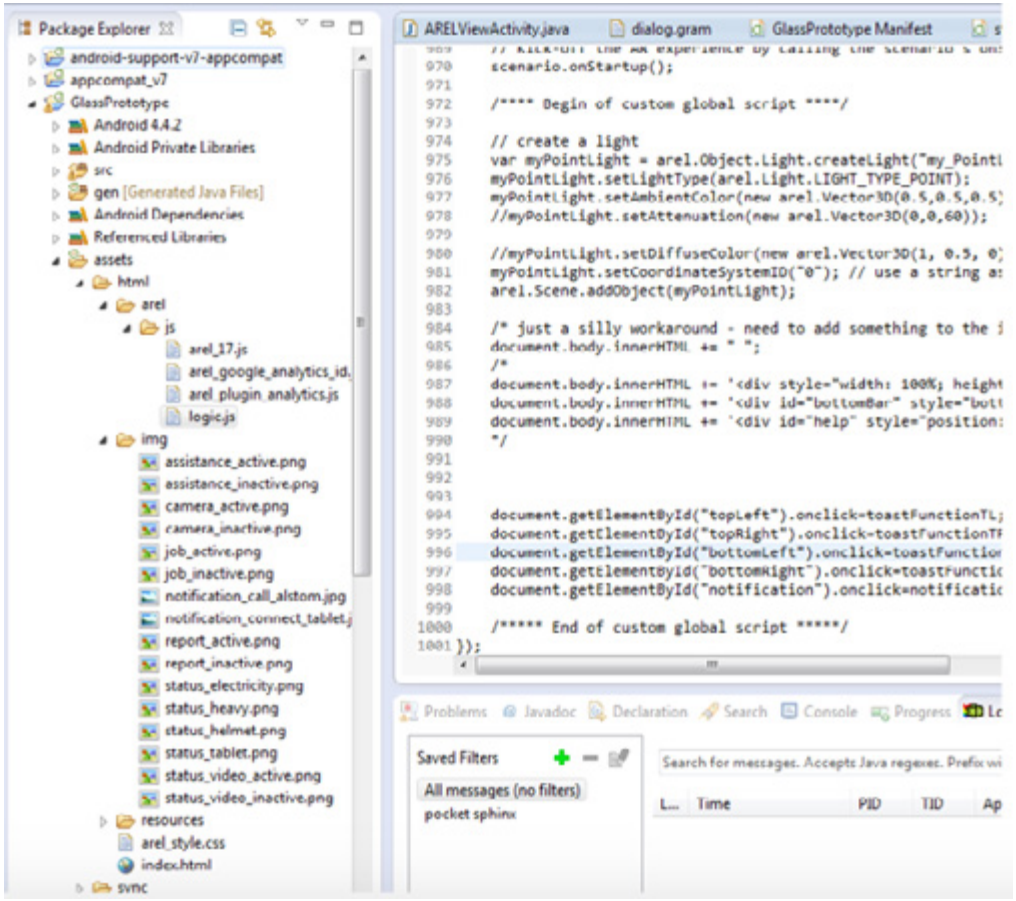
We can then import the just created project into Eclipse and start to customise it.

The configuration which trackable to look out for and which 3D model to display is stored in the assets/index.xml file. So it is no problem to replace the trackable or the 3D model later on.

Glasses Prototype

Adding GUI elements

The next step was adding all the GUI elements from the glasses interface we all agreed on. Thanks to Metaio ArelJS this is quite easy. All the ArelJS files can be found in assets/html/arel.



ArelJS files in the previously exported eclipse project

Glasses Prototype

First of we needed to add all the icons to the img folder and create the structure of the interface in index.html using arel_style.css to position and style everything. In a next step we then needed to add interactivity based on touch events. We added this into logic.js. The workflow was similar to creating a website.

Screenshot of the glass interface with all GUI elements added

Set up Javascript Bridge

As the whole ArelJS interface is running in a WebView container overlaying the camera image, we need to be able to control this WebView from the native Java code of the app. All we need to do to enable this, is to add a Javascript interface to the WebView in com.ipole.mcfly.steamvalve.ARELViewActivity.java.

```
@SuppressLint("SetJavaScriptEnabled")
    protected void onStart()
    {
        super.onStart();
        // attach a WebView to the AREL interpreter and initialize it
        mARELInterpreter.initWebView(mWebView, this);
        mWebView.getSettings().setJavaScriptEnabled(true);
        mWebView.addJavascriptInterface(new JsObject(), "myInterface");
    }

//Here you define all the methods that you want to access from Javascript
    private class JsObject {
       @JavascriptInterface
        public void showToast(String s){
        Toast.makeText(getApplicationContext(), s, Toast.LENGTH_SHORT).
show();
        }
    }
```

Code to create Javascript interface in the native code

Call Java from Javascript

We can now easily call Java code from Javascript:

```
window.myInterface.showToast("job description");
```

Call JavaScript from Java

The Javascript Bridge also works the other way around, so we can now call Javascript functions from Java code. The only requirement is that the Javascript function is public. This is important if we want to change the look of our application based on events in the native code.

```
myWebView.loadUrl("javascript:myjavascriptfunc()");
```

Voice Control / Speech Recognition

The next step was adding voice control, so that the user can interact with the app by using voice commands to switch between views and react to questions and dialogs.

Requirements

braucht RECORD_AUDIO permission - http://developer.android.com/reference/android/Manifest.permission.html#RECORD_AUDIO

Solutions

Android SpeechRecognizer
Google is providing every developer with a already functional SpeechRecognizer class through their Android SDK which was added already in Android 2.2 (Froyo). The service requires Google services to be installed and sends all the voice data to Google servers for evaluation. We read that it is also possible to download all the speech recognition functionality to ones own device to make it available offline, but we did not test this.

Source

Android Dev Guide, SpeechRecognizer class - http://developer.android.com/reference/android/speech/SpeechRecognizer.html

CMU Sphinx

CMU Sphinx is an open source toolkit for Speech Recognition developed by Carnegie Mellon University (CMU). It is able to work offline and there are libraries for various different platforms, one of them of course being Android. It is possible to create your own vocabularies and language models and it therefore works with all kinds of different languages.

Source

CMU Sphinx Website - http://cmusphinx.sourceforge.net/

Conclusion

While Google SpeechRecognizer may be more precise in recognizing speech commands, it has other limitations: it only works online (although you could download all the speech recognition data) and “always-listening” is limited to 10s (to decrease unnecessary server traffic). Also you need to have the google services installed on your smartphone, which the Epson glass does not have per default.
Sphinx on the other hand is a platform independent open source Java Framework that works offline and with lots of different languages.

Glasses Prototype

CMUSphinx.

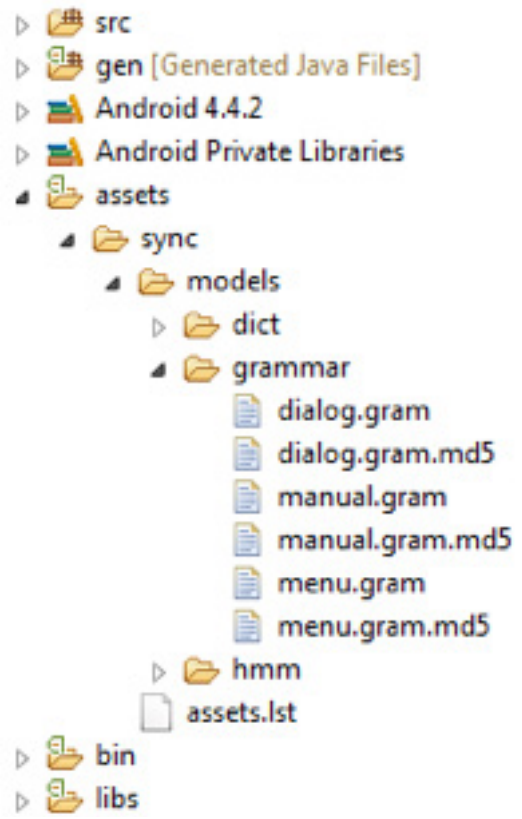
All modern descriptions of speech are problematic to some degree. The only way to have a good speech recognition, is to somehow train your program with tons of voice data. Luckily for us, there are existing models for CMU Sphinx for the English language.

Keyword spotting.

Always listening to everything being said, can cause a lot of errors and strange behavior. A better solution would be to do it like Google Glass, which seems to have some kind of different “listening states” and trigger commands to switch from one of these states to another. While in one state / context, the device only pays attention to the commands that matter for that state and ignores everything else. This is also called keyword spotting and is what we are going to use for our prototype.

Adding pocketsphinx-android to the prototype.

CMU Sphinx is providing a library specifically created for Android called pocketsphinx-android. It also contains a demo application demonstrating the basic features. The grammars defining what words the program should listen to can be found in assets/sync/models/grammar



File structure of the pocketsphinx-android demo application

Setup grammars

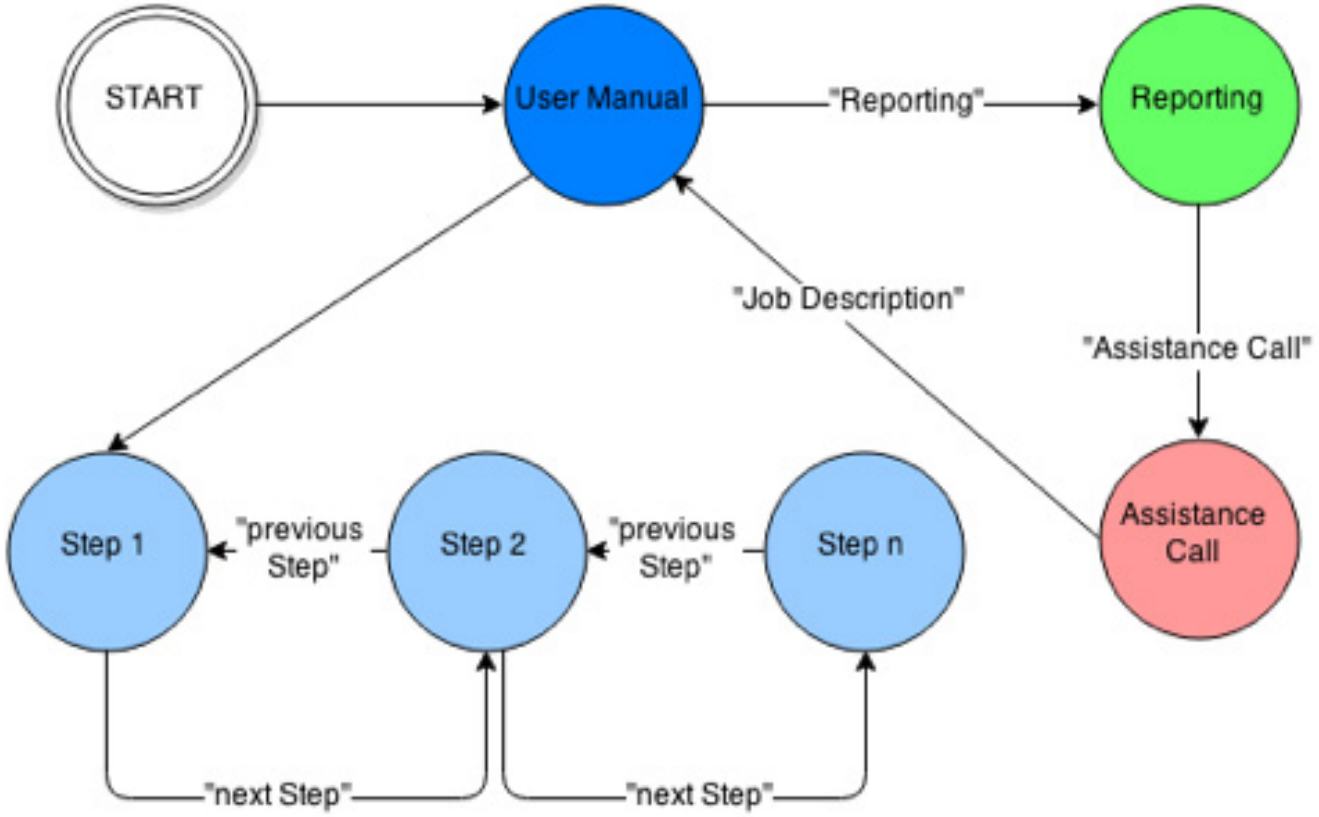
CMU Sphinx is using the JSpeech Grammar Format (JSGF), which is a standard format to define grammars used in speech recognition. You can find the w3c standard at http://www.w3.org/TR/jsgf

Unfortunately the Pocketsphinx JSGF compiler is incomplete. While it is supporting all the important functionality, it only supports one public grammar per file, and it does not support importing.

Glasses Prototype

State Diagram

The next step was adding voice control, so that the user can interact with the app by using voice commands to switch between views and react to questions and dialogs.



State diagram showing the different states of the glass prototype and the voice commands to change from one to the other.

Glasses Prototype

Grammars

Based on the state diagram we went on to create the different grammars for the different states. Basically every state knows the commands “Reporting”, “Job Description” and “Assistance Call”, so you can always switch directly to another state. In the User Manual state, you have two additional commands “next Step” and “previous Step” to proceed through all the steps.
For example the user manual grammar looks like this:

```
#JSGF V1.0;
grammar mcfly.manual;

public <command> = next step | previous step |
job description | reporting | assistance call;
```

The first line is just a comment, the second one is the name including the namespace of the grammar. On the last line is the definition of the grammar. “|” means “or”, so if any of these terms are detected, there will be an event in the application.

Screen recording for demo video.

Since Android KitKat (4.4), Android devices now have a screenrecord function that makes it very easy to make screen capture videos. Unfortunately the Epson glass is running Android 4.0.4 so we had to use a Nexus 7 tablet running Android 4.4.

‘adb -s 015d324925580a13 shell screenrecord /sdcard/alstom1.mp4’
stop capture with CTRL-C
‘adb pull /sdcard/alstom1.mp4 D:/alstom1.mp4’

Source: http://www.phonearena.com/news/How-to-record-your-screen-on-Android-4.4-KitKat_id49133

Source code

Of course this document does not contain all the source code of the glass prototype. However, all our source code is hosted in a private repository on github.com. We would be more than happy to provide anyone interested with a copy. Just write an email to:
christian.glatthard@students.fhnw.ch.

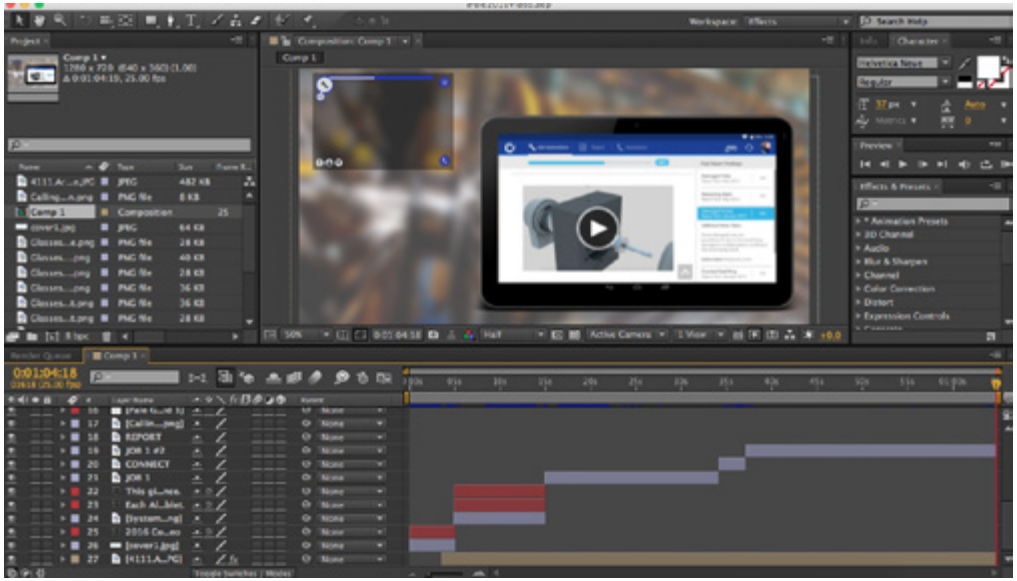
2016 Video Creation

Once we had completed the interfaces and prototypes for both the glasses and tablet interfaces, we wanted to create a short video to really show the interaction between the two and how they would complement each other. We wanted to show a workflow of the two interfaces and how the user would progress through a job using our two interfaces.

To create this video we first began in After Effects. We used this program to animate certain parts. We had created a previous video in which we attempted to show both interfaces on screen at the same time, however this did not work because you could not see exactly what was happening. We used after effects to make the interfaces shrink and grow to show when something was happening on that particular screen, you will see this in the video.

We have used the still mockups of the glasses interface in the video and animated them slightly to show how they would function and we have used a screen capture from Proto.io to show the tablet interface and how the user can interact with that.

We decided that the best way to communicate the interactions between the glasses, tablet and worker would be to have both visual and audio representations. We wanted to display not only the touch interactions of the tablet, but also the voice command capabilities and how the user can navigate through the application quickly.



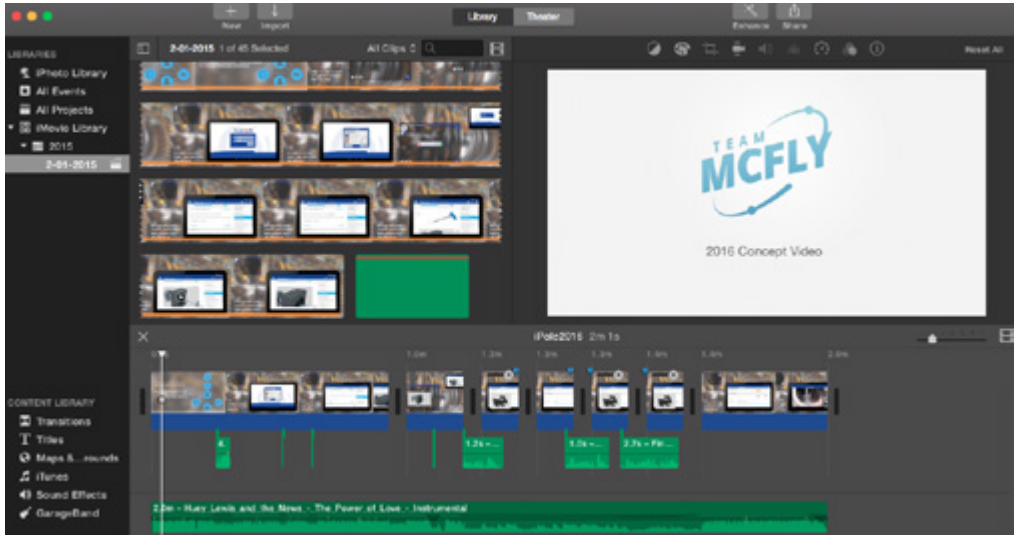
2016 Video Creation

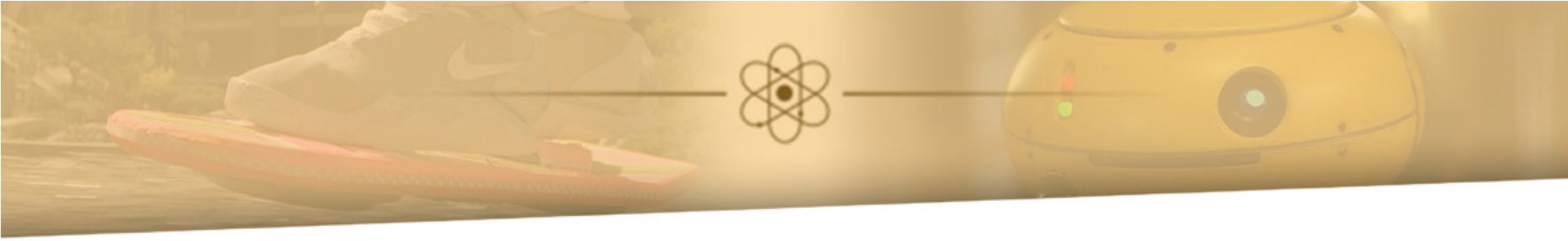
For the voice over, we wanted to make sure that everything was as clear as possible for the audience to hear, and so we used a specialist Tascam audio recording device to record a few small voice clips. These clips were then edited to take out any unwanted background noise and to make the audio as clear and as clean ad possible.

Once the voice over was recorded everything just needed to be put together, We used the program iMovie to edit everything together. Although it is a fairly basic program, it was all that we needed to combine our audio track, video and also a backing track. We have also added 'ducking' to the backing track, so that whenever the main voice over is on, the backing track is lowered to make sure the voice over can be heard perfectly.

Also because we are team McFly, we have used a slight back to the future reference in our video, that being the backing track. We have used an instrumental version of "The Power of Love" that was featured in the back to the future soundtrack and movie.

A link to view the 2016 video can be found at the beginning of this document in the "Business Summary" (bottom of page 5).





2024 Vision Development

Running alongside our 2016 development, we also had to focus on our design solution for 2024. We had to keep in mind our group aim of providing the right information, for the right person, at the right time. We also had to create a possible solution for Alstom in the future, where almost anything could be possible.

2024 Choice Of Technologies

In order to develop our vision for 2024, we conducted research into different directions: We looked at smart materials, holograms, wearable technologies, brainwave technology, the internet of things, smart glasses, smart contact lenses, nanotechnology surfaces, holograms, projected interfaces, etc. Everyone researched into a direction they were interested in and in the end we presented our findings to each other.
In the next step, we started discussing which of these technologies we could use to improve user manuals in 2024.

From the beginning, brainwave technology was a hot favorite. We were quite excited about the new possibilities that this technology would bring. We were convinced that with this technology, we could save Alstom a lot of time – after all, if they just had to "think" the report rather than write it by hand, the whole process could be sped up considerably. However, after discussing things for a while, we came to the conclusion that brainwave technology would probably also come with a few downsides. We imagined that the employees would be quite skeptical about this technology. After all, who could prove to them that the technology would only read the thoughts they used to control the system. We could imagine that the employees would have many questions regarding this technology. For example: "If I had a bad day at work and thought 'I really should find another job' – would that send notification to HR straight away?" It would be hard to prove to them that this kind of thoughts would not be read.
So then, after discussing things for a while longer, our solution for 2024 would consist of three key components:

•Internet of Things (IoT):
The machine is self-diagnosing, i.e. it continually takes measurements and if something is out of order, it sends a message via IoT. As a result, the technician will know exactly what is broken and will not have to spend time searching for the fault. In addition, he will already know which parts will need to be replaced. This will save Alstom a lot of time (and, therefore, money).

•Smart materials:
The technicians will wear jackets made of smart materials. Parts of the jacket can be used as a screen, for example. This has the advantage that the technicians no longer have to carry around an additional device. All the devices are integrated: Either in the jacket or in the safety glasses.

•Holograms:
The hologram will illustrate how to take the machine apart. For example, it shows the technician how to remove the screw, and then the technician removes it. Then, the hologram shows the technician the next step, etc.

2024 Research

Internet of Things (IoT)

The Internet of Things is no longer a futuristic vision: Large companies such as Cisco (http://www.cisco.com/web/solutions/trends/iot/overview.html) already offer IoT solutions for various industries. In a press release dating from March 2014, Gartner, the world's leading information technology research and advisory company, even reckons that "By 2020 the IoT Will Include 26 Billion Units"

Smart materials

There are many different types of smart materials and first applications can be found in the medical industry. For example, the NHS funded a unique steerable catheter project that is based on shape memory materials are used: "The device has small pieces of shape memory alloy disposed at its tip, each piece of metal is electrically heated, as it become warm, it deflects the catheter tip in a controllable and precise way."
In her paper INTRODUCTION, CLASSIFICATION AND APPLICATIONS OF SMART MATERIALS: AN OVERVIEW (published in the American Journal of Applied Sciences in 2013: Sasmita Kumila lists different types of smart materials, outlines the self-adaptation characteristics of such materials and describes the resulting advantages: "By changing their properties, smart materials can detect faults and cracks and therefore are useful as a diagnostic tool. This characteristic can be utilized to activate the smart material embedded in the host material in a proper way to compensate for the fault. This phenomenon is called self-repairing effect." We think this is a very interesting application of smart materials and one that could help Alstom reduce down time.

Holograms

There are also interesting developments in the area of holograms. The British company Musion, for example, is the company that produced the famous "resurrection concert" of Tupac Shakur in 2012. More recently, Musion was contracted by the now Premier Minister of India, Narendra Modi, during his electoral campaign. With the help of Musion's hologram technology, Modi simultaneously addressed audiences in 53 locations in India during his speech in April 2014.
Furthermore, the application of holograms is currently being tested in the medical field. A study with the title of Medical Holography for Basic Anatomy Training, which was published in 2013, suggests that medical students who study using holograms learn more effectively than students who use traditional materials like paper handouts. The study lists several factors for this improvement:

- The first is the "wow-factor". Textbook handouts are very commonplace and elicit little inherent interest subsequently. The medical holograms are a novel technology [...]". The same could be true for manuals: holograms would be a novel technology and make manuals more interesting.

2024 Research

•The medical holograms have the advantage of being natively 3D, unlike textbook handouts. As such, the medical holograms may be directly translated to a mental image, while a 2D textbook handout requires 3D reconstruction within the working memory." Again, the same could be true for manuals: Understanding an animated 3D hologram would require less work than understanding a technical 2D drawing of a machine.

•Finally, the medical holograms may simply provide superior visual capabilities due to their 3D nature. Many anatomical structures are difficult to conceptualize, such as the spatial relationships between various blood vessels, the valves of the heart, and the chambers of the heart. Medical holograms provide additional 3D data to understand these relationships, such as depth cues." The same would apply to machines: Unlike the 2D drawing of the machine, the 3D hologram would provide spatial information that might be important for the technician.

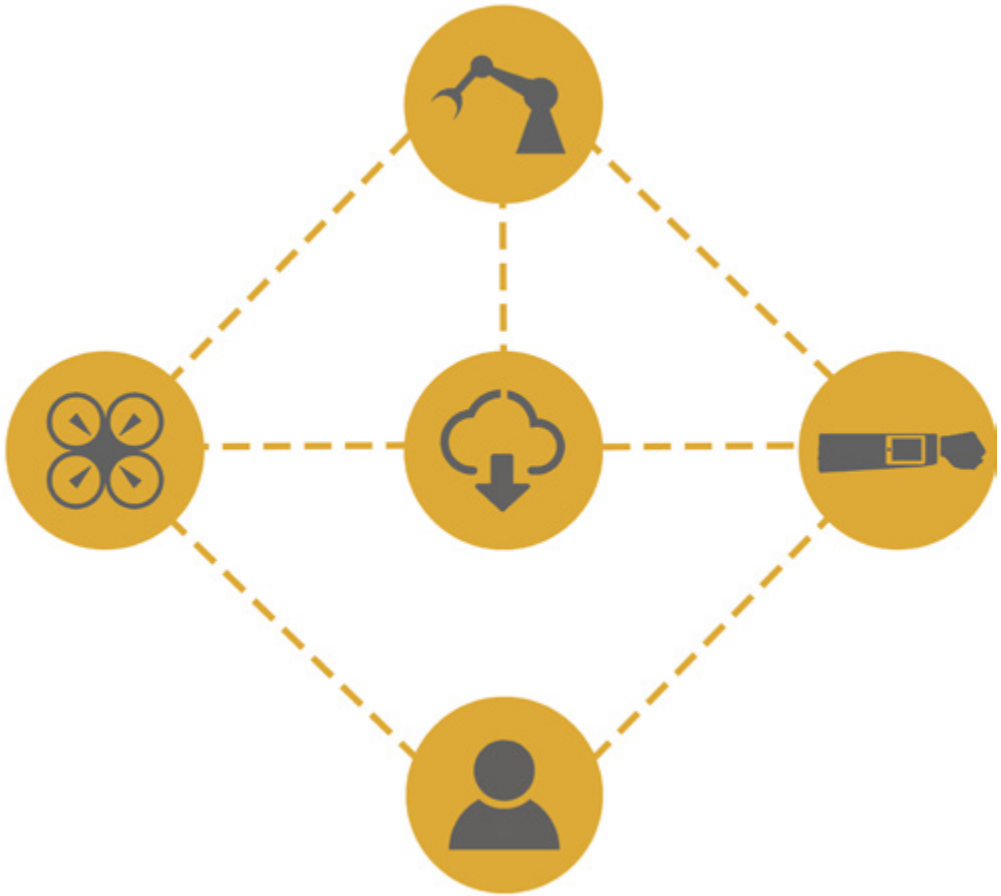
Weebo -From Flubber

When discussing these points further, we all decided it would be a good idea to add in a drone for the user, as at this point we were struggling to find a way to integrate the holograms into the solution. Our inspiration for this idea came in the form of Weebo from the well-known film Flubber. Weebo is a flying assistant for the professor in this movie and would be a perfect addition for an alstom worker in a future environment. The drone would follow the worker around, displaying hologram images when needed and also pointing out any details using a laser pointer.

Souces:

•http://www.gartner.com/newsroom/id/2684616
•http://thescipub.com/PDF/ajassp.2013.876.880.pdf
•http://www.brunel.ac.uk/etc/research/bio-medical-matrials/applications-of-smart-materials-for-medical-devices
•http://musion.com/?portfolio=tupac-coachella-2012-hologram
•https://www.youtube.com/watch?v=TF_LmujSteM
•http://www.zebraimaging.com/Portals/151303/docs/Medical_Holograms_Whitepaper.pdf

2024 System Diagram



Here is the system diagram for our 2024 solution. The system relies on the Internet of things. The user will be connect to both the assistant drone and their smart clothing. These will in turn be connected to the internet of things and also the machine itself. The machine will be made from smart materials, they will be able to detect a problem and request maintenance.

2024 Storyboard

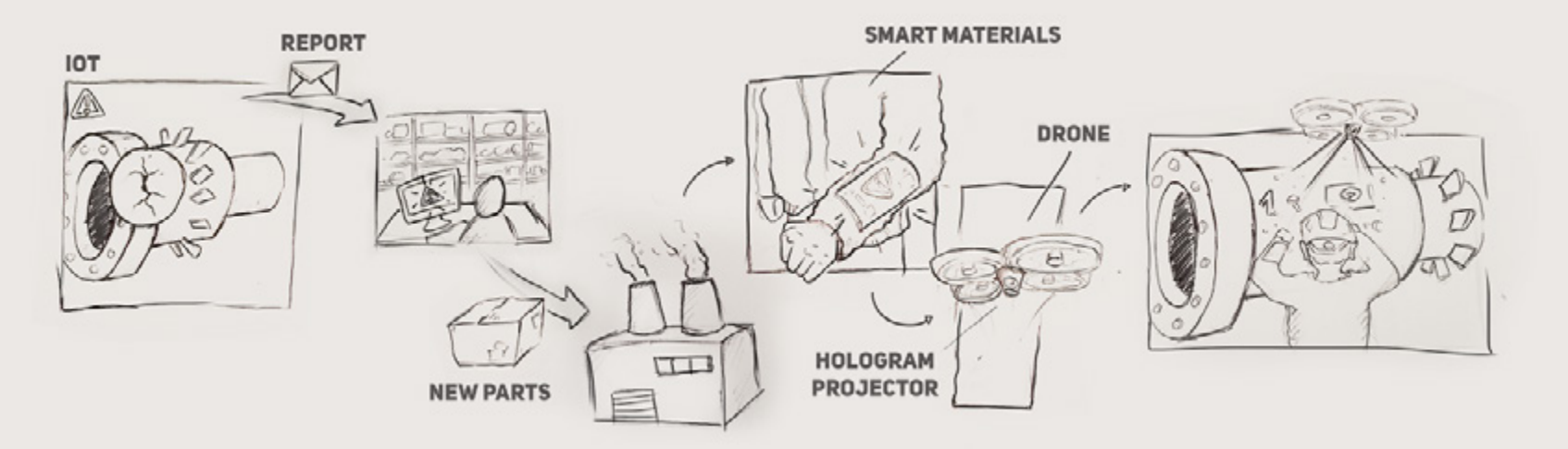
After we had conducted out research, we need to start thinking about a possible scenario and how we could present this in a promotional video. This quick story board was drawn up to depict a possible scenario in which all of our ideas would come together.

In the storyboard below, the machine will be connected to the internet of things. It will be able to detect when there is a fault and notify the support centre of the problem. This will in turn trigger the release of the needed parts. Once the new parts are delivered, the worker will begin work on repairing the machine.

The worker will have a jacket that includes smart materials on the sleeve, allowing for a display to be shown. This will display instructions to the user.

Finally, the user's drone will assist the user by showing holograms of information and pointing out parts to aid with the work.

This story board will be used to develop and create a promotional video showing our proposal for 2024.



2024 Video Creation

We wanted to create an animated video for our 2024 vision. To do this we have used the programs Adobe Illustrator and after effects.

We first wrote down a scripted storyboard to get our ideas across, we decided to again use the Tascam voice recorder to record a voice over to narrate the story, as we felt this would be the best form of communication.

Storyboard for 2024 "video"

For more infos see also:
https://docs.google.com/document/d/1H9iJDvjcaNKh40er4iTYVttHWhtd7n39u_UlrSEUHw/edit

Here's what Milan and I came up with - please add your comments!

We decided to go with the "something is broken and needs to be replaced" scenario, rather than with the "maintenance" scenario.

----------to be read from james----------

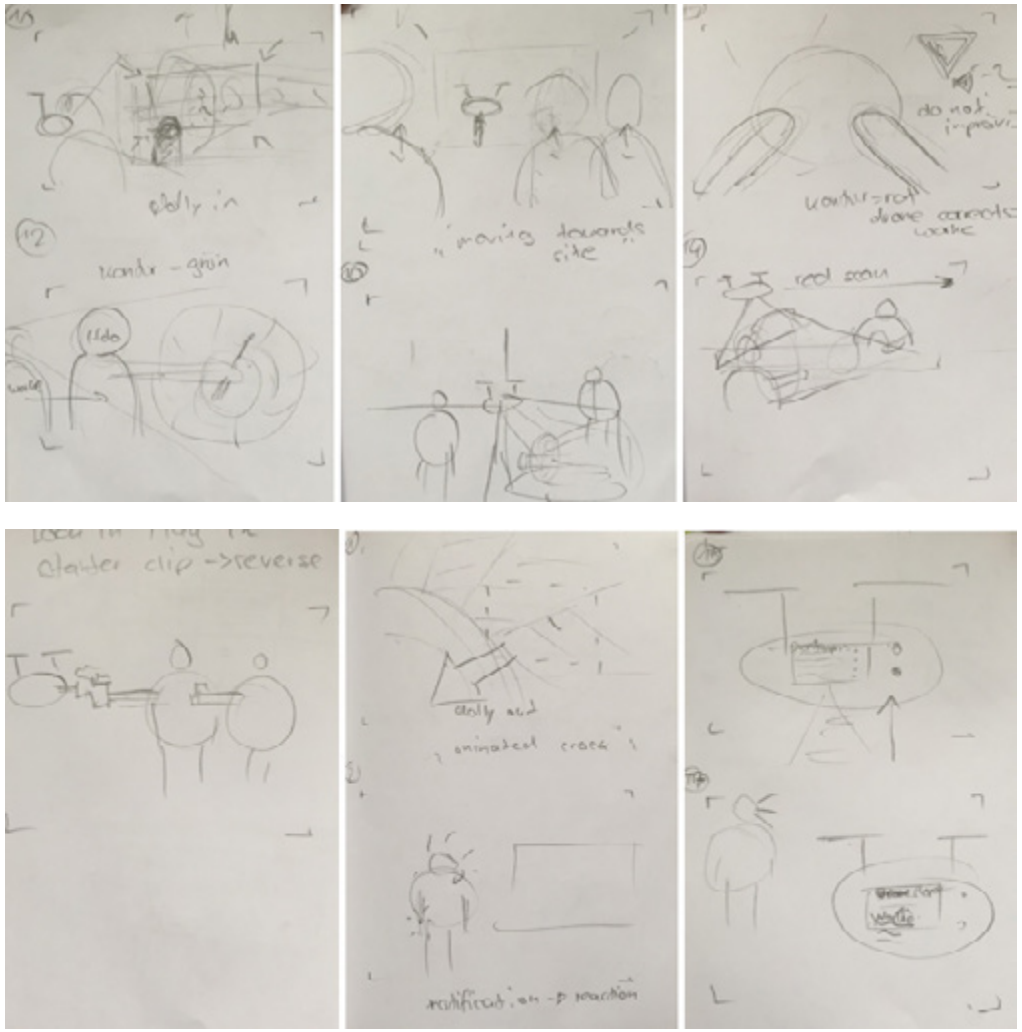
1. Some part in the machine is broken. This is detected and via the Internet of Things this sends a message to the central system: "Part XY in machine KL384 is broken." (or something like that).
2. The system then automatically dispatches a team to go and fix the machine.
3. The team gets all the necessary information (where to go, what tools and parts to bring, etc.).
4. When the team is on site, they first do the lock out/tag out. (We briefly thought about digitalising this process, but in this case, a physical lock seems much more secure than anything digital. Furthermore this process has proven efficient in the past, so we won't change it.)
5. At the same time as the technician does the lock out/tag out, the drone prepares the tools for the task.
6. After the technician has locked away the key, signed the work order, the technician and the drone go to the machine.
7. The drone projects the hologram. There are different types of holograms:
    a. A hologram that shows all the steps. The team would be standing around the hologram and discuss who does what.
    b. A hologram that is projected directly onto the machine
    c. A hologram that shows not only the machine parts, but also a worker - this would enable the technician to see exactly where he has to stand/how he has to hold a certain part, etc.
8. The drone can issue warnings if the technician is about to lift something heavy or touch something hot. It could do this by coloring the hot part red, by issuing sound and other warnings
9. During the entire disassembly process, the drone would take measurements (e.g. with laser). The measurements are directly filled into the report. On his smart-material sleeve, the technician can always see these values appear in the report. The technician can react if he thinks a measurement is wrong. In the end, it is the technician who needs to sign the report, so he must make sure that all the values are correct.
10. For tasks that are very delicate (like lifting out the yoke), the drone will not tolerate any improvisation. It will let the technician know that he must work exactly as instructed (otherwise, an expensive part could be damaged or - worse - a person could be harmed). For other tasks, the technician can work slightly differently. If the does something different and more effective, the drone will notice and add it to the manual.

----------to be read from james----------

2024 Video Creation

We then drew out some rough sketches of the story board to get an overall idea of what parts we had to create in Illustrator.

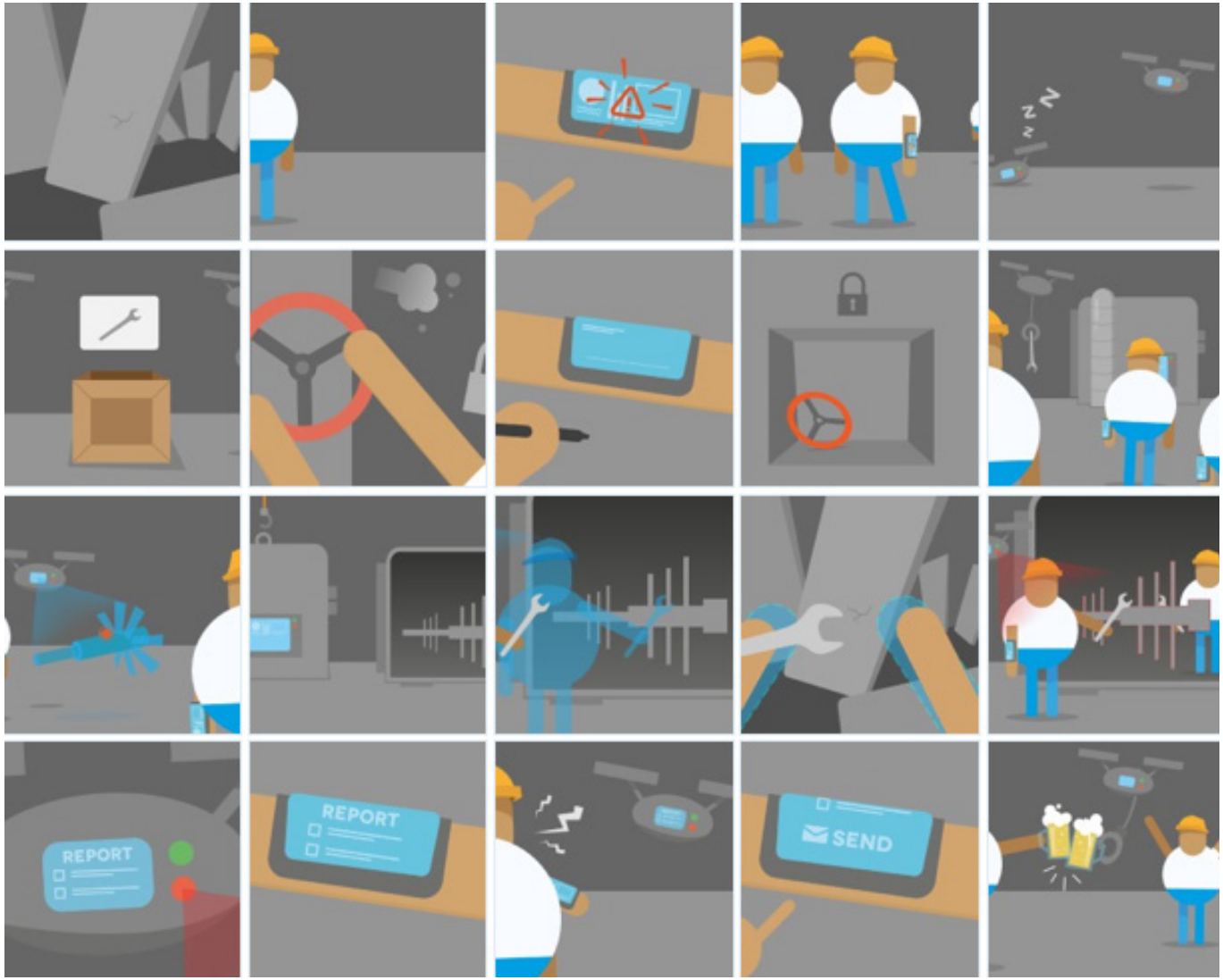
Below are a few examples of the sketches that were created:



2024 Video Creation

These rough sketches were then taken into Illustrator and drawn out properly in vector form. This would allow us to keep each individual part of the drawings on separate layers so that they could be animated separately. We went with a simple cartoon theme for the drawings, they are very basic, but get the story across in a fun visual manner.

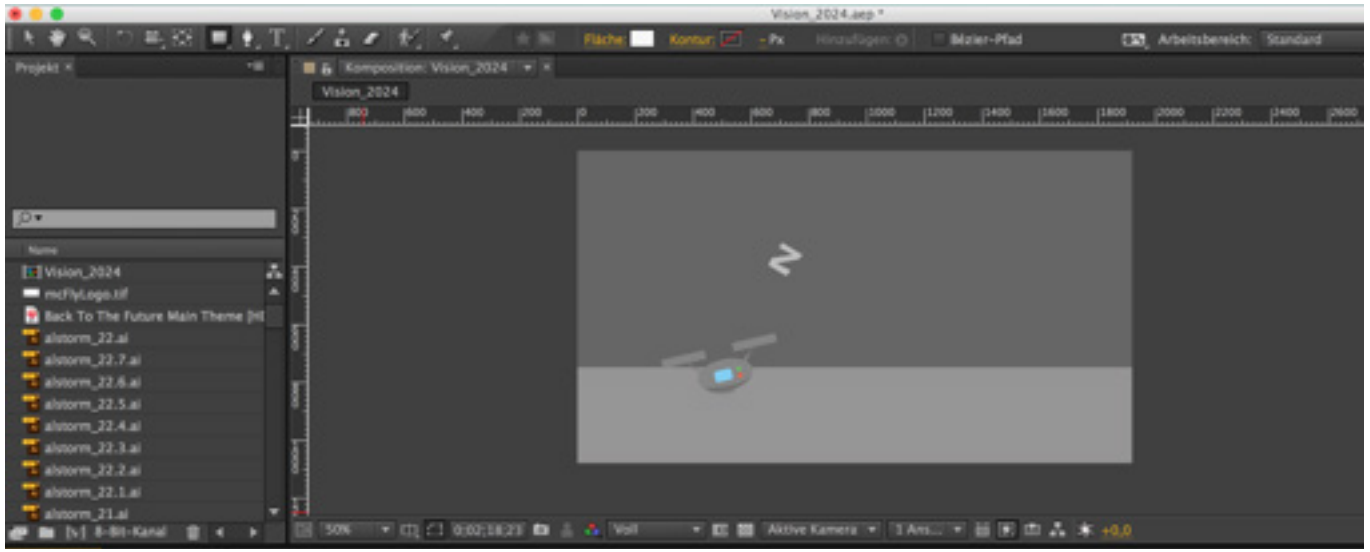
Below are the final images that we have used to create the video with.

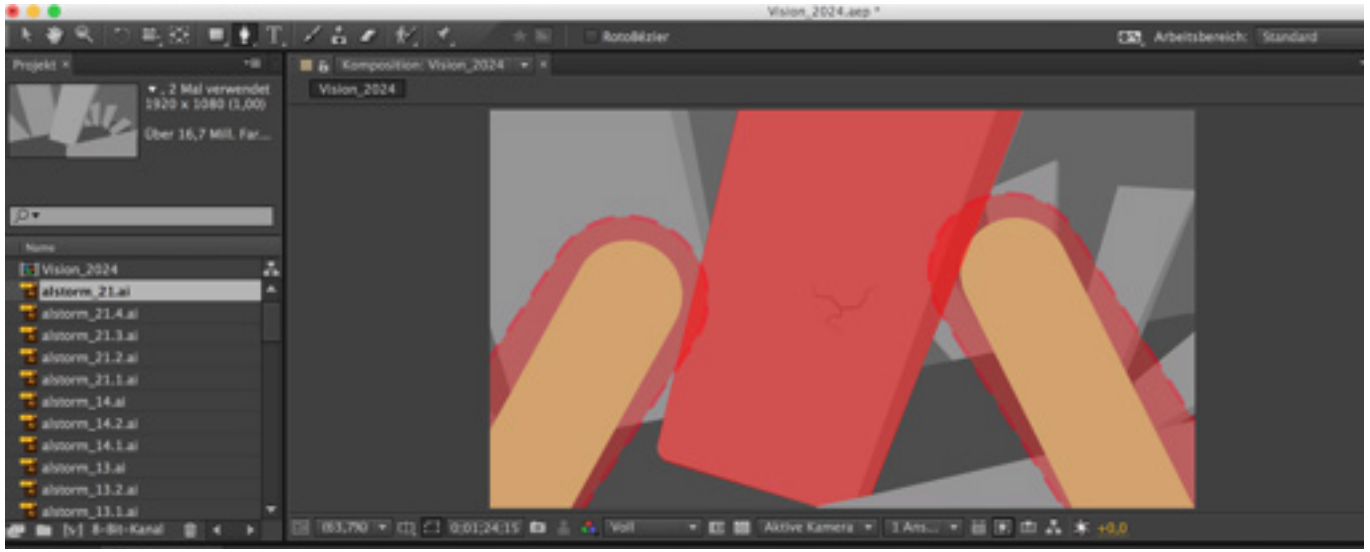


2024 Video Creation

We finished up the video in After Effects, animating the separate sections of the video and putting everything together. The outcome is a strong video that displays our 2024 concept and describes a potential scenario in which our vision will exceed.

A link to view the 2024 vision video can be found at the beginning of this document in the “Business Summary” (bottom of page 5).





Final Reflection

For us, the iPOLE project was intense, but rewarding, and we really enjoyed working on it. and it was interesting to see how much we could achieve in such a short amount of time. We learned a lot about technologies and wearables during this project, and thanks to Alstom, we gained insight into a completely new area.

At the beginning of the project, we had to get to know each other. We had to find out what skills the team members had and what experience they brought to the table. We also had to find out about each other's circumstances: who is studying full time, who is studying part time, who is also working part time, etc.

Challenges

Communication

Given that the team was distributed across four countries, we knew that communication would be important. Having a weekly Skype call was a good start, but we soon found that it was not enough. That is when we decided to start using Slack, which improved the communication a lot. We used Slack to:

- Give the rest of the team a heads-up on how we were doing (for example: "I'm having some problems with the glasses; I can't use them in developer mode")
- Ask for opinions (e.g. "How could I improve the video?")
- Give feedback on the wireframes.
- Post links to important documents (Slack comes with Google Drive integration, which was very handy)
- Post interesting links.
- Discuss topics/problems in dedicated channels so everyone could re-read the discussion and look up stuff if they did not remember the details.

Sharing knowledge

In order to share the knowledge between the different team members, documentation was important: After each team meeting we sent out the meeting minutes. They summarised what we had discussed and what decisions we had taken. They also listed the tasks each team member agreed to complete by the next team meeting. We were also careful to document our research findings: While we presented them during the team meetings, we also provided them in written form. This was useful for three reasons: Firstly, it meant that everyone could read them again in their own time, which, given the complexity of the subjects, was often necessary. Secondly, we could then include these findings in our design document. And thirdly, written documentation also helped bridging some language barriers that we might have had.

Reflection

What went well

During the entire project, we really worked together, and the result is very much a team effort. There are several aspects that had a positive impact on our teamwork:

- All the team members showed a lot of initiative and commitment. We did not feel that any team member worked a lot more or a lot less than the others. Everyone put in a lot of effort and this kept us motivated.
- The team members were proactive. For example, we never had long discussions as to who would present during the review meetings, because people volunteered to present. This meant that we could spend our time and energy on the things that really mattered (rather than spending them on determining who would do what).
- During our weekly team meetings, we defined the tasks that needed to be completed by the following week and then distributed them. We were careful to clearly define the tasks and the deadline (which was usually the next Thursday) so there would not be any misunderstandings.
- We notified the rest of the team in advance if we saw that we would not be able to complete a task in time (for example because the task turned out to be more time-consuming than initially anticipated, or because we had exams).
- The team members were not afraid to ask questions or to ask for help.
- We had a very good feedback culture: The team members were happy to both give and receive constructive feedback. We did not just split the tasks, complete them, and put everything together. Instead, we actively reviewed each others' work and gave feedback on it. We are convinced that this iterative approach improved our solution.
- We exchanged knowledge - not just between team members, but also across teams. For the animations, for example, we worked together with another team.
- And last but not least: We were lucky that we all just got along really well!

Reflection

Lessons Learned

Looking back on this project, we would try to keep the tools to a minimum. For example, we used Trello as well at the beginning to assign tasks, but it turned out that this created overhead. After a few weeks, we just stated the to dos in our meeting minutes and crossed them out when they were completed.
We would take inspiration from critical feedback, but do not let it destroy our vision completely. There were many coaches and every one of them had their own ideas about how the teams should take on the task. As a team, you have to have a vision and stick to it. While constructive feedback is always welcome, it is hard to please everyone. It took us a while to realise that and we probably lost some time at the beginning of the project due to this.

Slack in use