

**Advanced Seminar**

# **uFixit - Augmented Reality Manuals**

## **An AR Product Concept**

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## **Abstract**

Eine Zusammenfassung der Problemstellung und der wichtigsten Ergebnisse auf maximal einer Seite.

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# 1 Introduction

Everyone of us already had to deal with a defective consumer product. Years ago there was a good chance you could repair it by yourself. But with electronics getting more complex and integrated into nearly everything we own, this is becoming impossible.

One of the best examples are laptops. They originated from a - by design - highly modular hardware system. Every part has a standardized connector that makes it possible to build up a computer out of components from various manufacturers. But due to market demand the devices had to shrink more and more. To cope with the hassle of little space, manufactures began to integrate these single components in one another. This greatly reduces the overall product size.



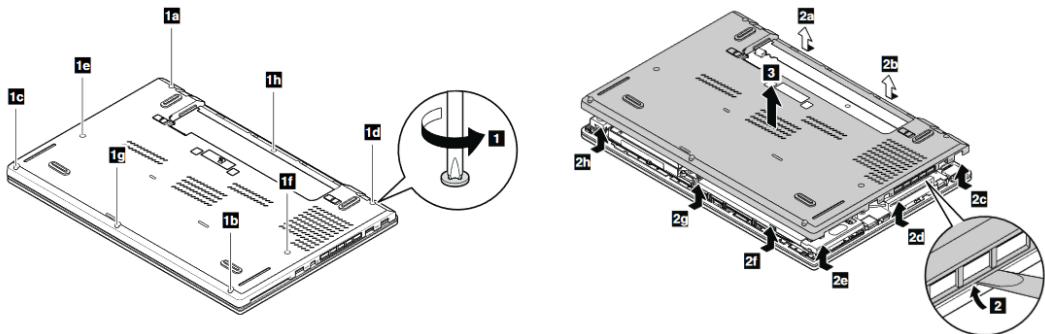
**Figure 1.1:** Disassembled Apple MacBook 2015 that got a iFixit Repairability Score of 1 out of 10<sup>1</sup>

<sup>1</sup><https://de.ifixit.com/Teardown/Retina+MacBook+2015+Teardown/39841>

## 1 Introduction

The most recent achievement of these politics can be seen in Figure 1.1. The Apple MacBook 2015 is extremely thin which led the engineers few possibilities regarding the size of the electronics. Contradicting the traditional modular idea, everything from CPU to flash memory is soldered onto one single circuit board. It can only be replaced as one expensive part, but only if this is possible at all. The use of special adhesive saves the space needed for screws, yet it is not possible to handle for an end user.

Of course this is not limited to mobile computer hardware. In almost every industry products become less and less fixable. Where 30 years ago you could repair your car by replacing the broken part in a straightforward way, nowadays you do not even know what's defective without the help of professionals.



**Figure 1.2:** Typical step-by-step manual for business laptop hardware, taken from Hardware Maintenance Manual by Lenovo Thinkpad<sup>2</sup>

*Furthermore the manufacturers do not want you to refurbish a product. They want you as the end user to buy new things.*

Solely the business sector demands products that are serviceable. Figure 1.2 shows an excerpt from a hardware maintenance manual for a professional business notebook by Lenovo. Almost all parts of this laptop are replaceable when following the instructions. But creating this manual, providing spare parts for end users and most importantly design the product in a way it can be easily fixed are pretty expensive. This effort will be omitted with consumer products.

### So what can you do?

For one thing, ask the manufacturer. In most cases a service option is available but can be really expensive. If these costs exceed the cost of a rebuy, you got a constructive total write-off. This happens quite fast considering cost for spare parts, shipping and time for the professional personal. When doing the repairs yourself, you can save on the last two which often are the major part of the expenses.

<sup>2</sup>[https://download.lenovo.com/ibmdl/pub/pc/pccbbs/mobiles\\_pdf/t440s\\_hmm\\_en\\_sp40a25360\\_04.pdf](https://download.lenovo.com/ibmdl/pub/pc/pccbbs/mobiles_pdf/t440s_hmm_en_sp40a25360_04.pdf)

But repairing stuff all by yourself is complicated, if one is not specially trained. Therefore there are manuals. Sometimes the manufactures provide these (see Figure 1.2), but very often it is not in his financial interest to do so. Over the last years online communities and portals formed themselves to share and improve simple self-made manuals for repairing equipment.



**Figure 1.3:** Single step taken from an iFixit repair manual for replacing the Apple iPhone 5 logic board<sup>3</sup>

One of these is iFixit, a US company with a website providing high quality step-by-step repair instructions. They mainly focus on electronic equipment like smartphones or notebooks. Figure 1.3 shows one picture that illustrates one step during replacing a circuit board inside a Apple iPhone 5. Additionally iFixit conveniently provides an online shop for all tools you might need to do your low price repair.

uFixit will improve the overall experience by adding augmented reality to the equation. Up till now, one has to find the correct manuals on the internet and follow a step-by-step instruction set on some sort of second device. This is unhandy and success greatly depends on the quality of the tutorial. Whereas iFixit instructions and photos are top-notch, much user created content lacks clarity and professionalism.

With uFixit however, we want to change that. All you need is a augmented reality device. It will recognize your broken product, find the corresponding tutorial and immediately start with instructions for repairing. Of course someone already tried this. One solution can

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<sup>3</sup><https://de.ifixit.com/Guide/id/20246>

be seen in Figure 1.4. It helps engine service personal to visual and highlight single components inside a car. Also it proposes the best methods for replacing it with detailed descriptions.



**Figure 1.4:** Professional augmented reality equipment by Bosch designed to help the repair shop personal<sup>4</sup>

But every single bit of content is created by the hand of professional 3D CAD engineers. It is nearly impossible to create a community in which everybody can design tutorial on their own.

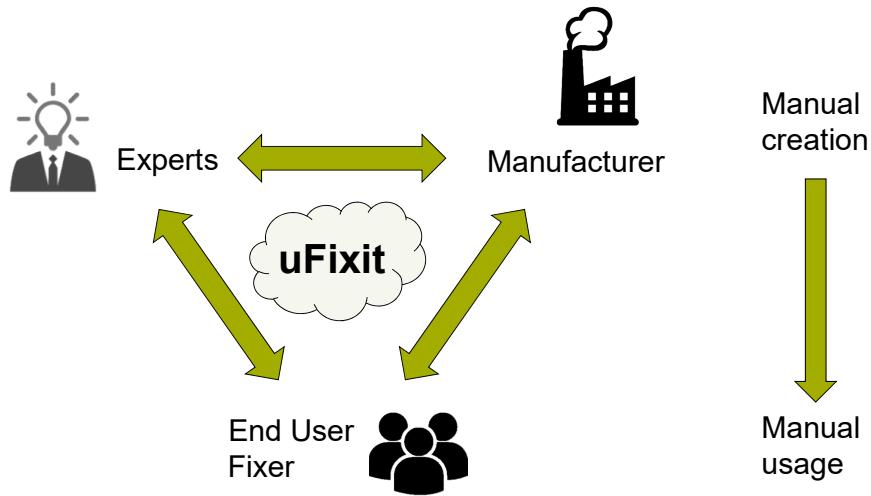
uFixit will resolve this. Chapter 2 describes in detail how that works. Chapter 3 takes a look at the specific problems that have to be faced when using augmented reality. Finally chapter 4 checks out the possible business opportunities we are facing.

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<sup>4</sup>[http://www.bosch-presse.de/presseforum/details.htm?txtID=6938&tk\\_id=109](http://www.bosch-presse.de/presseforum/details.htm?txtID=6938&tk_id=109)

## 2 Concept Description

uFixit is a platform on which user can get manuals that help them repair things. It does not matter from which manufacturer it comes, it works with all products of either brand. There is only one minor constraint: The part has to be fixable.



**Figure 2.1:** Parties involved in the uFixit environment

As one can see in Figure 2.1, **Experts** and **Manufacturers** create the manuals, whereas **Fixers** use them on their own device. An Expert is a person that has the same equipment as the end user, but does not create manuals. He will not have special training or software to do so. Manufacturers on the other side have detailed information and models of their products and therefore can develop high quality instruction steps with animations and extensive highlightings.

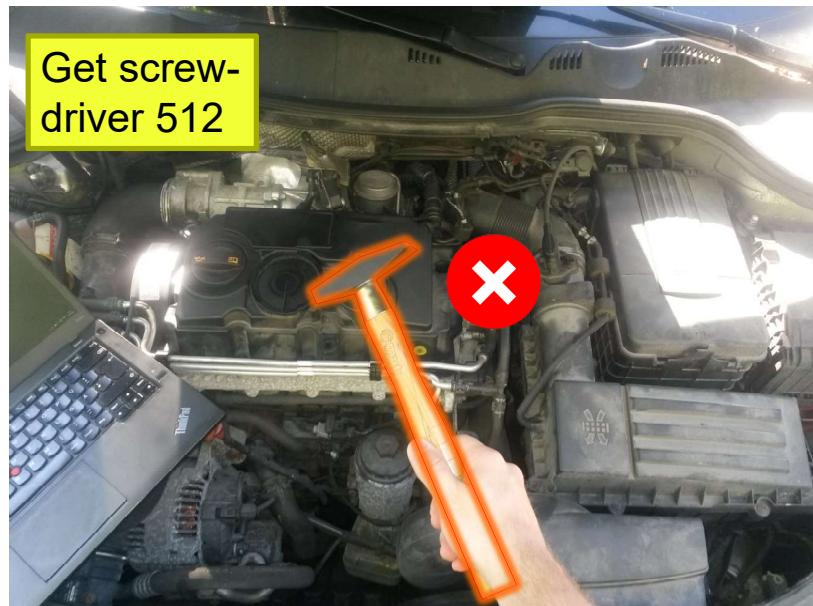
After describing how the instructions inside a manual will look like, we discuss how uFixit helps experts as well as manufacturers in creating the best possible manuals for the end user. For the conclusion of this chapter we will have a look at how the experts will be motivated to create content for our platform.

## 2.1 Instructions format

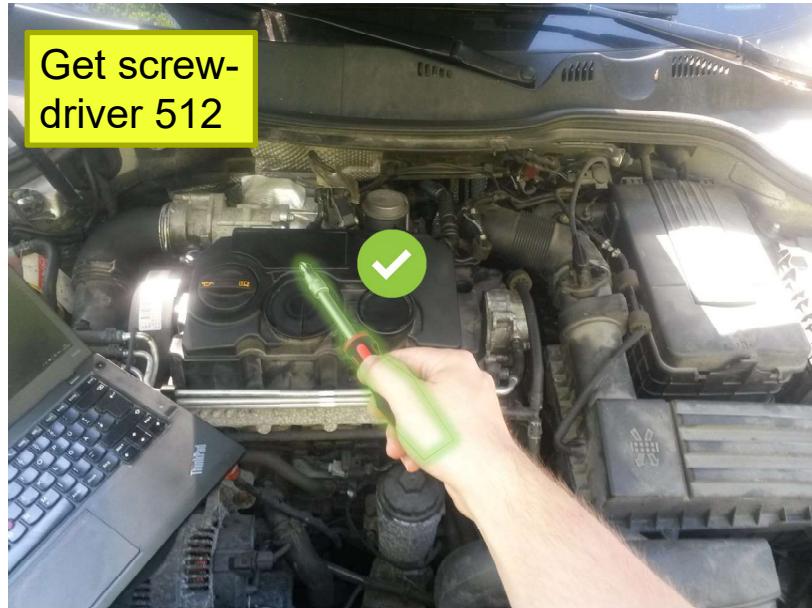
Every manual will be separated into several individual steps. The first step is always the diagnosis because to do the repair itself, we do need to know what is broken. While holding the defective part into the FOV of the camera, uFixit will try to match it to a internal database. If this succeeds, the next step is to get the right manual and the suitable tools.

After this preparation phase, the actual repair process begins. Each of the steps will ask the user to perform a specific task to fulfill. Subsequently the manual must transition to the next step. There are a few different possibilities:

- The AR device constantly watches the fixer while performing the task. Due to sophisticated algorithms, the application can detect when it is finished and will automatically jump to the next one.
- Ideally the used device has a microphone built in. With that, the fixer simply can issue a voice command.
- Although it is more of a feature to jump to a specific step in the tutorial, forward and backward buttons will be provided on screen for easy access.



**Figure 2.2:** Parties involved in the uFixit environment



**Figure 2.3:** Parties involved in the uFixit environment

Figure 2.2 and Figure 2.3 show how one instruction step would look like. The necessary job to finish is shown in the top left - here: "Get screwdriver 512". When the user holds up a hammer, the AR device will register that and tell him that he is holding the wrong tool. After holding up the right tool, the manual will continue to the next step automatically.

## 2.2 Using existing AR hardware devices

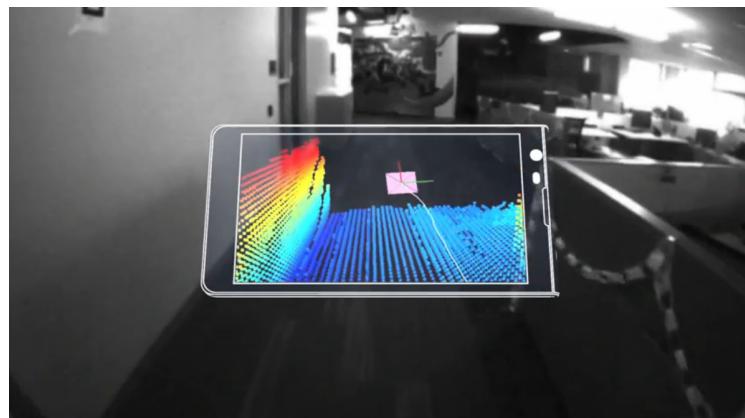
One of the clous abouts uFixit is, the fixer can use almost every AR device on the market. It only has to fulfill a certain list of requirement that you can see in chapter 3. Although users will get the most excellent experience with AR head mounted devices like the Microsoft HoloLens or the Meta 2 (Figure 2.4), other devices like smartphones are also supported.

## *2 Concept Description*



**Figure 2.4:** Meta 2 - Only one of the many devices uFixit will support

One outstanding example of this kind, which will receive special support, is Google's Project Tango. This is basically an augmented reality platform definition for Android based phones and tablets.



**Figure 2.5:** Registration visualized using Project Tango by Google

Of course if one does not have a suitable device, the manuals always can be watched using a webbrowser on our web portal as simple classical pages.

### **2.3 Software**

To create the manuals we were talking about in (2.1), we need special software. This will be the major products uFixit will ship. One are plugins for a variety of well-established 3D CAD software which is already used to design the products. Before discussing this, the focus will be the other one: an application for the Experts that do not have special software but only the same devices as the end user.

### 2.3.1 Our gem: Community Manual Creation Software

- for everyone that owns an AR device
  - very intuitive, simple, fool proof
  - insert arrows by gestures, ...

### 2.3.2 3D CAD software for manufacturers

- needs good 3D model
  - can contain animations or see through content
  - complicated, only possible with previous training

### 2.3.3 Use tutorials on the device you like

- basically bring manual to as many devices as possible
  - classical screen
  - smartphones, tables with back camera
  - AR head mounted devices

## 2.4 Experts Motivation

uFixit relies heavily on the Fixers to get involved in the community and to start creating own manuals. This can solely be based on idealism. Believing this would work on the other hand is pretty naive. Our solution: Money!

Many big software companies nowadays have something called bug bounty program. This means if a person finds a bug of a certain severity in the manufacturers product, he will get rewarded when reporting it. This is very convenient for the company considering they do not have to pay everyone that is searching for these flaws in the software.

We want the same principle integrated into uFixit. Experts should be lured into a **manual bounty program** that will reward them every time a Fixer solves a problem using his tutorial. The money will come from the manufacturer who themselves do not have to pay for personal but rather only a small amount for high quality content.

## 2.5 Feedback

To provide the user with highest quality manuals, there will be an opportunity to rate each one of them within a review system. Online shopping nowadays would be unimaginable without reviews just because no one likes to buy untested stuff. Especially when the end user needs quick and good help, he might invest in a manual that has a 100% rating instead first trying the free to use 75% one.

## 2 Concept Description



**Figure 2.6:** Example of product reviews on [amazon . com](https://www.amazon.com) with a overwhelming good average rating

Figure 2.6 is a screenshot from the [amazon . com](https://www.amazon.com) website. It shows a product review page with an overwhelming good average rating. Most of the users would now be convinced this is a great product and buy it without further research or thinking. the uFixit review system will be quite similar to this one because it will increase community involvement and building.

## 3 AR specific problems regarding realization

### 3.1 Hardware

As uFixit only provides the software solution for interactive manuals, the ~~user~~ is free to choose, which kind of AR hardware he would like to use for the application. To make the selection process easier, we first specify the requirements that the hardware has to fulfill and then propose two possible hardware solutions that are compatible with ~~uFixit~~.

#### 3.1.1 Requirements

Although there is no specific augmented reality hardware that is required to run uFixit manuals, a few requirements have to be fulfilled.

~~Firstly~~, the hardware has to be **mobile**, so that the user can take the instructions to the item he wants to repair. This is especially important if the item in question is too heavy to be moved, or is firmly mounted to its location. Therefore, the ~~uFixit hardware~~ has to be small and light enough to be carried around ~~and also has to assemble and disassemble~~ quickly.

This also rules out head tracking systems for the augmented experience, which require the installation of tracking cameras around the user to follow his head movements. Instead, a high resolution **RGB camera** is used for the object detection and an optional **depth camera** provides the exact distance between the observed object and the ~~uFixit hardware~~.

Another important factor is, that many repairing tasks ~~require~~ both hands to be executed. Therefore, the augmented reality device has to be **worn on the head**, so that the user can see the instruction manual all the time, without holding the device in one hand. This also requires a **lightweight** hardware solution, as the whole weight is carried only by the ~~head~~.

If the current step of the manual is completed by the user, the next step is selected by speech commands. Speech control is the only suitable way for navigating through ~~an~~ uFixit manual, because it requires no hand interaction and therefore lets the user concentrate on the task. This means, that the hardware ~~also~~ has to supply a **microphone** to **pick up** the user commands.

The last requirement regarding the **computational power** of the device, is ~~a~~not very restrictive. As uFixit essentially replays previously defined sequences of markers and overlays, the main computational effort lies in the real time object detection and ~~to match~~ those

### 3 AR specific problems regarding realization

augmentations with the real world. This task is already executed by the hardware used in today's mobile phones and therefore is not a limitation for the hardware selection process.

#### 3.1.2 Hardware Proposals

Now we propose two already existing hardware solutions, which are guaranteed to be compatible with the uFixit application.

The first one is the "Meta 2", a-lightweight optical see through glass with an integrated 720p camera and a 3D depth sensor. It also has additional sensors for head movement tracking, which support the optical camera tracking via sensor fusion. The downside is, that the "Meta 2" has no integrated processor and has to be connected to an additional Laptop. It also provides no microphone, which however is no problem, as the microphone can be connected to the computer. Other optical see though glasses are of course also possible candidates for uFixit, as long as they have at least a camera, which is HD-ready, microphone support and enough processing power for the application.



**Figure 3.1:** Meta 2 - Augmented Reality Glasses

The second class of supported hardware are mobile phones, especially in combination with projects like "Google Cardboard" or Samsung's "Gear VR". These head mounts transform the phones to fully functional augmented reality glasses.



Figure 3.2: Google Cardboard and Gear VR

The big advantage of mobile phones is, that they are already very common and therefore uFixit can be used without spending extra money on additional hardware. Modern smart phones also meet the basic requirements for our application, as they already include high resolution cameras, sufficient computational power and a microphone for user input. We would also like to emphasize that devices, which are certified by Google's "Project Tango" are especially suited for uFixit, as these devices provide a depth camera for an even better augmented reality experience.

## 3.2 Software

### 3.2.1 Computer Vision

To provide the best augmented reality experience possible, it is essential that the virtual objects and annotations of the uFixit manual always remain at the same spatial position they were initially attached to. The software provides two different approaches to find the right locations for the annotations.

The first one uses the camera of the augmented reality glasses to detect the features of the object parts, that are visible to the camera view. The software is now tracking these features from frame to frame throughout the video stream and matches them to the systems internal, virtual representation of the object. The information about matched feature positions is then used to overlay the annotations provided by the manual onto the users view of the real world.

As uFixit is a platform for repairing broken or deformed parts, it might be impossible for the system to detect the features of the object in question. This is why it is also possible for

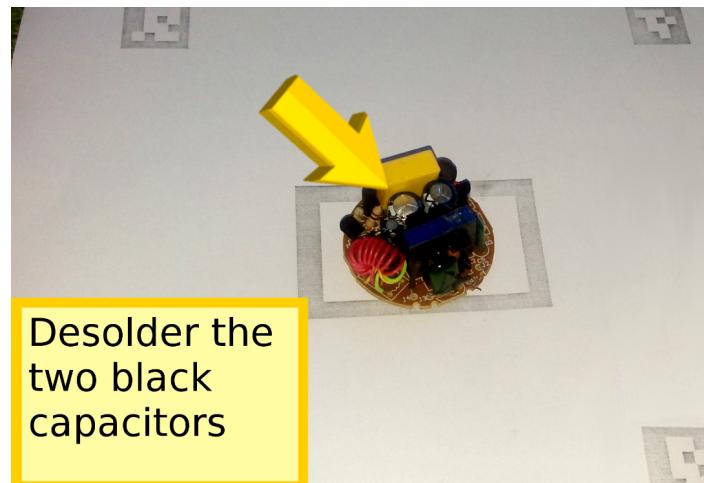
### 3 AR specific problems regarding realization

the creator of a manual to provide positions for optional Fiducial Markers. The fixer prints these markers on paper and attaches them to the specified locations of the broken item. The big advantage of Fiducial Markers is, that compared to object features, the markers have a predefined shape and a limited set of colors. Therefore they are easier to recognize and track by the system.



**Figure 3.3:** Printer with Fiducial Markers at specified positions

Some objects, like for example watches, are too small for markers to be placed on them. For this scenario, there is an alternative solution, by printing a sheet of paper with markers on its edges. The user then has to position the object, he would like to repair, at a marked position on the sheet. This makes it possible for the system to show an augmentation of the object by tracking the paper sheet with the item being at a known offset to the markers.



**Figure 3.4:** Small object, centered between Fiducial Markers

As described in the hardware section 3.1, uFixit also supports an optional depth camera. This adds the feature of occluded virtual elements to the system. The additional depth information enables the application, to determine the exact distance between the watched item and the AR glasses. Therefore, if a virtual annotation is attached to the other side of the object, uFixit is able to temporarily hide this information from the user until the object is turned around again. This feature helps the user to better understand the spatial relation of the virtual annotations and the real world object. As this is an optional feature, the application also works without a depth sensor. The only drawback is, that all annotations of the current manual step then are visible at once, even if some of them should be occluded by the object.

### 3.2.2 Manual creation (Manufacturer)

Instead of shipping paper manuals with their product, uFixit provides an alternative solution for manufacturers. The big advantage of a digital manual is, that errors in the manual or information updated to the product do not require a reprint of the whole manual, but only an update of the uFixit database. Nowadays, industrial products are designed in CAD software like "Solidworks". These softwares packages also provide additional features like animation of the designed items (like rotating screws), creating semi transparent highlighting objects, or adding text objects for explanations. This is why uFixit provides an import interface for industrial instruction creators. This interface is able to import CAD projects and use them as a part of an uFixit manual. Each of the imported snippets then makes up one step of the final instruction set.

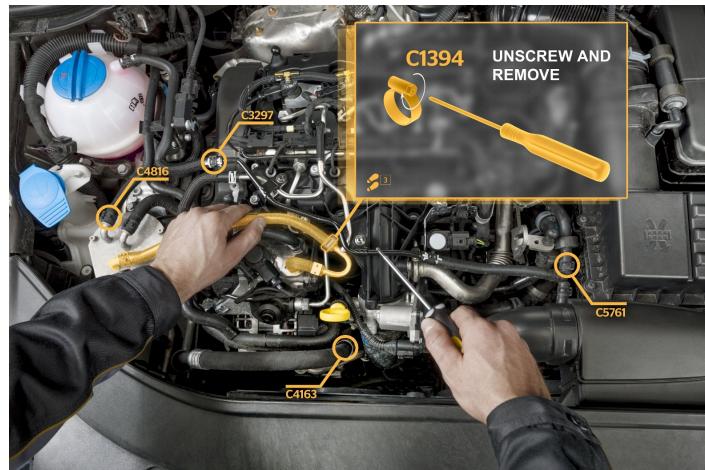


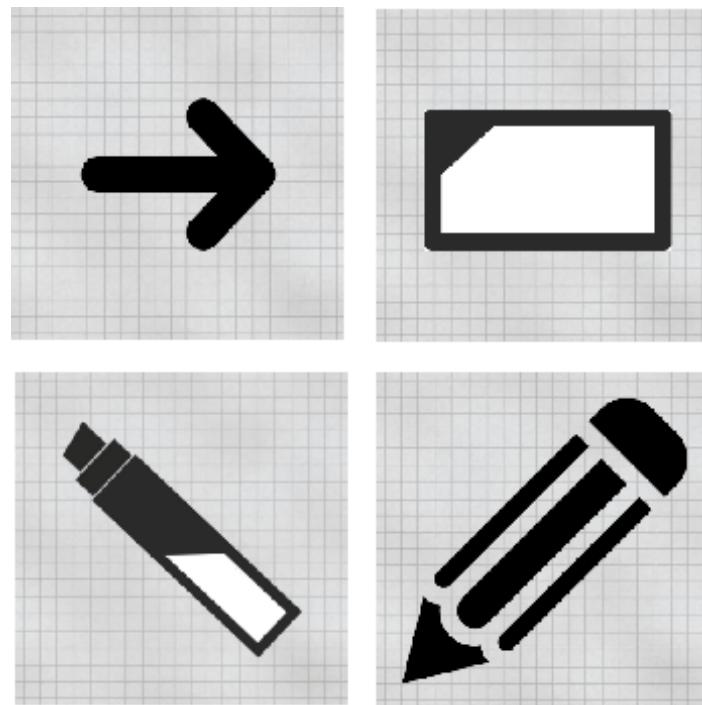
Figure 3.5: Manufacturer created uFixit manual

### 3.2.3 Manual creation (End User)

Each uFixit user is also able to create own instruction sets and provide them to the community. For the creation, the same hardware is used as for following a manual. The only constraint is, that a depth camera is a requirement for the manual creation. It is important for the precise spatial registration of the manual annotations with the key features of the real world object. For each step of the instruction manual, there are the following annotations possibilities:

- Arrows
- Text
- Highlighting
- Sketches

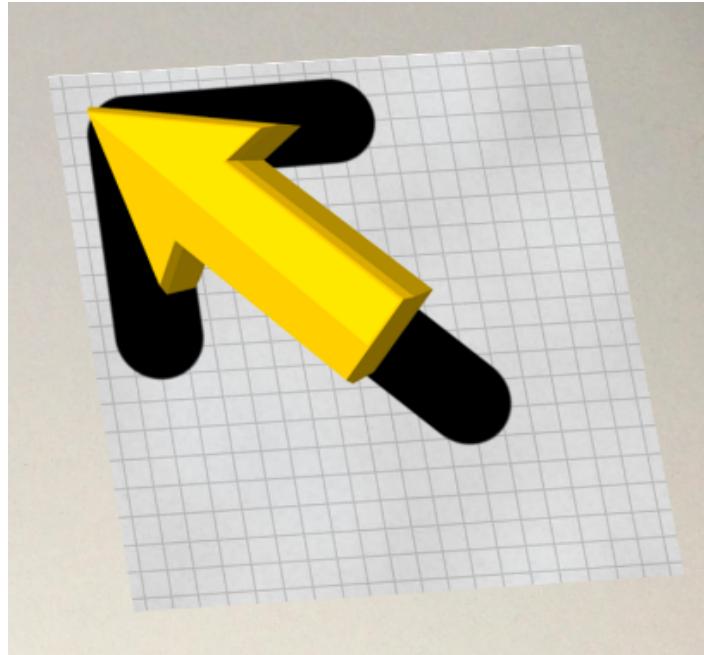
To annotate items, uFixit uses representations of the annotations in paper form. When paper templates are recognized by the camera, the software adds the corresponding virtual annotation object to the scene. The annotation matches the template's location and also follows the movements of the paper template.



**Figure 3.6:** Annotation templates

If for example, an arrow should be added to the current manual step, the following steps are taken:

1. Hold the printed arrow symbol into the camera view
2. Move the paper until the virtual arrow matches the target position
3. Finalize the position by speech command ("Attach Here")



**Figure 3.7:** Paper template with virtual annotation arrow

The text annotation is positioned in exactly the same way. After positioning, the text is filled in also using speech recognition. Highlighting and painting with the pen is controlled slightly differently. First, the manual creator moves the tip of the printed highlighter (or pen) at the start position of the annotation. Drawing begins after the "Start drawing" speech command. All locations in the vicinity of the highlighter/pen tip are then annotated until the stop command is given.

### 3.2.4 Live support

In contrast to the static manuals, the uFixit live support focuses on quick and simple features. Writing annotation texts or creating animations simply takes too much time for the direct communication of the live scenario. This is why the live support limits the possibilities for augmentation to these three features:

- Arrows
- Highlighting
- Audio communication

In contrast to all other functions of uFixit, the expert providing live support uses a tablet or PC for the interaction. During the live support, the expert's display shows the camera stream of the AR device. The expert draws and positions the annotations by using a touch

### *3 AR specific problems regarding realization*

screen or mouse. Due to the visual object tracking by camera, the software is able to anchor the provided visual annotations to their corresponding items. This means, that if the live support highlights specific locations of the camera view, these annotations remain with the object even if the camera view changes.

To avoid scrawly drawings, due to the constantly changing camera view, the camera stream can be frozen. During a frozen stream, annotations are drawn onto one single image of the view, but are still updated in real time into the fixer's augmented view.

# 4 Business Plan

In this section we introduce our business idea and we describe our plan to introduce our product to the market. For this purpose, we analyze the current market situation by determining our clients and competitors, and describing the opportunities and threats that we see in the market. Also we describe the marketing strategy, that we will follow to reach our clients. Finally, we include a detailed overview of our capital costs calculation.

## 4.1 Business Idea

uFixit is a platform for augmented reality user's manuals. We will introduce our service to every company that has a hardware product with a user manual. Our goal is to equip each new hardware product with an augmented reality application, which represents a copy of the traditional owner manual. This application will help the user to install the product before the first use and to repair it in case of bugs. The augmented reality manual will be able to detect the problem in the product, search for a solution in the manual data base then guide the user through the repair steps. We will also offer the users the opportunity to make their own augmented reality repair tutorials. Then they will be able to share it with other users or include it in the original company's manual, after it gets tested and approved by it. The company will be able to update the manual regularly with new fixes.

## 4.2 Clients

We can categorize our clients in 2 major groups: B2B and B2C. B2B clients are the companies producing the hardware, which we want to equip with the augmented reality user manual. These can be from different fields: Automotive and mobility, smartphones and tablets, computers, domestic appliances, plant construction, industrial equipment... Each hardware producer can be a potential client. Our target clients are mostly the companies that thrive to optimize their after sales service.

B2C clients are the end users of the hardware products. A consumer in this case can be any individual that has access to an augmented reality capable device. This can be a smartphone, a tablet or augmented reality glasses. Our product is offered for both sexes and from the age of 12 years old. The Experts category can be an intersection of both clients' categories. In fact, an expert can be an end user with advanced knowledge

about the product, that allows him to create instruction sets for some bugs or a repair shop, which we consider as a B2B client.

### 4.3 Competition

As competition we understand every augmented reality developer with a platform able to develop user manuals. Based on our market research, we defined two competitors, which already offered similar products:

- The first is Vuforia, which is an augmented reality platform offering a powerful Software Development Kit. Its platform has more than 225000 registered developers and has more than 25000 apps<sup>1</sup>. It was a Hyundai partner by the development of its virtual owner's manual, which was presented in Los Angeles Auto Show in January 2016. It is "the first mainstream automaker to launch an augmented reality owner's manual app"<sup>2</sup>.
- The second competitor is RE'FLEKT which developed an augmented reality application for Bosch Flex-Inspect that was introduced in NADA ATD Convention and Expo 2014 in New Orleans. This product only shows a live diagnose of the examined car, which allows the user to detect the problems.

Both introduced competitors have the advantage of the experience with the augmented reality applications. However, none of them have the same service that we plan to offer. In fact, our idea differs from Vuforia's product in the sharing platform that we will build for the end users, where they can exchange their experiences with the different bugs and problems. Our platform will also offer standard tools for the development of the manuals. These can be used by any client regardless from the product that he wants to document. The difference to RE'FLEKT's product is the added value that comes with the interactive repair steps, displayed after the diagnose is done and the problem has been defined.

### 4.4 Market Situation: Opportunities and Threat

The evaluation of the augmented reality market after defining our clients and competitors allows us to determine the points where we can see the opportunities to grow and predict the threats that we could face.

The augmented reality market is expected to have a big and fast expansion in the next few years thanks to several application fields of this technology. Its revenues are expected to exceed those of the virtual reality, as described in Figure 4.1. In fact, Digi-Capital predicts

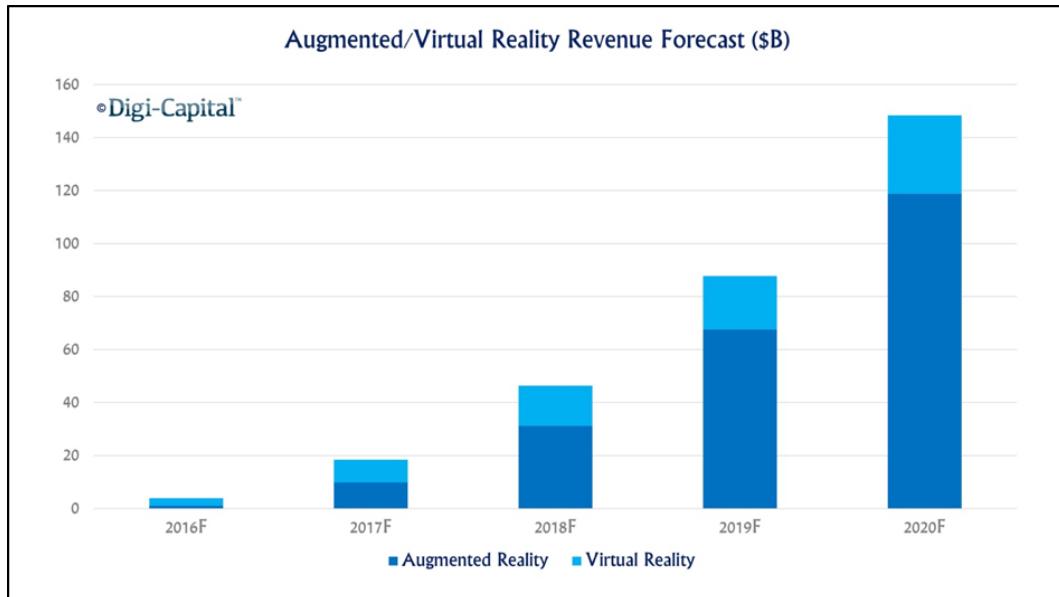
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<sup>1</sup><http://www.hyundainews.com>

<sup>2</sup><http://www.vuforia.com>

#### 4 Business Plan

it to reach \$120 billion by 2020, 4 times more than the virtual reality. Its fast growth rate is reflected by a forecasted 12.000% increase of the revenues between 2016 and 2020.



**Figure 4.1:** Augmented Reality Market Forecast<sup>3</sup>

We see in this fast development rate good opportunity to start a new business, that we also expect to grow as fast as the augmented reality market. With our idea we intend to create a new market of virtual manuals. We will be able to draw the traits of this market and play a pioneer role in its expansion. The experience and client basis that we will acquire through this process is our biggest asset to face the emerging competition.

However, we also identified some areas where we see important threats. We are aware about the volatility of the new market that we want to build. In fact, we cannot predict the reaction of the clients to the new idea. We intend to face this problem with a studied marketing strategy based on past experiences. With this strategy, which is described in the next section, we plan to reach a wide range of customers in an increment way. Experience sharing has been continuously increasing since the globalization brought by the internet and similar communication channels. Our vision is to be the green future of user manuals, as part of the digital transformation, which will be the trend of the next years, according to several studies. Another potential threat that we see is the slow development of the augmented reality technology, especially while dealing with complex problems such as the spatial and temporal registration issue. This can be resolved by increasing the research and innovation investment in this area.

<sup>3</sup><http://www.digi-capital.com>

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>• New Business idea</li> <li>• Talented developers</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of experience with augmented reality software development</li> <li>• First startup for all founders</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>• No direct competitors</li> <li>• Several potential clients</li> </ul>	<ul style="list-style-type: none"> <li>• Market volatility</li> <li>• AR technology not mature yet</li> </ul>

Figure 4.2: Augmented Reality User Manual Market: SWOT Analysis

## 4.5 Road Map

We plan to follow an incremented strategy while introducing our product to the market. In fact, we want to reach every client category in different steps. We have three main milestones in our plan, as described in Figure 4.3:

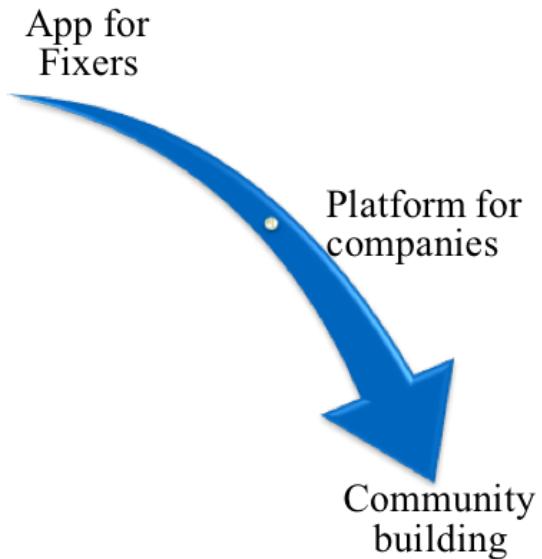


Figure 4.3: uFixit Road Map

- First we will provide our service for end users and experts. They will use our app to create and follow simple augmented reality instruction sets. In this stage, our user manuals will be equipped with simple annotation elements, such as text or arrows.
- In a second step, we will provide a platform to integrate the 3D CAD models to our app. The manufacturers could use this service to create higher quality augmented reality user guides. This will enhance the quality of their after sales service for the existing or new products.
- Finally, our target is to build a fixer community where they can share not only their repairing experiences but also their feedback and opinion about the augmented reality user manuals.

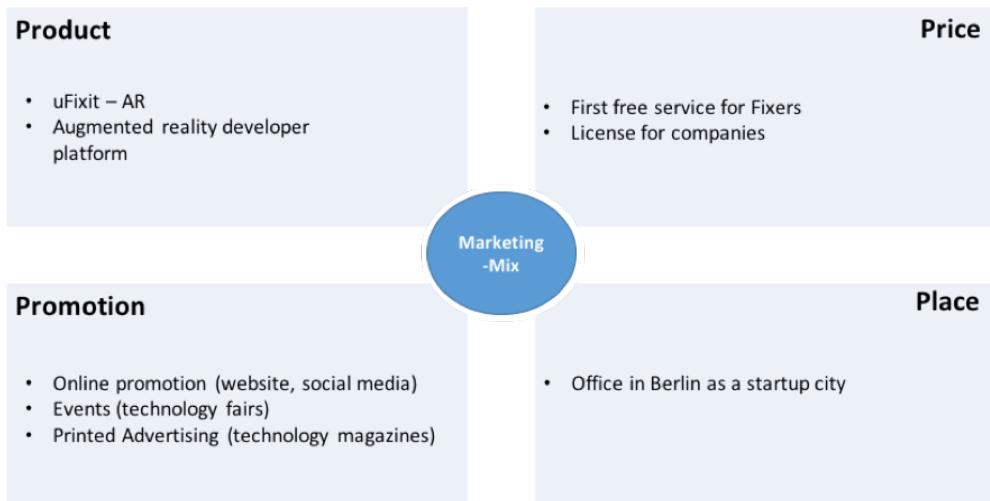
## 4.6 Marketing Strategy

We are aware that creating a new market and convincing our clients with the added value that our product offers, has to be addressed with a smart marketing strategy. First, we intend to reach the end users, who are repairing their own hardware and who we like to call "Fixers". We will offer an application where they can build their own augmented reality repair instruction manuals. The channels that we plan to use for this purpose are social media and internet forums. After building our Fixers basis, we intend to move to the next step in our road map. We will reach the hardware producers to offer them a platform, where they can use their 3D Models of their product to build augmented reality manuals. For this purpose, we will focus on exhibition and fairs events, together with the traditional advertising, such our website presence and the technical magazines.

**Table 4.1:** Marketing Expenses for the First 2 Years

Marketing channel	Costs	Costs for first 2 years
Branding	-	3.500 €
Website	-	4.500 €
Social media	1.500 €	36.000 €
Content marketing	1.500 €	36.000 €
Traditional advertising	2.500 €	60.000 €
Events	4.500 €	108.000 €
Total	10.000€	248.000 €

In Table 4.1, we calculate the marketing costs that we expect for the first two years. Our target is to reach a break-even-point in this period. We estimate the total marketing costs for this period by €248.000.



**Figure 4.4:** uFixit Marketing Mix: 4P's

## 4.7 Capital Costs

In this section we present our calculation for the capital costs, which we estimate based on present start-up founding costs and current market prices of promotion services, real estate, augmented reality hardware... This calculation, presented in the table TAB, also extends until the targeted break-even-point, and yields a total of €422.510, which we need to acquire in the first phase.

**Table 4.2:** Capital Costs for the First 2 Years

Capital costs	Costs for first 2 years
Administrative founding costs	100 €
Office	56.000 €
Marketing	248.000 €
AR Hardware	40.000 €
Server & other Hardware	40.000 €
Total (incl.10% buffer)	422.510 €