How can the Seven Modes of Design Innovation help combine the UX of two different AR products?

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MASTER THESIS

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Abstract

With the constant rise in implementation of Augmented Reality solutions across various industries, Organizations providing such solutions are in need of constant evaluation of offerings to stay ahead of the market. RE'FLEKT GmbH, a technology company that offers Augmented Reality solutions across the globe identified the need to re-evaluate its offerings which brought about the initial question - How do we combine our existing products? Which laid the foundation of this thesis.

In-order to address this question, The Design Innovation Process and methods proposed by Vijay Kumar was used as the framework resulting in the framing of the research question - How can the seven modes of design innovation help combine the user experience of two different Augmented Reality products?

The key findings prove that the design innovation process and methods outlined in the thesis could be practiced in organizations for the innovation of new products and services. The conclusion outlines the next steps and limitations that need to be considered by RE'FLEKT GmbH towards the realization of the prototypes.

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Introduction

The aim of the thesis was to find a possible way to realize the question, How can we combine two Augmented Reality products? A goal that RE'FLEKT GmbH as an organization are striving towards. The realization of this question required in-depth knowledge about the existing products, technology and design method that would be considered.

The identification and selection of Design Innovation process and method proposed by Vijay Kumar as the framework for this paper resulted in rephrasing the Initial question to, How can the seven modes of design innovation help combine the User experience of two different Augmented Reality Products since this paper focuses on the user experience of the new products and not the technical aspects of product development.

The non-linear, iterative design process facilitated the transition through each step of the design process which were, Sense Intent, Know Context, Know People, Frame Insights, Explore Concepts, Frame Solutions and Realize offerings.

The design research method was practice based as it involves gaining knowledge by implementing a design method as a framework in the development of a new product which is supported by the artifacts that were a result of the design research. The steps involved in the realization of the artifacts are described in the following chapters.

The key learnings extrapolated answers the research question, How can the seven modes of design innovation help combine the user experience of two different Augmented Reality products.

Problem Definition

The following chapter deals with the initial step of the research – Defining the problem that was intended to be solved. In order to get a comprehensive understanding of the problem, Three main topics where taken into consideration – The background of the or-organization and its current products, Augmented Reality and In-novative Product Design.

2.1 Relevance of the Topic

RE'FLEKT is a technology company based in Munich which offers human-centered platforms that enable businesses and industries to create their own Augmented Reality solutions (RE'FLEKT GmbH, n.d). There are two products that RE'FLEKT offer - REFLEKT ONE and REFLEKT Remote.

REFLEKT ONE is an Augmented Reality platform that is scalable, enabling companies to create their own Augmented Reality appli-cations that can be visualized in real time on real objects using hand held devices such as phone and tablet along with head mounted devices to simplify operations, maintenance and training (RE'FLEKT GmbH, n.d).

REFLEKT Remote is a platform that enables companies to pro-vide their technicians and its customers with real time video re-mote sup- port with Augmented Reality. This is achieved through RE'FLEKT's intelligent routing system that identifies and connects the technician to the right expert using smart glasses, phones or tablet. It also provides technicians with a global database of issues that have already been resolved that helps accelerate maintenance and repair processes (RE'FLEKT GmbH, n.d).

RE'FLEKT as a company is now focusing on bringing these two state of the art products together in order to create an Augmented

Reality Enterprise solution that would further reduce down times and increase efficiency in the areas of operations, maintenance and training.

Bringing two products together does not necessarily mean that the user experience would be simple and this was the problem that had to be addressed. This brings about the framing of the initial question,

How do we provide a Seamless User Experience whilst bringing both the products together?

User experience is the focus of this paper as it is not just about the way the product looks but also about the way people interact with it. People need to be able to easily navigate through the product and understand how to use it as it really matters when it comes to bringing future traffic and business to the product (Cousins, 2019).

2.2 Augmented Reality

Augmented Reality can be defined as the ability to deal with new virtual computer generated information that influences, enhances or augments the physical real world environment directly or indi-

rectly (Alkhamisi & Monowar, 2013).

With massive technological advancements and the increase in complexity of machinery, there is always a requirement or need for new technologies that can help or simplify processes in areas of operations, maintenance and trainings. Augmented Reality is one of those technologies that is capable of addressing or presenting new possibilities of the way the world sees and interacts with information which inherently enhance operations, maintenance and trainings (Alkhamisi and Monowar, 2013).

RE'FLEKT being an Augmented Reality solution provider, and with the constant growing need to be able to simply the customers processes comprehend the significance of an Augmented Reality ecosystem.

2.3 Innovative Product Design

The factors that influence a customers decision making has changed from product price to product design over the years as it can be seen that the success of a product is based on its uniqueness and the superiority it provides over its competitors and the way it is perceived by the customers, which shows that there is an evident need for innovative product design (Moon, Park, and Kim, 2014).

Product design is used as a strategy by many companies to make sure that their products are successful in the market as the demand from the customer changes rapidly. The use of innovative product design creates a positive impression of the company"s innovativeness. Hence it is important that product design is always examined in the context of innovation (Moon, Park, and Kim, 2014).

Innovative product design refers to weather the qualities of the product that we offer were the outcome of product design, meaning the improvements in a products aesthetics, features and its ergonomics are the result of advancement in design and not due to

advancement in technology (Moon, Park, and Kim, 2014).

There are two main attributes that need to be considered during product design are aesthetics and features as they play a major role in the way a customer perceives a product as innovative.

Aesthetics of a product is not to be regarded lightly as distinctive or a unique style it influences the customers purchasing decision when the compare two products that have the same functionality and features (Kotler and Rath, 2011).

Features of a product can be refereed to the functions offered by the product that create benefit to the users. It can also be viewed as the way the customer uses the product. A functional product also helps a company to stand out of the competition (Moon, Park, and Kim, 2014).

Since customers perceive the value of a product based on its design and the offerings that it can provide, it is essential that the products that need to be designed as essentially and effectively designed with a balance between performance and appearance (Kotler and Rath, 2011).

There are many strategies and methods that can help in creating innovative products through design. The design method that was used for bringing RE'FLEKT's two products - REFLEKT ONE and RE-FLEKT Remote together while making sure that it offers the features that are needed to enhance operations and still be aesthetically appealing was the design innovation model by Kumar.

As the Design Innovation Model was chosen as the framework of this thesis, the initial question was to be rephrased whilst fulfilling the necessary requirement - Bringing the User Experience of two products together. Hence the finalized research question is as mentioned in the following page.

How can the Seven Modes of Design Innovation help combine the UX of two different AR products?

Methodology

The following chapter deals with the methodology that was used as the framework of this research paper. The design framework chosen was – Design Innovation Model that was developed by Vijay Kumar which is explained in detail and how each step was carried out in context to the research carried out.

3.1 Design Innovation Model

Design innovation can be broadly defined as the process of innovation in a field that is more often considered design, in the likes of graphic design, UX and UI Design. It is also applied to the use of methods such as design thinking to bring about innovation in the fields of business, engineering and education (Spacey, 2017). Design Innovation can also be defined as not just the method of coming up with new ideas and products but as the change that inherently brings about growth and differentiation (Reeves, 2014).

Design can be described as a conscious process that not only links form and function, but also enhances the outcome of various innovation activities that bring forth benefits such as the increased quality of products and services. Design also brings about various ways of thinking, accomplishing things and tackling wicked problems to generate novel and ingenious solutions (Bucolo and Matthews, 2011). Design can also be seen as the process that connects all the important factors of a product, from its production, distribution and consumption. Design is often seen to be interpreted in many ways, sometimes as product design and other times related to market research, creativity or in some cases branding (Verganti, 2008).

Innovation is the end result of a creative activity that not only focuses on the new and novel idea, but also the usefulness of the creative activity that potentially leads to utility. It can also be described as the embodiment and synthesis of knowledge in new ways that

bring about products and services that are of value and relevance (Multu and Er, 2013). Innovation can also be seen as a viable offering that is always new based on the specificities of context and time (Kumar, 2013).

The role of design has come a long way in organizations as they have understood that design can significantly add value not only to the products and services that are created but also to the firms strategic capabilities. Design is no more considered as a purely manufacturing related activity but also as a strategy to increase the strategic value of the business (Wrigley, 2017).

The design innovation model that we employ is a generic framework that can be used for any design innovation process which was developed by Vijay Kumar, an associate professor, Institute of design, Illinois Institute of Technology, Chicago.

3.2 Framework

This design innovation model framework is an iterative, non linear process that has seven modes or key elements that are listed as follows (Kumar, 2009).

Sense Intent
Know Context
Know People
Frame Insights
Explore Concepts
Frame Solutions
Realize Offerings
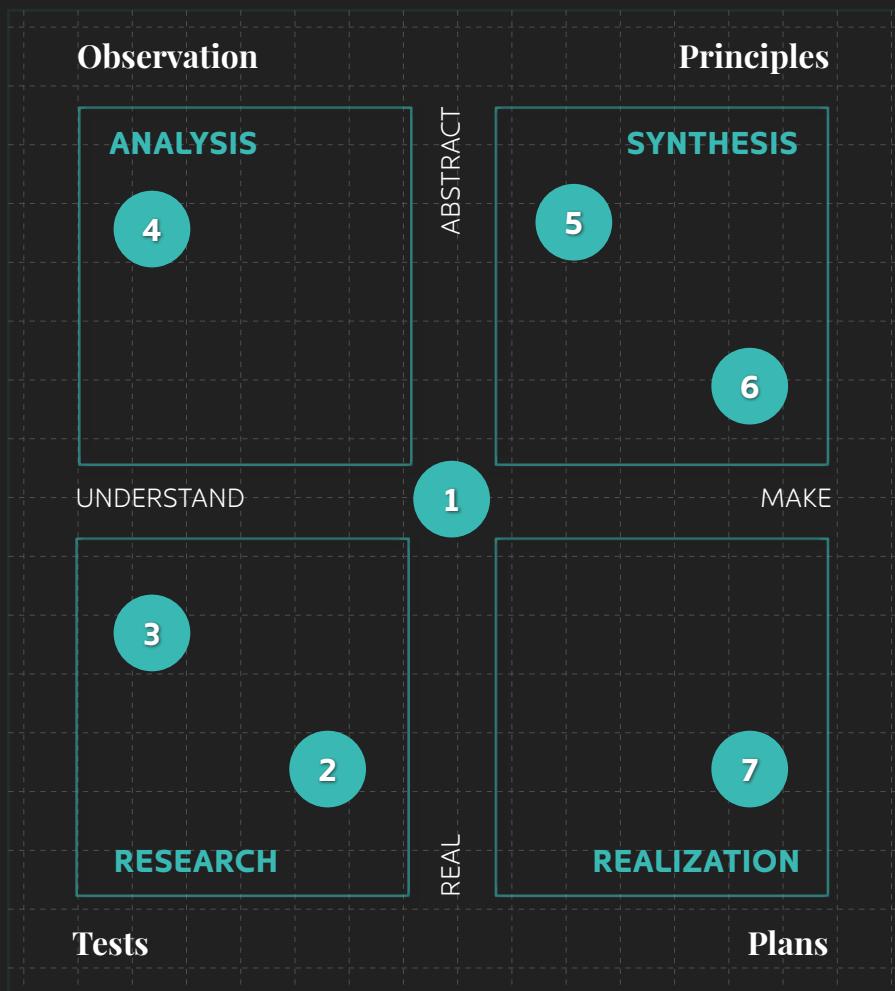
Observation

Principles

ANALYSIS

SYNTHESIS

4

5

6

ABSTRACT

UNDERSTAND

1

MAKE

3

2

RESEARCH

REAL

7

REALIZATION

Tests

Plans

Sense Intent | Know Context | Know People

Frame Insights | Explore Concepts | Frame Solution

Realize Offerings

Fig 1: The seven modes of design innovation (Kumar, 2013).

3.2.1 Sense Intent

This mode being the initial step is where the definition of the prob-lem and the innovation intent is carried out. It mostly begins with a rough goal and some form of initial problem that we intend to solve. Two primary activities are usually carried out in this mode. This first activity is framing the problem by running quick diagnostics about the problem in hand, both within and outside the organization. The second activity is looking for relevant changes and trends in the in-dustry, the users, technology and so on (Kumar, 2009).

3.2.2 Know Context

This is the second step where the goal is to understand the content of the problem and to generate insights. This is basically carried out by diving deeper into considering the offerings that are made by the organization, comparing it with its competitors, innovations, conducting a comprehensive market research and finding out how the services or products we intent to offer added value to existing and new customers. Some tools that can be used during this mode are context maps, Reference product tool guides, competitors and complimenter analysis (Kumar, 2009).

3.2.3 Know People

This is third step where the goal is to understand the users through observations and to generate insights based on the findings. This step is most important especially when we are inter to offer new or novel solutions to existing users. In order to understand our users better there are many tools that can be used. Some of the most commonly used methods are surveys and Interviews. In the context of this paper, Expert interviews are conducted and existing users feedback about the existing products are taken into consideration to understand the pain points of existing users and potential stake-holders within the organization (Kumar, 2009).

3.2.4 Frame Insights

This is fourth step with a goal of identifying patterns and to create concepts based on the data that has been collected so far. In this mode we identify the user group that we are facing on, technologies that we would use and also identify unrealized opportunities or needs (Kumar, 2009). Framing insights can be done by analyzing the results of the expert interviews that were conducted and from the existing user feedback. This method further helped create personas and user journeys that are explained in detail in Chapter 5.

3.2.5 Explore Concepts

This is fifth step with a goal of identifying opportunities and exploring concepts starting from the insights, principles and criteria framed earlier. This mode involves in structured brainstorming workshops that encourage bold thinking and concepts that are created can be categorized from products, services, environments, brands and business models (Kumar, 2009). In the context of this paper a brainstorming workshop was conducted to identify the key features and user flow of the new product that we intend to offer to our users. The details of the workshop are explained in detail in later chapters of the paper. The outcomes of the workshops were user flows and sketchbook prototypes that are explained in detail in Chapter 6 and 7.

3.2.6 Frame Solutions

This is sixth step with a goal of prototyping concepts and framing solutions from that data that we have collected from the previous step. Since the previous method results in a large number of ides, they need to be evaluated, categorized and prioritized to make sure the offerings provided are of high value to the users as well as the stakeholder in the organization. The failure or success of the new concept depends on how well it addresses the users needs. And in order to make a successful fit, the concepts framed need

to be made into prototypes that can be iterated and tested before its implementation (Kumar, 2009). Prototypes could be sketches, click-able dummies or Low fidelity sketches. In the context of this paper, high fidelity prototypes are created that are explained in detail in Chapter 8.

3.2.7 Realize Offerings

This is seventh step with a goal of evaluating the solutions and planning the implementation of the prototyped offerings. It has to be made sure that sufficient user testing was conducted and that the product or services offer real value to the users. We also need to make sure that the new product or service adds economic value to the organization (Kumar, 2009). As this phase requires a lot of time and investment in realization, this paper does not look into the realization of the prototypes that were created.

Know Context

The following chapter deals with the underlying research, which was conducted in order to achieve a better understanding of the markets, customers and products. Analysis of trends and Competitors in Augmented Reality were conducted. And in order to better understand the existing products they were analyzed using the product field reference guide.

4.1 Trend Analysis

Augmented Reality has the potential to contribute significantly in the way content is being is being consumed in the fields of education, entertainment and productivity. With the continuous growth and improvement in the Augmented Reality technology, development of potential applications across several industries are evident (Seal, 2019).

Some of the industries where the use of Augmented Reality and its constant advancement can be noticed are Healthcare, Automotive, Enterprise, Mobile and Field Service.

4.1.1 Healthcare

Augmented Reality provides valuable information for doctors, nurses, surgeons and medical students. Augmented Reality enabled devices help bridge the gap between digital data and medical professionals who use it more effectively than ever before (Seal, 2019).

4.1.2 Automotive

The integration of Augmented Reality has also been a growing technology in the automotive sector, where information such as the speed of the automobile, Mileage and directions can be displayed

on the windshield of automobile (Seal, 2019). Augmented Reality is being used to enhance safety and driving accuracy by holographic overlays of information that are in the drivers line of sight (Makarov, 2019).

4.1.3 Enterprise

Augmented Reality powered solutions for the enterprise have constantly been on the rise which is enabled by hand held devices such as the mobile, tablets and smart glasses. The enterprise solutions focus on making operations, maintenance and training effective across various industries. Some of the predominant use cases in the enterprise sector are the Military, Manufacturing, Energy and Transportation (Makarov, 2019).

4.1.4 Mobile

Augmented Reality has seen a constant growth in the Mobile sector which have been enabled by companies such as Apple and Google. With the introduction of ARKit 2.0, there has been an improvement in tracking, measuring and rendering. The ARCore based software on the market saw a jump from 100 million to 250 million users in the android enabled smart-phone sector (Makarov, 2019).

4.1.5 Field Service

One of the best Augmented Reality use cases can also be seen in field service. Field service technicians have difficult or rather complex tasks that need to be accomplished when it comes to maintenance in sectors such as Aerospace and Energy. Augmented Reality helps improve efficiency and reduces downtime on machines as it provides the technician with real time information that can be directly displayed on the machines by the use of hand held devices or smart glasses (Seal, 2019).
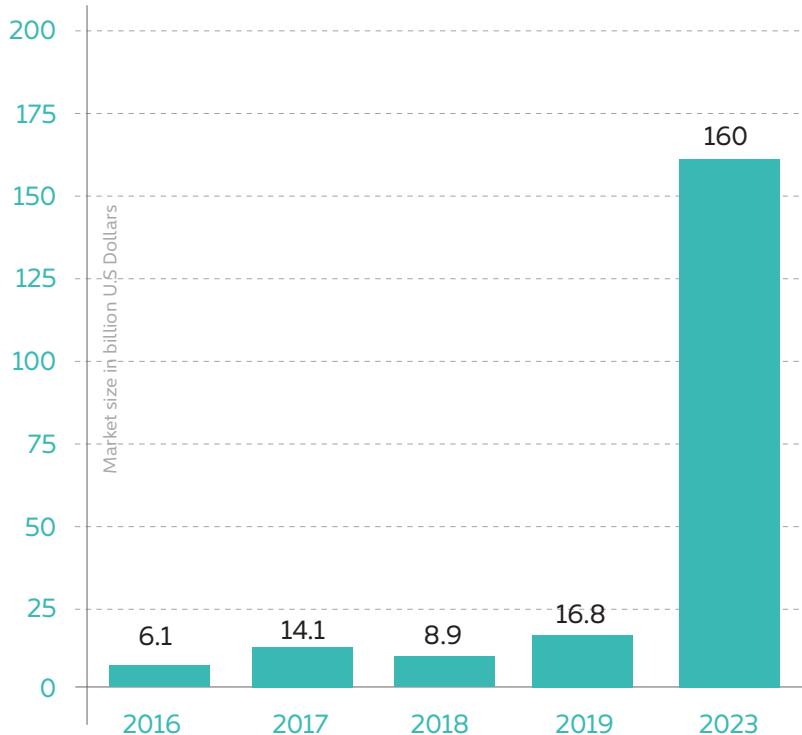
Fig 2: Forecast Augmented Reality and virtual reality market size worldwide from 2016 to 2023 in billion U.S. dollars (Lui, 2019).

The Augmented Reality and Virtual Reality market amounted to a forecasted 16.8 Billion U.S Dollars in 2019 and is expected to grow up to a 160 Billion U.S Dollars by the year 2023. One of the major factors that accounted for this rise in the market of Augmented and Virtual Reality is the consumer spendings (Lui, 2019).

Consumer spendings on Augmented and Virtual Reality are on a constant rise. Among segments such as location based Virtual Reality, Augmented Reality content/Apps and Virtual Reality content/Apps, The segment with most amount of spending is in the creation of Augmented Reality content and applications that can support and enable this content (Lui, 2018).
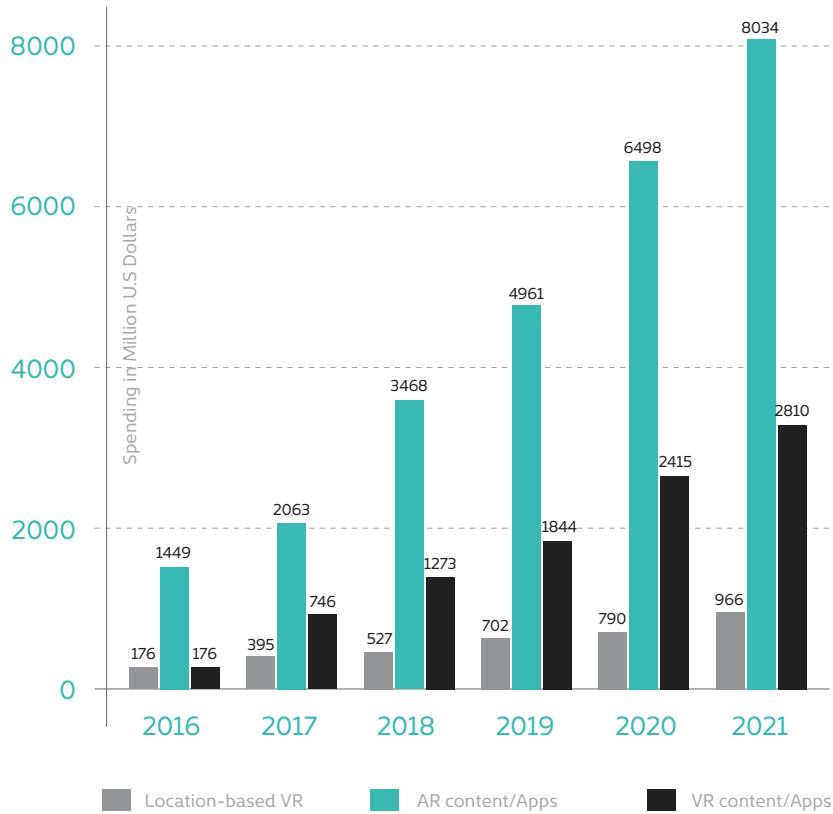
Fig 3: Consumer spending on Augmented Reality and Virtual Reality content and apps worldwide from 2016 to 2021 in million U.S. dollars (Lui, 2018).

4.2 Competitor Analysis

The competitor market was analyzed in detail in order to create an overall competitor analysis. Some of the questions that needed to be answered or taken into consideration were: What kind of companies or organizations need to be considered as competitors? Which companies to be considered as direct competitors? Which should be considered as indirect competitors?

This paper focuses on bringing two existing products together, the

first product - REFLEKT ONE is an Augmented Reality platform that is scalable, enabling companies to create their own Augmented Reality applications that can be visualized in real time on real objects using hand held devices such as phone and tablet along with head mounted devices to simplify operations, maintenance and training (RE'FLEKT GmbH, n.d).

The second product - REFLEKT Remote is a platform that enables companies to provide their technicians and its customers with real time video remote support with Augmented Reality. This is achieved through RE'FLEKT's intelligent routing system that identifies and connects the technician to the right expert using smart glasses, phones or tablet. It also provides technicians with a global database of issues that have already been resolved that helps accelerate maintenance and repair processes (RE'FLEKT GmbH, n.d).

Bringing these two products, creating an ecosystem is something that has not been done by other companies or organizations at the moment and hence there are no direct competitors in this segment of the market. On the other hand there are many companies that provide products that enable the creation of Augmented Reality content and remote services that enable and facilitate field operation services, which can be carried out using hand held devices, smart glasses and head mounted devices. Companies providing the similar set of existing products and services at the moment are the likes of PTC, Scope AR and Atheer.

PTC is a global software company that enables companies to differentiate their services, products by improving its efficiency and productivity using its market proven solutions. Some of the solutions that PTC provide are tools that enable Augmented Reality content creation, product life cycle management and so on (PTC, n.d).

Scope AR is a leader in developing Augmented Reality solutions and products that focus on many industries in the fields of maintenance, manufacturing and training. The products that are offered

are called Worklink Create which is an Augmented Reality content creation platform that enables any company or organization to create its own in house Augmented Reality applications based on the use case and the other product is called Worklink Assist that provides remote solutions that enable technicians to carry complex tasks more efficiently (Scope AR, n.d).

Atheer is a technology company that pioneers in providing an Augmented Reality management platform with the focus of improving productivity, security and effectiveness for industrial work forces, customers and supply chains (Atheer, n.d).

With the advancement in technology and the ever growing ability to make more and more content available in Augmented Reality, the near future does see other companies and organizations moving into the same direction of creating an enterprise ecosystem in order to provide a much more efficient and simpler user experience in the fields of operations, maintenance and training. This would make existing companies such as PTC, Scope AR and Atheer direct competitors in the near future.

Company	Products	Market Segments
PTC	Vuforia Studio Vuforia Expert Capture Vuforia Engine Vuforia Chalk	Aerospace, automotive,Electronice, Life Sciences, Oil & Gas, Retail & Consumer products
SCOPE AR	Worklink Assist Worklink Create	Industrial, manufacturing, telecom, aerospace, automotive,mining & energy
ATHEER	AiR Enterprise AiR Experience	Automotive, aviation, consumer packaged goods, logistics and warehousing, manufacturing, oil & gas, energy, and transportation

Table 1: Competitor Analysis – Own Representation

4.3 Product Field Reference Guide

The product field is a method that can be used for the innovation of new, redesigned or substantially improved products. It is also a tool that facilitates in the explanation and visualization of various aspects that are involved in product innovation which supports stakeholder impact (Frahm, Schieben, & Beholz, 2016).

The product field is divided into twelve different aspects that consider all possible factors of product innovation such as stakeholders, strategies and artifacts. The twelve different aspects of the product field are as follows (Frahm et al., 2016).

Goals
Drivers
Enablers
Production
Distribution   CONTEXT
Customers
Users
Motivations
Problems
Solutions
Alternatives   CORE
Uniqueness

ID
EA

VAL
UE

GOALS

MOTIVATIONS

DRIVERS

Uniqueness

Problem

USERS

ENABLERS

Solution

Alternatives

CUSTOMERS

PRODUCTION

DISTRIBUTION

RESO
URCE

MAR
KET
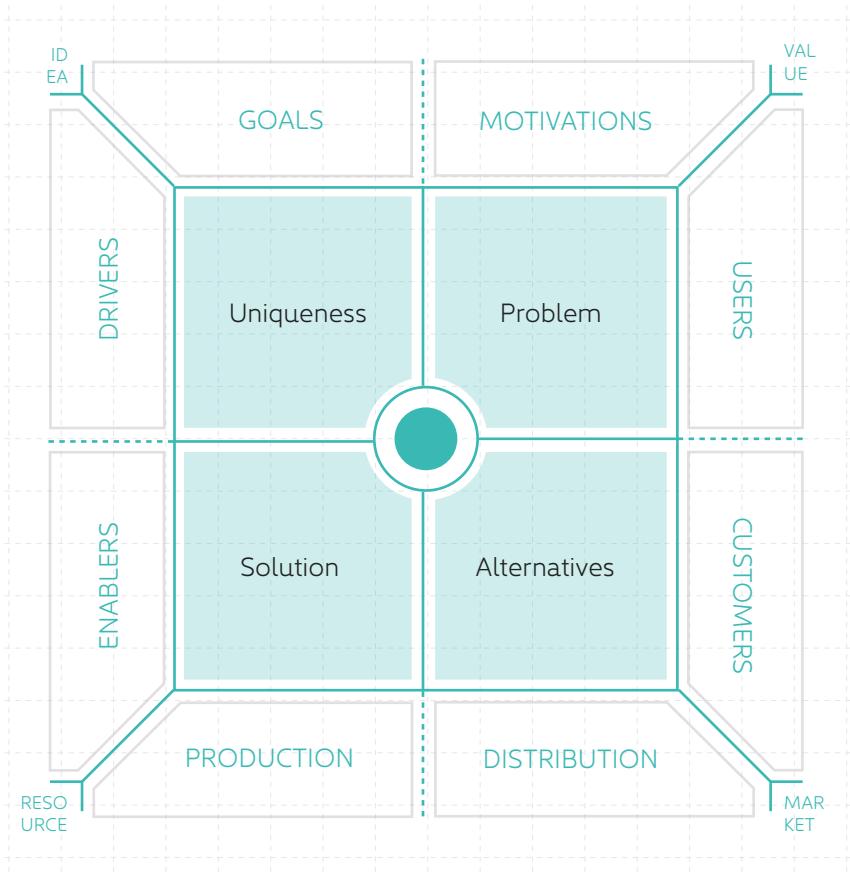
Fig 4: The product Field | Frame | Aspects (Frahm et al., 2016).

GOALS - Goals describes the business objectives or strategies which we want achieve with the product innovation (Frahm et al., 2016).

DRIVERS - Drivers are the teams and people responsible for shaping and driving for outcome of product innovation, this helps decision making processes more efficient (Frahm et al., 2016).

ENABLERS - Enablers are the resources and the assets that are required for product innovation, this is required to identify potential risks that might occur (Frahm et al., 2016).

PRODUCTION – Production is how the product or service gets built, this helps in identifying the skills or prerequisites that are required for production (Frahm et al., 2016).

DISTRIBUTION – Distribution is how we get the product or service to the end user or customers, This helps in identifying the go to market approach and logistics that are required (Frahm et al., 2016).

CUSTOMERS – Customers are the ones the bring the organization revenue as they pay for the products or services that are offered. Identifying the customers help in understanding how buying decisions are made , how and when they can be reached (Frahm et al., 2016).

USERS – Users are the ones who use the products or services offered that help them overcome specified problems, Understanding users help in identifying their motivations and pain points (Frahm et al., 2016).

MOTIVATION – Motivation describes the purpose of why a user uses the product or service offered. Understanding the users motivation brings insight in design and development of user centric product innovation (Frahm et al., 2016).

PROBLEM – Problems are the things that prevent users from being able to achieve what the they want to with a specific product or service. Identifying the problems helps us to provide a suitable solution (Frahm et al., 2016).

SOLUTION – Solutions are how a product or service enables a user and how it helps tackling users problems. Describing the solution heps us identify how and what are intended offerings would include (Frahm et al., 2016).

UNIQUENESS – Uniqueness of a product or services is what differentiates it from other competition. This is what drives users to

choose our solutions instead of others. Describing the uniqueness helps in identifying the additional value of a product or a service and the way it can be adopted or scaled by the user (Frahm et al., 2016).

ALTERNATIVES – Alternatives are the products and services that are currently available for a user to choose from. Identifying the competitors products or services helps in benchmarking the uniqueness of our innovation that helps us stand out of the competition (Frahm et al., 2016).

4.3.1 REFLEKT ONE
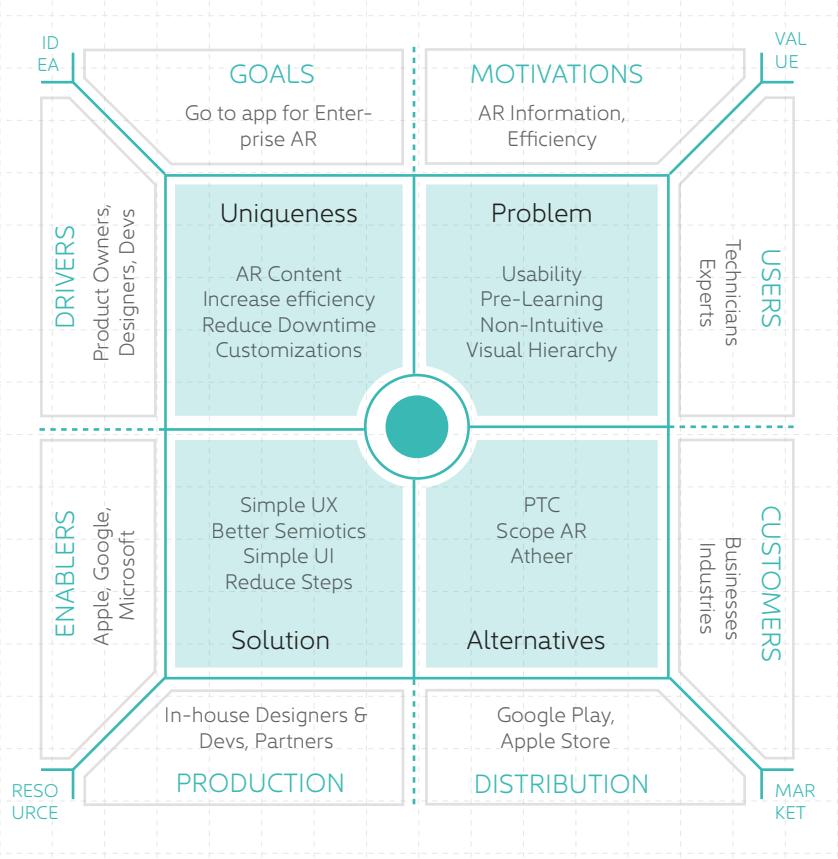
Fig 5: The product Field | REFLEKT ONE | Own representation (Frahm et al., 2016).

In order to gain a better understanding of REFLEKT ONE, it was analyzed using the Product Field. The following are the findings that were identified.

GOALS – The goal of REFLEKT ONE is to be the go to application on the market for enterprise Augmented Reality which enables easy creation and publication of Augmented Reality content across various platforms.

DRIVERS – As the drivers are the ones that bring about the realization of the product, stakeholders would include Head of Products, Product Owners, Designers and Developers.

ENABLERS – The resources and assets that are required or which enable the realization of product innovation are technology companies such as APPLE, GOOGLE, MICROSOFT as they provide products, services and devices that are essential in the realization of bringing changes, improvements or the creation of new products.

PRODUCTION – The prerequisites that are required are in house designers, developers and external technology partners.

DISTRIBUTION – The prominent channels that can be used to get the product to the market were identified as the Google Play store and Apple store as most of our users use devices that are either Android or iOS.

CUSTOMERS – As REFLEKT ONE is an enterprise Augmented Reality solution, the targeted customers would be businesses and industries with a need to improve efficiency and productivity in the fields operations, maintenance and trainings.

USERS – The people who use the applications can vary from technical authors who validate the Augmented Reality content that was created to field technicians that carry out operations and maintenance tasks and to operations managers who use Augmented Re-

ality content for employee training.

MOTIVATION - The motivations for industries or businesses to invest in the product are the fact that Augmented Reality improves productivity and efficiency as it provides the right information and eliminates the need of going through heavy documentation to carry out an inspection task.

PROBLEMS - The problems that were identified with the existing application is the basic overall usability. The application is complex and had a steep learning curve due to complexities in visual hierarchy, semiotics and the steps involved to complete a task.

SOLUTIONS - The solution to make the product much more efficient and user friendly would be the creation a simple user experience by reducing the steps needed for a user to identify and accomplish basic tasks. Improvements are required with the way information is provided with better semiotics and an overall update in the user interface.

UNIQUENESS - Features that make the existing product stand out from the rest of the competition are the availability of Augmented Reality content that can be tailor made based on the use case. The ability to provide white labeled solutions to businesses and industries is another feature that adds value to the product.

ALTERNATIVES - Existing alternatives in the market are the products and services offered by the likes of PTC, Scope AR, Atheer and so on.

4.3.2 REFLEKT Remote

In order to gain a better understanding of REFLEKT Remote, it was analyzed using the Product Field. The findings that were identified are as shown in the figure and explained in following page.

	GOALS	MOTIVATIONS	
IDEA			VALUE
DRIVERS Product Owners, Designers, Devs	Uniqueness	Problem	USERS Technicians Experts
ENABLERS Apple, Google, Microsoft	Solution	Alternatives	CUSTOMERS Businesses Industries
RESOURCE	PRODUCTION	DISTRIBUTION Google Play, Apple Store	MARKET
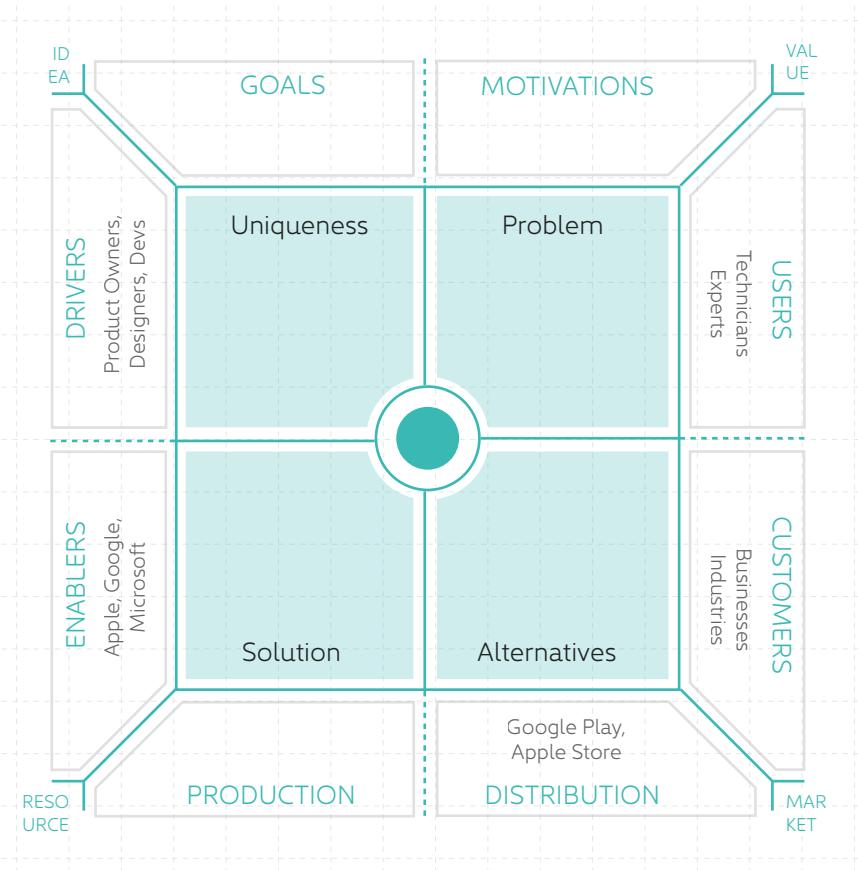
Fig 6: The product Field | REFLEKT Remote | Own representation (Frahm et al., 2016).

GOALS – The goal of REFLEKT Remote is to be the go to application on the market for Field Service which provides its customers and field technicians with real time remote support along with Augmented Reality across various devices and platforms.

DRIVERS – As the drivers are the ones that bring about the realization of the product, stakeholders would include Head of Products, Product Owners, Designers and Developers.

ENABLERS – The resources and assets that are required or which enable the realization of product innovation are technology com-

panies such as APPLE, GOOGLE, MICROSOFT as they provide products, services and devices that are essential in the realization of bringing changes, improvements or the creation of new products.

PRODUCTION – The prerequisites that are required are in house designers and developers.

DISTRIBUTION – The prominent channels that can be used to get the product to the market were identified as the Google Play store and Apple store as most of our users use devices that are either Android or iOS. Since REFLEKT Remote also supports head mounted devices, publication of the application on the Microsoft Store could be another channel to the go to market.

CUSTOMERS – As REFLEKT ONE is an enterprise Augmented Reality solution, the targeted customers would be businesses and industries with a need to improve efficiency and productivity in the fields operations, maintenance and trainings.

USERS – The people who use the applications are field technicians that carry out operations and maintenance tasks. Experts that provide immediate assistance to the technicians in the field. Another set of users would be administrators of the applications who configure and maintain the user accounts in an organization.

MOTIVATION – The motivations for industries or businesses to invest in the product are the fact that Augmented Reality improves productivity and efficiency as its field technicians are routed to the right expert who provide precise information in real time with the use of sticky annotations and other Augmented Reality features that enables the technician to carry out his task with no lose of time.

PROBLEMS – The problems that were identified with the existing application are terminology, user journey and the user interface.

SOLUTIONS – The solution to make the product much more ef-

ficient and user friendly would be the creation a simple user experience by reducing the steps needed for a user to identify and accomplish basic tasks which would include the elimination of the need to find an expert and add contacts. Improvements are required with the way information is provided with better semiotics and an overall update in the user interface.

UNIQUENESS - Features that make the existing product stand out from the rest of the competition are support across cross platforms, The ability to make audio and video calls with limited or no cellular data, The addition of sticky annotations would open the product to new markets and intelligent routing to the right expert would increase the possibilities of achieving a simpler overall user experience.

ALTERNATIVES - Existing alternatives in the market are the products and services offered by the likes of PTC, Scope AR, Atheer, Whatsapp, Messenger and so on.

Know People

The following chapter describes the underlying secondary research, which was carried out in order to gain a deeper understanding of the topic in hand and the targeted users. Subject Matter Expert Interviews were conducted which provided the required insights that facilitated the creation of relevant user personas and user journeys for the targeted user.

5.1 Expert Interviews

As the focus was to gain a comprehensive understanding, explanation and nature of the topic in hand a qualitative research approach was taken into consideration as it is a process of gaining in-depth-meanings unlike quantitative data (Frances, Coughlan, & Cronin, 2009). Expert interviews were done in the beginning or explanatory phase of the project as it is a more efficient and concentrated method of gathering data unlike user observations and surveys (Bogner, Littig, & Menz, 2009).

5.1.1 Interview Structure

There were several steps involved in the formulation of the expert interviews. The first step was to determine and define the kind of information that was expected from the interviews. The second step was to elaborate what type of information is needed in order to find the appropriate experts to be interviewed and in order to broaden the scope of the research two types of experts were chosen.

The third step was the preparation of the questionnaire for the interviews. It was necessary to have a prepared questionnaire in order to guide the experts through the interview which can be found in the appendix of this paper. The fourth step were the interviews that were conducted individually on different days in relevance of

to availability of the experts. The fifth step was the activities during the interview, and as interviewing involve active listening, the participants were requested to grant permission so that the interviews could be recorded which would be transcribed and summarized to extract interesting insights in the sixth and final step.

Some insightful quotations from the interview are as follows,

"Only an ecosystem can help provide a seamless user experience!"

"We have to provide a consumer based experience! "

"User experience and User interface of a product are of highest priority as they help fix technical problems! "

"Its is absolutely essential that we get the usability right making it easy and efficient! "

"We need to understand the clients use cases in-order to provide a standardized solution! "

5.1.2 Results

Since the interviews were conducted with experts who specialized in different fields, a broader perspective of the topic in hand was gained providing deeper explanations and understanding which are summarized as follows.

The interviews began with providing the expert an introduction and background of the topic in hand followed by a general discussion about their opinions on Augmented Reality and its future which provided a background, current state and limitations of Augmented Reality in the Enterprise sector. This brought us to the next question about the need of an ecosystem and its importance to have a competitive advantage in the existing market. The consensus of the experts were that an ecosystem can provide a seamless user experience and that products and the services in the field of Augmented Reality need to reach a point where they can provide a consumer based experience which is as simple as using services like Amazon or Netflix.

The interviews progressed about the history and current state of our existing products and services. It was clarified that improvements in user experience and user interface of our existing products are of highest priority and that it is absolutely essential that we get the usability right making our products and services much easier and efficient. It was also pointed out that more time and effort needs to be invested in really gaining in depth knowledge about our customers environments and their use cases which would provide significant insights towards the improvement of our products enabling the creation of standardized products and services.

Another important insight from the interviews was the topic of scalability of our products and services. Considerations need to be made with the way our products and services work making adoption of Enterprise Augmented Reality solutions for new businesses and industries easy and efficient.

5.2 Personas

For any effective design to be accomplished a deep understanding of the user and user needs is essential (Constantine, 2005). User-centered design, human-centered design and customer-centered design the user or customer is represented through out the design process by the creation of personas (Miaskiewicz & Kozar, 2011).

Personas are abstracts of a group of users or customers who share common needs and characteristics which are fictionally represented. A Persona is a fictional representation of an individual who represents a group of users with common characteristics (Miaskiewicz & Kozar, 2011).

A name and picture is always used to represent a persona followed with a narrative description. The goal of the narrative is to make the persona seem like a real person and to provide a story which encapsulates the needs of the user in the content of the product that is being designed (Miaskiewicz & Kozar, 2011).

The benefits of using personas in the design process are better communication of the user or target users needs across teams and stakeholders, increased focus on the user, understanding of the needs of the users, extrapolation of diverse situations of the users and the reduction of changes in the final phases of the product development enabling smoother and efficient product deployment (Miaskiewicz & Kozar, 2011).

Using insights gained from the expert interviews and examination of our existing products using the product field reference guide focusing on the field technician who uses our current products, two personas were defined. The first persona is a senior technician who is experienced in his field with lesser inclination towards technology while the second persona is a junior technician with minimal experience in the field and greater inclination towards technology.

Phillip Reiniger

Phillipp Reiniger is a 50 year old man who is married and has children. He has been a senior industrial technical with more that 20 years of work experience who carries out a range tasks on different machines across the factory floor. With his experience in the field, he is required to travel often across Germany to carry out maintenance and operation tasks on off-site machines.

Phillip is a person who believes in hierarchy and organizational structure and is usually not willing to take up any other tasks that are outside his responsibility and just wants to carry out his daily tasks. As he is coming closer to his retirement, he wants to make sure of carrying out his job with no complication or hassles and looks forward to retiring in good terms with the management so that he can spend time with his family.

Some of the challenges that Phillip faces are the constant change in the company, machinery, introduction of new ideas and technology which he finds to be very complicated. And since he is retiring he also finds the need to train new technicians, but finds it difficult to use new tools and technology.

As Phillip is used to using emails and regular calls or even whatsapp to get information that he needs to carry out his daily operations, he does have strong objections towards new technology as he finds them complex as they have steep learning curve.

Phillip's challenges can be solved by providing him with an intuitive tool that requires less or no training which also reduces his travel time to off sites and also reduce his time in searching through documents that are required for maintenance tasks and enables easy reporting to his managers.

Phillip Reiniger

TITLE
Senior Industrial Technician

INDUSTRY
Automobile

AGE
50

MARITAL STATUS
Married

HOBBIES
Football, Cars, Beer

GOAL
Retiring

CHALLENGE
New Technology

OBJECTION
Too Complex

QUOTE
"Young people lack practical experience and the patience to learn. I do not see how they will manage with machines constantly getting more complex."

Patrick **Wulf**

Partick Wulf is a 25 year old man who is single. He has is a junior industrial technical with about five years of work experience who carries out a repair and maintenance tasks on machines across the factory floor. Since Patrick is young he is required to travel often across Germany to carry out maintenance and operation tasks on off-site machines as well.

Patrick is a person who strives to accomplish his goals that include job security and to Constancy grow in his career. He exhibits great responsibility and is always quick to learn and to take feedback to improve the way he works. His career goal is to be able to become a technical engineer or a product manager.

Some of the challenges that Patrick faces in his work place is the fact that he is at the bottom of the career ladder with strong hierarchies and traditions in his organization which makes it difficult for him to prove himself or bring about change in the work place. He also finds the work environment old fashioned with a lot of documentation that are outdated which are not applicable for the new machines.

Patrick also faces objections when he tries to recommend new technology to his superiors as the cost is too much and that they do not have devices that support new services.

Patrick's challenges can be solved by providing him with an intuitive tool that requires less or no training which enables him be more productive so that he can prove himself and that he could prove that new technology can reduce machine downtimes which increases return of interests.

Patrick Wulf

TITLE
Junior Industrial Technician

INDUSTRY
Automobile

AGE
25

MARITAL STATUS
Single

HOBBIES
Football, Cars, Traveling

GOAL
Job Security & Career

CHALLENGE
Junior in the industry

OBJECTION
Not taken seriously

QUOTE
"I learn a lot from manuals and tutorials I look up online. But, there is little time for that when we are at a customer location."

5.3 User Experience Maps

The phrase "The customer is always right" was originally used in 1990 by the founder of Selfridges department store in London to describe a service ecology that was designed to convince customers that they will always receive the best service and to also motive employees to live up to that expectation of the customer (Samson, Granath, & Alger, 2017).

In todays development of process, products or services a focus on user experience and user centric approaches are considered (Kojo, Heiskala, & Virtanen, 2014). User experience has been defined as the end user's interactions with an organization, its products and services (Kojo et al., 2014). User experiences are social in nature which are influenced by other customers or users resulting in organizations having lesser control over the whole user experience and user journey (Lemon & Verhoef, 2016).

Customer or user experience maps provides insights into the motivations, feelings, attitudes and behaviors of the user while using a product or a service. A user experience includes all the activities and events that related to the service or the product that help the user achieve their goal. It is also a physical and an emotional that the customer or user experiences from their perspective (Kojo et al., 2014).

One of the methods involved to collect direct and unbiased information of a customer's or user's experience while using a product or a service is self documentation. This involves the customer or the user to document their own behavior, feelings and motivations while using the product or service (Kojo et al., 2014).

Self documentation was the method used to determine the user experience while using the products under observation - REFLEKT ONE and REFLEKT Remote which are visualized and explained in the following pages.

REFLEKT ONE

(THINKING)
This looks interesting.I'll try this

(UNSURE)
Is this more efficient?
Not sure how long this will take!
Do I need login credentials for every?
Do I have all the docs I need?
Do I need to connect to the WIFI?

(THINKING)
The login seems straight forward

(UNSURE)
Hope I remember my credentials!
Forgot my password, how do I reset
it? How long would it take?

(SATISFIED)
I found the scenarios I need
It shows me how to initiate tracking
Found my personal scenarios
Overview of the app UI was clear

(WORRIED)
I do not find my scenarios!
How do I find my scenarios?
Where do I find the server details?
Why do I have to enter these details?
What if I enter the wrong details?

(SATISFIED)
Tracking was quick and easy
The animation was clear & Intuitive
The text was clear and precise
Number of steps are clearly mentioned
Freeze mode helps keep content in place
Additional image was helpful

(UNSURE)
have to initiate tracking all the time
I don't understand the step
Not sure which step I am at
Too much information
Complicated UI
The UI is not intuitive

(SATISFIED)
I received a checklist after all the steps!
The tasks were easy to follow & Precise
I Received the exact steps I need!
I was able to complete the task faster!
I did not need my manual!
There was no need of documentation!

(UNSURE)
I Have I completed all the steps?
I was not able to follow the steps!
I would rather make a call.
How are the steps documented?
Could I chat or call an expert?
The app is too complicated

1 **APP CONSIDERATION**   2 **OPEN APP**   3 **SCENARIOS**   4 **TRACKING & USING**   5 **WAIT & WONDER**   6 **TASK COMPLETE**

→ **USER DROP OFF**

Fig 7: User Experience Map | REFLEKT ONE | Own Representation of customer journey maps (Wójcicka, 2015).

5.3.1 REFLEKT ONE

The user experience map in the previous page illustrates the positive and negative feelings and questions that a user had when they used REFLKET ONE. The positive feelings are named as thinking and satisfied where as the negative feelings are named as unsure and worried. The explanation of the previous illustration is as follows.

1. APPLICATION CONSIDERATION – When the user considered using the application the user thought that it was interested as it is a new product with new features that include Augmented Reality content. On the other hand some of the things the user was unsure about were if this application is more efficient than his normal way of carrying out a task, If the application has all the documents that are required, if the application would work even if there is limited or no cellular or Wifi connectivity and if he has to remember his credentials every time he logins in.

2. OPENS APPLICATION – Once the user opened the application he was requested to login which the user thought was a normal task that needs to be carried out, but on the other hand there were uncertainties such as what happens if i forget my login credentials? And if i have to reset my password, How long will this take and will i be wasting time instead of being able to carry out my regular task?

3. SCENARIOS – After the user had successfully logged into the application, the user was satisfied if he found the scenarios that he needs to work on and with the instructions provided to initiate the tracking and when the steps that need to be carried out are simple and clearly mentioned. On the contrary the user was worried when they were not able to find the scenarios straight away and need to enter server details and other credentials to be able to access the information he needed. Other worries also included questions such as why do i have to enter server details and what if i enter the wrong details? Potential drop off of the user was observed since the user exhibited more worry than being satisfied at this step.

4. INITIATE TRACKING AND USE THE APPLICATION – The user was satisfied with the way the tracking was initiated as clear instructions were provided and that the tracking was successful. The users were also satisfied that the number of steps where clearly mentioned and that additional information such as images were available while carrying out a scenario. The other thing that users were satisfied about was the ability to freeze and 3D mode if they would have to use both of their hands to carry out an operation and pick up the device and carry on from where they left off. Some of the things that users were unsure about were that they have to initialize tracking every time they move away from the object and some steps seem to be overloaded with information which made the user interface seem too crowded and not intuitive.

5. WAIT AND WONDER – As the user was carrying out the steps in a scenario some of the questions that arose which made the user worry were, I am not able to follow this step, Would i be able to call an expert to solve this problem? Is it possible for me to chat with an expert who could help me solve this issue? How is my work documented that makes it transparent for reporting to my superiors? These questions also brought about a potential drop off of the user or customer.

6. TASK COMPLETE – Even though users had their questions and concerns in the previous step, there was a positive reaction once they were able to successfully carry out all the steps required in the scenario. They were satisfied that there was feedback or checklist regarding the steps that were carried out, No requirement of having to go through manuals of documentation to carry out the required task and that they were able to carry out the task much more effectively and efficiently using the product.

This process provided comprehensive insight into the pain and the gain points that the customer faced while using REFLEKT ONE providing deeper understanding of the feelings and motivations which can be extrapolated for further development of the product.

REFLEKT REMOTE

USER EXPERIENCE MAP

1 APP CONSIDERATION

(THINKING)
This looks interesting! I'll try this

(UNSURE)
Is this more efficient?
Not sure how long this will take!
Do I need login credentials for every?
Do I have all the docs I need?
Do I need to connect to the WIFI?

2 ONBOARDING

(THINKING)
The login seems straight forward

(UNSURE)
Hope I remember my credentials!
Forgot my password, how do I reset
it? How long would it take?

3 CHAT

(SATISFIED)
I like that I can chat or call an expert

(WORRIED)
Who is the expert I would get?
Um, is anyone there?
I don't understand that response!
Do I have to find an expert myself?
Do I need to add the expert to my contact?

4 INITIATING CHAT

(SATISFIED)
It was easy to use to send a text!
It was easy to describe my issue

(UNSURE)
Was my description clear?
Will I get in touch with the
right expert?

5 WAIT & WONDER

(WORRIED)
Do I need cellular data to make a call?
Have I done the step before calling?
How do I know if the expert is free?
Do I need more documentation?

6 PHONE/VIDEO CALL

(SATISFIED)
The expert resolved the issue for me!
The option to switch to video was helpful!
Sticky annotation made pointing perfect!
I had the right expert!
The call resolved my issue!

(SKEPTIC)
I have to explain a lot to the expert
It was hard to explain everything – chat
I would like to solve it myself

7 WONDER

(WORRIED)
Whats the status of the chat?
Do I need more documentation?
Can I contact the same expert?
The app is too complex!

8 TASK COMPLETE

(SATISFIED)
The task is done!
The steps were easy over the video call!
The expert had the right data!
I did not have to explain my issue!
Annotations improve accuracy!

↻ USER DROP OFF

5.3.2 REFLEKT REMOTE

The user experience map in the previous page illustrates the positive and negative feelings and questions that a user had when they used REFLKET REMOTE. The positive feelings are named as thinking and satisfied where as the negative feelings are named as unsure, skeptical and worried. The explanation of the previous illustration is as follows.

1. APPLICATION CONSIDERATION - When the user considered using the application the user thought that it was interested as it is a new product with new features that include Augmented Reality content. On the other hand some of the things the user was unsure about were if this application is more efficient than his normal way of carrying out a task, If the application has all the documents that are required, if the application would work even if there is limited or no cellular or Wifi connectivity and if he has to remember his credentials every time he logins in.

2. ON-BOARDING - Once the user opened the application he was requested to login which the user thought was a normal task that needs to be carried out, but on the other hand there were uncertainties such as what happens if i forget my login credentials? And if i have to reset my password, How long will this take and will i be wasting time instead of being able to carry out my regular task?

3. CHAT - As soon as the user successfully logged into the application, the user was satisfied that he could contact an expert to solve the problem that hinders him from accomplishing his task. On the other hand the user was worried about issues such as, Who is the expert that i would get? Is he the right expert that would help me solve this task? How do i know when a expert has answered to my chat? How long do i have to wait for an expert to respond to my chat? Do i have to find the expert myself and do i have to add him/her to my contact list? This indicated that there were more pain points at the initial stages of using the application which made the

user feel like they were wasting time and that they would drop off from the application or use other alternatives such as whatsapp.

4. INITIATING CHAT / INCIDENT – Despite the concerns the user exhibited in the previous stage, once the user was able to get in touch with an expert he was satisfied that he could just write a small description of his issue. On the contrary some of the things that brought about uncertainty were, was my description enough for the expert to understand my issue? Would this expert be able to solve my issue or would i be redirected to another expert?

5. WAIT & WONDER – Once the user initiated the chat and was waiting for the expert to respond, some of the questions that made the user worry were, Would i be able to make a call if the chat does not help resolve my issue with limited or no cellular or wifi? Have i carried out all the steps before i initiated the chat? How do i know if the expert is free at the moment? Is there any more documentation that i need to go through or provide the expert with to have my issue resolved?

6. PHONE / VIDEO CALL – The user was satisfied that they were able to switch between a phone / video call from within the chat and the availability of annotations for pointing out exactly where the issue was, enabling the expert to provide precise information that helped resolve the issue. Even though the user was able to get the issue resolved, some of the things that the user was skeptical about the fact that they had to provide a lot of information such as descriptions in the chat and additional images to the expert, the need to add or being re-routed to another expert to have the issue resolved. This made the user feel that they were spending too much time in trying to get the issue resolved where as a simple document that provided the steps that needed to be carried out would have been much more efficient.

7. WAIT & WONDER – Some of the worries that the user had before they ended the chat or call were, Is there any further documenta-

tion that is required once the chat or call has ended? How do i confirm that the chat or call helped resolve the issue to my superiors? Will i be able to contact the same expert as he knew exactly what the issue was and had the right information? Do i have to log out of the application every time or do i just close the application?

8. TASK COMPLETE – In-spite of the concerns that the user had in the previous step, once the call was complete, the user was satisfied that he was able to have his issue resolved much more effectively with the video call as it was much more effective to point out issues using annotations compared to the chat option and that there was minimal explanation required to and from the expert to help resolve the issue.

The above findings provide insight into the pain and the gain points that the customer faced while using REFLEKT REMOTE providing deeper understanding of the feelings and motivations which can be extrapolated for further development of the product.

The creation of user experience maps for REFLEKT ONE and REFLEKT REMOTE helped evaluate the users attitude and behavior towards our products. The identification of pain and gain points provided the foundation required to conduct a design workshop that focused on realizing the initial research question –

How do we provide a **Seamless User Experience** whilst bringing both the products together?

Explore Concepts

The following chapter describes the process of exploring concepts which was the result of the design workshop that was conducted based on the findings obtained from the expert interviews and the user journey maps. The results of the workshop facilitated in the realization of user flows which were later prototyped.

6.1 Workshop

Businesses and organizations are increasingly using co-design in product and service design as it has many benefits (Steen, Manschot & De Koning, 2011). Co-design is a collaborative process that brings people together to share their knowledge, resources and skills in order to carry out a design task (Zamenopoulos & Alexiou, 2018).

In the process of co-design, various people such as researchers, designers, developers, product owners and head of products, experts in the field and sometimes also users or customers come together to bring about product or service innovation (Steen et al., 2011). Co-design is not only being used to tackle complex issues in product and service design but also in fields of education, social and political fronts (Zamenopoulos & Alexiou, 2018).

Co-design enables the generation, sharing, collecting and evaluation of ideas and knowledge about the matter in concern and facilitates the generation of new ideas (Zamenopoulos & Alexiou, 2018).

A co-design workshop was conducted that involved participants from various departments such as Research and Development, User Experience Designers, User Interface Designers, Marketing Designers and 3D Artists which resulted in the generation of ideas that answer the initial research question - How do we provide a seamless user experience whilst brining both products together?

6.1.1 Method

The workshop was focused on answering one question - How do we provide a seamless user experience whilst bringing both products together? With the pain and gain points identified from the expert interviews and by analyzing the user journeys of the existing products, an agenda was for the workshop was defined based on the design thinking method which was as follows.

Identify Vision
Identify User Needs
Cluster User Needs
Idea Generation

IDENTIFY VISION - This was the first session of the workshop and it was used to understand the problem that we are trying to solve and by empathizing with people to understand their feelings and motivations. Empathy is important in a design process as it helps eradicate personal opinions and assumptions by keeping the user in the center (Dam & Siang, 2019).

Fig 9: Workshop | Identify Vision

The participants were briefed about the overall question that needs to be answered which led to the question as to how we would go about solving it. This was carried out by writing what the participants thought about the existing products now followed by how they would want their ideal product to be on post-its which were clustered to summarize the overall goal. Some of the goals that were summarized from this session are as follows:

Our product should be the go to tool for AR, The product should be simple and easy to use, The product should be more intuitive, Our product should be a field technician's best friend.

IDENTIFY USER NEEDS - This was the second session of the workshop was to identify the user needs which was carried out by analyzing information that was created and gathered from the first step. Using the information from the first step of the workshop the participants were able to define the core problem and the problem statement in a human centered manner. The progression to the third step is accomplished by asking the right question (Dam & Siang, 2019).

The participants were asked to write down their thought on post-its which were answers the questions such as What i want? What i would i like to have? What i do not want? The answering of these questions help identify the user needs that need to be solved. Some of the user needs that were identified in this step of the workshop were as follows.
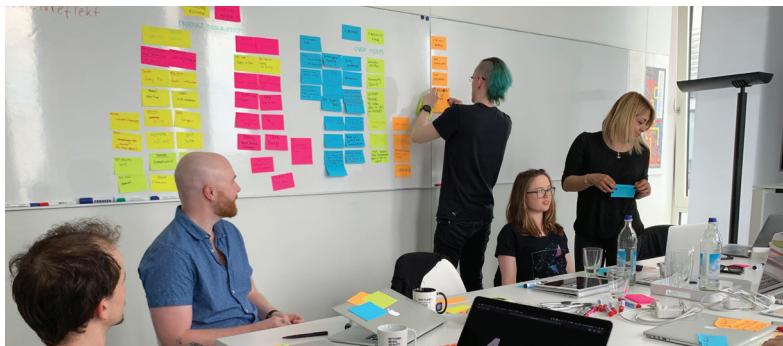
Fig 10: Workshop | Identify User Needs

I want an application that works **without any bugs**, I would like to have an application with **smarter User flows**, **Outstanding User Experience** and **Appealing User Interface**, I do not want an **overwhelming first experience** and **complicated user interface**.

CLUSTER USER NEEDS - The third session of the workshop was clustering the user needs that have been identified in the previous session. Participants were provided with 3 stickers each and were requested to vote on the user needs that were created and posted on the post-its from the previous session. This phase of the workshop facilitated in prioritizing the user needs, pain and gain points of the customer that needed to be addressed. This helps in identify-

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ing new solutions to the existing problem statement (Dam & Siang, 2019). Some of the most important topics that resulted out of the clustering the user needs are as follows.

Fig 11: Workshop | Cluster User Needs

Smarter User flows, Outstanding User Experience, Appealing User Interface and Polished visualizations.

IDEA GENERATION – The fourth session of the workshop was idea generation with the four prioritized topics from the previous session. Since the goal of the workshop was to answer how we could provide a seamless user experience whilst brining the two products together, the participants were provided with printed material which included outlines of an iphone and ipad so that they could sketch out how user flows.

With the four prioritized user needs the participants sketched out various versions of user flows that provided immense insight

into how the ideal user flow of the application could possibly be achieved which would provide a seamless user experience whilst bringing the two products together.
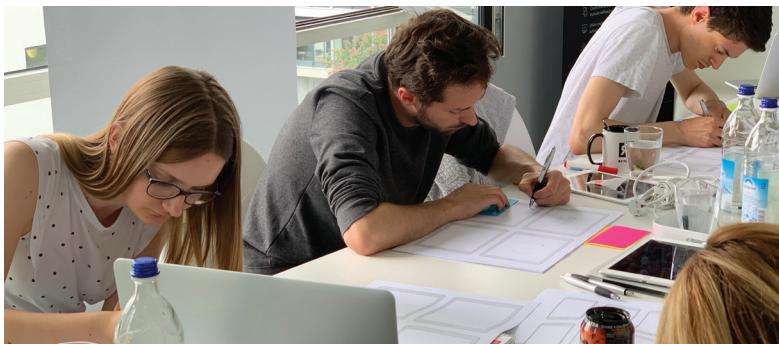
Fig 12: Workshop | Idea Generation

The workshop enabled the generation, sharing, collecting and evaluation of ideas and knowledge about how the two existing products can be brought together. The workshop enabled all the participants who were from different departments work focus on the needs of the user. Once the participants understood and famil-iarized themselves with the overall problem and task to achieve, generation of great solutions where achieved faster and much more efficiently.

Some of the benefits of co-design workshops are improvements in the creative process, products and services offered, Project man-agement and long term effects on the organization (Steen et al., 2011). Benefits of a co-design workshop do not end with one rather increases when teams conduct them regularly (Spool, 2016).

6.2 User Flows

User flows are the path taken by a user on a website or application to complete a desired task (Optimizely, n.d). User flows are also a visual representation of how a user navigates through a website or

an application (Crawford, 2019). User flows need to be designed with the pain points, expertise and the preferences of the user in mind and some of the questions that need to be answered while creating user flows are

What is the user trying to achieve? What is important for the user? What call to actions are required? What information does the user need to carry out his tasks? What are the users hesitations and barriers to accomplish the task?

Creating user flows that answer the above questions enables product development teams to build products and services that are much more effective and more likely to be trusted by the user or customers (Crawford, 2019).

Based on the sketches that were done in the workshop, two user flows were created, A mobile and tablet version of the application as REFLEKT ONE and REFLEKT Remote are support cross platform capabilities. The mobile and tablet user flows are as follows.

– Open Application **1**
– Login
– Select Scenario (based on login credentials)

– **Tracking** (based on scenario selected)

– **Step by Step** (Spacial POI)

– **Contact Expert** (Create # and add description)

– **Select Chat/Call**

– **Get support** (based on the step)

– **Complete call** (Rate Support)

– **Open Application** ---------------------------- **2**

– **Login**

– **Select Scenario**

– **Tracking** (3D / Model Tracking)

– **POI** (Based on the step)

– **Tap POI** (Full screen mode)

– **Call option** (during each step)

– **Add details** (Machine related/step related)

– **Expert add annotaion** (Recorded)

– **Call Complete** (Recording added to right step)

1 **MOBILE USER FLOW**   **2** **TABLET USER FLOW**

Frame Solutions

The following chapter describes the process of framing solutions that is carried out by prototyping the results obtained from the co-design workshop that was conducted. The user-flow was used as the foundation for the prototypes. A first draft of a mobile version was created which was scrutinized by various stakeholders who provided in-depth feedback which were later realized into the final draft of the prototype. A tablet version was also created that can be found in the appendix.

7.1 Prototypes

One of the most critical activities that are carried out when it comes to product development is prototyping (Lauff, Kotys-Schwartz, & Rentschler, 2018). Prototyping is also perceived as a significant method for supporting clarification, conception and design phases in various fields (Israel, Bähr, & Exner, 2015). Prototyping is also a seen as a common practices that i used to represent various states of a design phase which enables for the exploration of all possible options (Houde & Hill, 1997).

Prototypes are not just visuals of a product or a solution but they are also means of examining design problems and evaluating solutions . Once a prototype has been created, there are several groups of people that the designers discuss their prototypes with. Some of them are the design team, various stakeholders in the organization and the end user. Prototypes are scrutinized within the design team that are further scrutinized by various stakeholders of the organization such as product owners, developers and the research & department. From the feedback that is received, iterations are made which are further shown to the users to evaluate the prototype before they are handed over to the product development team (Houde & Hill, 1997). The following pages explain the first draft of the prototype.
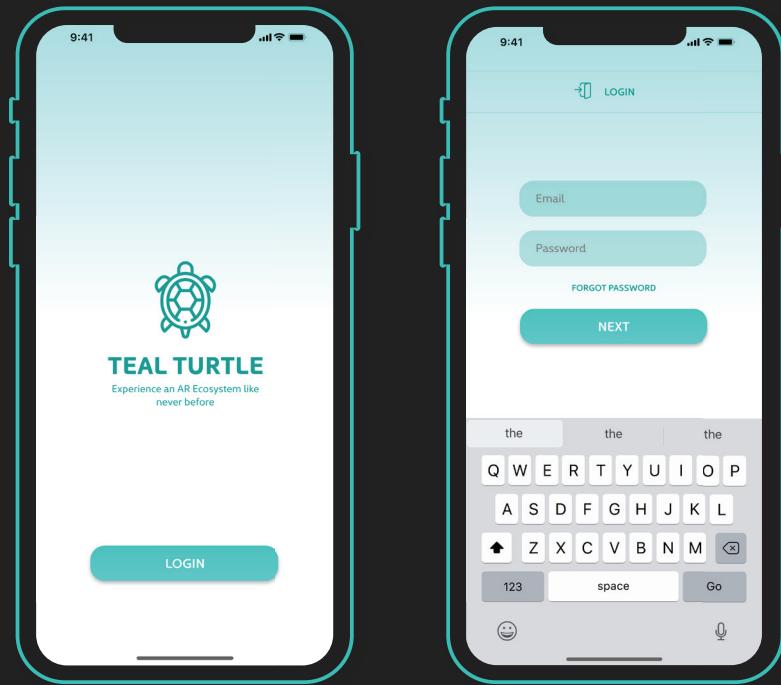
Fig 13: Welcome Screen

Fig 14: Login Screen

The Welcome screen of the application consists branding elements such as the brand logo with the inclusion of a tag line that provides an overview of the application which is subject to the organization. The welcome screen contains only the login option to eradicate the cumbersome process of a field technician having to sign up, which could be done more efficiently by the administrators of the application.

The login screen has default options that are available in almost all applications such as input fields, email and password. The user is also provided with an option to reset his/her password in the case of them forgetting it. Other login options can also be considered such as using fingerprint and faceid as it is a common feature in most mobile devices in the market.

Fig 15: Scenario Screen

Fig 16: Tracking Screen

Once the user has logged into the application, the user is provided with scenarios that he can select from which are based on his login credentials. This feature was considered to make the user experience much simpler by eradicating steps that involve the user to search for the scenarios by entering server details and so on. This can be accomplished through personalization settings of the users profile.

Once the user has selected the scenario that he wants to work on, the user is prompted to initiate tracking to enable the usage of Augmented Reality content. In this case the user will have to click on the icon to initiate tracking. Tracking options can also be optimized based on the scenario that a user selects. Once the user clicks on the icon, the user has to scan the area or the object to initiate tracking.

Fig 17: Initiate Tracking

Fig 18: Tracking Complete

This screen provides the user with feedback regarding the surrounding using visual queues that also educate the user how they would have to move the device to successfully initialize the tracking that is necessary to overlay the augmented reality content over the object or the tracking marker. The visualization of the initialization of tracking can also be customized based on the type of tracking required.

Once the user follows the visual feedback that was provided and successfully initiates the tracking that is required, The user sees the augmented reality content overlay-ed on the object or the marker that was used. The user is also provided with a confirmation message that the tracking was successful. The user also has options to go back to the previous step if they want to select another scenario.

Fig 19: Step1-screen1

Fig 20: Step1-screen2

This screen contains information required for the user to carry out the step by step procedure of the scenario. The menu bar has icons of home, 3D/VR mode, Chat and Video call. The portion above the menu bar consists information for the user about the step that he is in - Headline, number of steps in the scenario. An option to swipe up for more information is also available for the user to benefit from.

This screen contains more information for the user regarding the step that he in. The user can swipe up or click on the augmented content for detailed information regarding the step. In this version of the prototype, there were 3 stages of information that was provided on a specific step to the user.
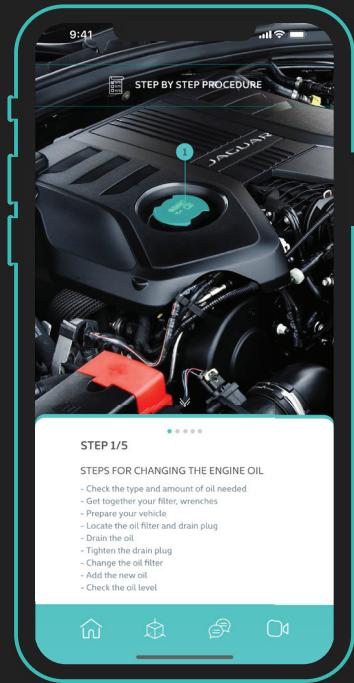
Fig 21: Step1-screen3
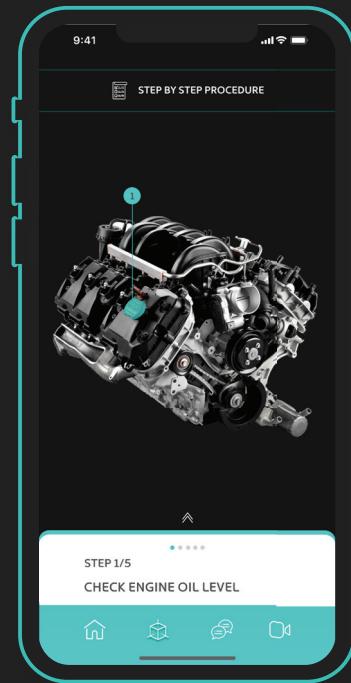
Fig 22: Step1-3D/VR Mode

Once the user clicks on the augmented content or swipes all the way up, he finds detailed information on the step as described in the earlier section. The use of points of interest along with the augmented content is also a feature that was included to always act as an indicator of which step the user is currently working on. The level of details provided to the user depends on the author of the content.

The availability of 3D/VR mode was included as they are currently available in the existing product. This feature enables the user to get a closer look at the object under inspection when they are not able to do it in the real environment. The 3D/VR mode also has the same features when it comes to the details that are provided to the user on a specific steps as the normal Augmented Reality mode.
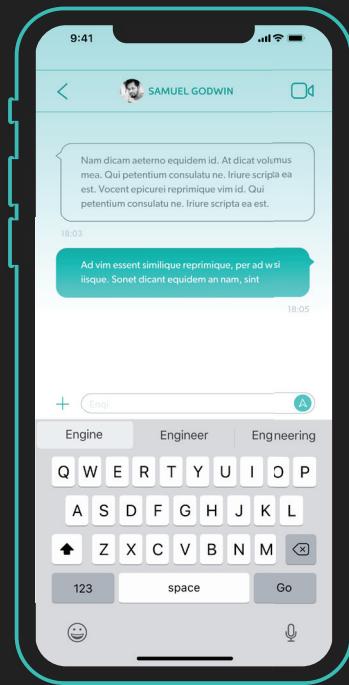
Fig 23: Messaging
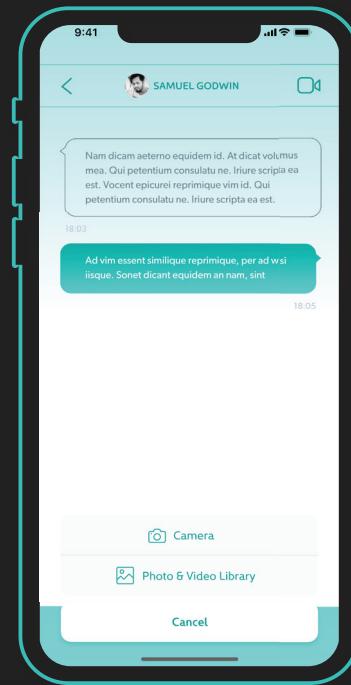
Fig 24: Messaging options

In the incident of a user not be-
ing able to follow the steps and
finds the need to contact and
expert to solve his issue, the
user can click on the messag-
ing icon on the bottom menu
which would redirect the user
to the right expert using intel-
ligent routing. While the user is
in the chat or messaging mode,
he also has the ability to make
a video call if the user find the
need for it, if it was suggested
by the expert.

While the user is in contact with
the expert, the user also has
additional options that he can
use such as using the camera
to take a photo of the object or
machinery under inspection to
provide a better understanding
of the problem to the expert.
If the user can also browse
his device for previously taken
photos or videos that can be
shared with the expert. A back
option to return to the messag-
es overview is also available.
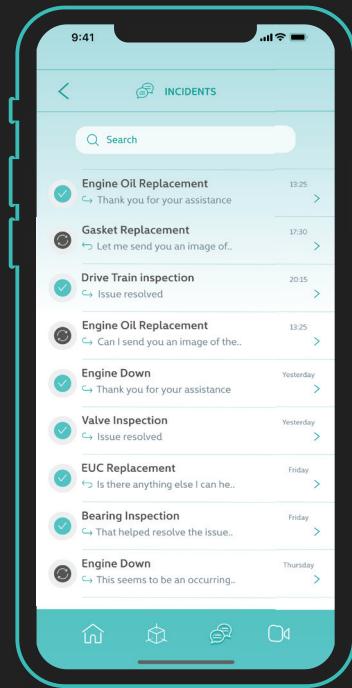
Fig 25: Messaging-Home

Fig 26: Video call screen

The messaging home screen consists of the messages or chats that the user had carried out prior to the current conversation. The overview also indicates the status of the message such as closed, open and pending which are visualized with icons such as a tick mark, circle and circle with arrows. This screen also has a search function from which a user can benefit to find old chats.

Once the user clicks on the video option regardless from the tool bar or within a chat, the user is directed to the video call screen which has options such as annotations, freeze screen, mute and end video call. The user is also provided with information of the expert using a photo that can be seen on the top of the screen. The menu bar is designed to change based on the main feature that is being used.

Fig 27: Annotations

Fig 28: Step1 - Screen1

Once the user chooses the options to create annotations, the options of redo and undo appear that are stacked over the bottom menu bar. The user can also delete the annotations to create new ones which can be done by using the icon on the top right of the screen. Annotations shown in the prototype are only for the purpose of visualization of how they could be displayed.

Once the user completes the video call, the user is brought back to the page that they started the chat or the video call. This is done so that the user knows the start point and does not miss a step that needs to be carried out. The change in tool bar options can be seen in the above image, compared to the previous screen.

7.2 Feedback

General feedback can be described as the information that one re-
ceives in response to an action or behavior from another from an
individual or a group that can be used for the betterment or im-
provement of the activity or behavior (DeFranzo, 2019).

In the context of human-centered design the early involvement
of the users pain, gain points, hindrances, attitudes and behaviors
eradicate costly changes that are required later on by the product
development team. One way of achieving this is by testing the pro-
totypes with various groups of users (Følstad & Knutsen, 2010).

Once the first draft of the prototypes were created, they were
tested with various users ranging from marketing designers, user
experience designers, User interface designers, Research and de-
velopment, Head of products and various other stakeholders. The
feedback was implemented into the next version of the prototype.
Some of the feedback received are as follows.

User flow not clear !
Reduce number of steps !
Make interactions clear !
Search option for scenarios !
Scalability of scenario page !
Better way to show information !
Full screen documentation ?
Checklist for each scenario ?

Confirmation on Chat / Call !
Privacy regarding video call !
Filter for chat !
No sudden break for chat !
Addition of sticky annotations !
Change of icons ?
Avoid stacking options !
Confirmation after chat /Call !
Prominent disruptive CTA'S !

7.3 Iterations

With the above mentioned feedback, iterations were made to the prototype. The second set of iterations were designed with reference to the Human Interface guidelines by Apple. As applications need to meet high expectations of Standard and quality in order to feature on the top of the apple store, The design themes had to be taken into consideration were clarity, deference and depth (Apple Inc, n.d).

Apart from the design themes, some of the design principles that needed to be considered were Aesthetic integrity, Consistency, Direct Manipulation, Feedback, Metaphors and User Control (Apple Inc, n.d). The following pages visualize and explain the changes that were carried out in the second prototype in comparison to the first draft that was created.
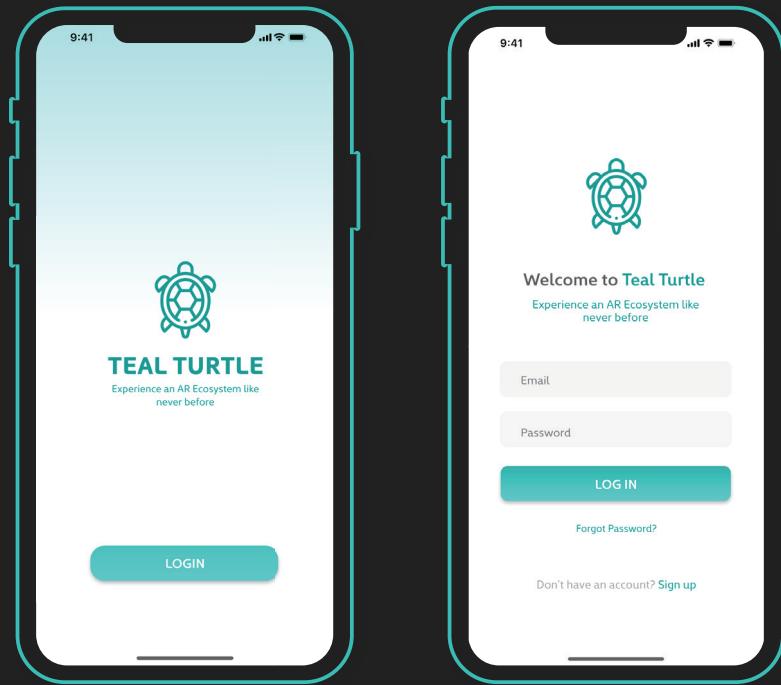
Fig 29: Welcome screen - Draft 1

Fig 30: Welcome Screen - Draft 2

The first Iterations were made on the welcome screen which in-cludes the sign up option that was not added in the first prototype. The reason that it was left out in the first draft was to eradicate the cumbersome process of filling in details that the field technician does not necessary has access to. On contrary it was added back to the second prototype as the number of input fields necessary to fill out could be reduced to the name of the organization, first name, last name, email and password. Another noticeable difference in the second draft of the prototype is the absence of the background gradient. The reason this was removed was to avoid unnecessary complications when it comes to development enabling easier im-plementation of the prototype and white labeling solutions that would have to be provided for organizations or businesses who implement the solution.
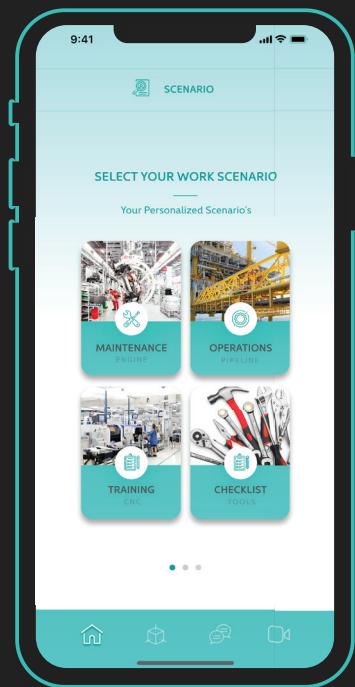
Fig 31: Home screen - Draft 1
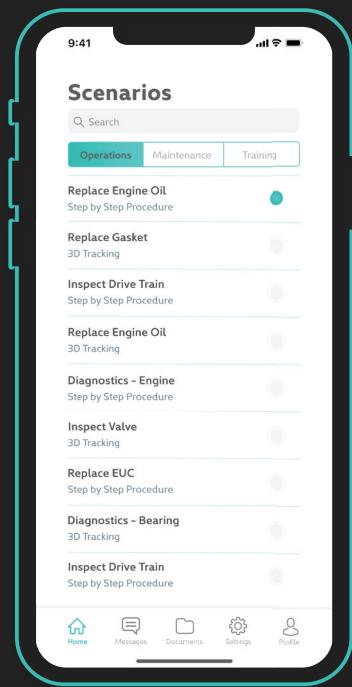
Fig 32: Home Screen - Draft 2

The Second iterations were made to the home page. The first draft of the home page contained a tool bar with options such as, Home, 3D/VR mode, Message and Video call. The iterations that were made in the second draft were, Tool bar with new legible and labeled icons that provide much more clarity to the user about the options available, Categories for scenarios which answer the question of scalability, Search option that enables the user to search for a specific scenario that he would like to carry on, Prominent headlines that follow native iOS guidelines. The options available in the tool bar of the second draft are, Home, Message, Documents, Settings and Profile which are explained in detail in the following pages. The iterations brought about significant clarity to the user regarding the features that are available on the home screen in comparison to that of the first draft.
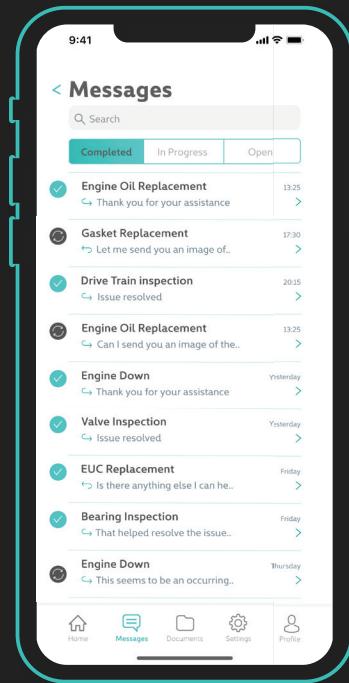
Fig 33: Messages Screen
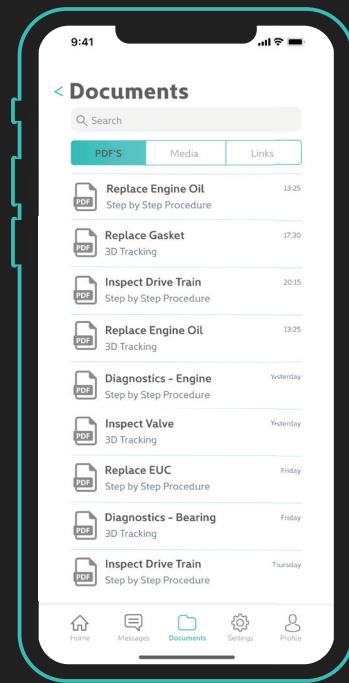
Fig 34: Documents Screen

The message screen could now be accessed from the home screen. Iterations carried out were, categorization of messages based on the status. The back option on the top of the messages screen would take the user back to the home page where as the previous version would take the user to the step that he was working on as the messages screen was only accessible while carrying out a step & not from the home page.

The documents page was a new addition when compared to the first draft. This page enables the user to browse through the various documents that have been shared to and from an expert. File types under categories include PDF, Media such as images and videos and Links. The user could also use the search function to find precise files that are available on the user device.
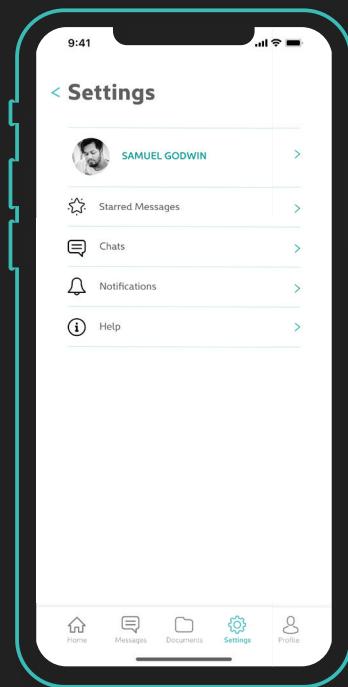
Fig 35: Settings Screen
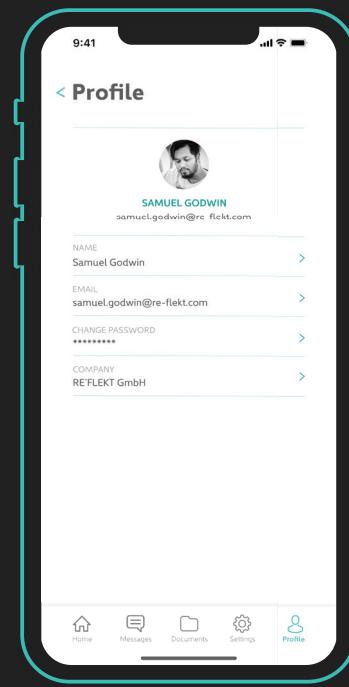
Fig 36: Profile Screen

The settings page is also an addition compared to the first draft. Some of the options available are chat settings, Notifications, Help and Profile. The user has the ability to access each of these settings for further customization of the application. The user can click on the name to enter the profile page or the profile icon available in the tool bar. Using the back button would direct the user back to the home page.

The profile page is the last addition to the home page which enables the user to edit personal details such as the name, email, password and organization name. A profile page was created to visualize the minimalistic nature of the sign up option that we intend to offer on the welcome page. Further information can be added to the user by the administrators of the application on premise.
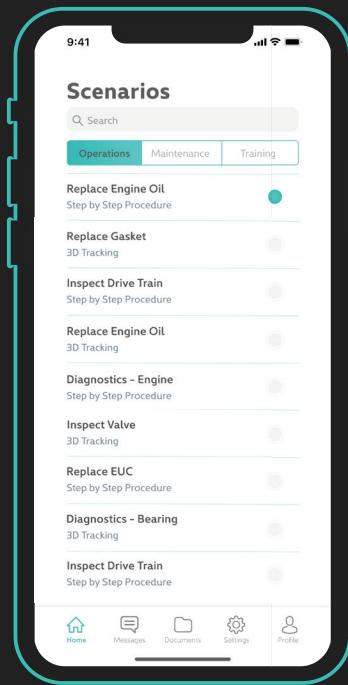
Fig 37: Home Screen
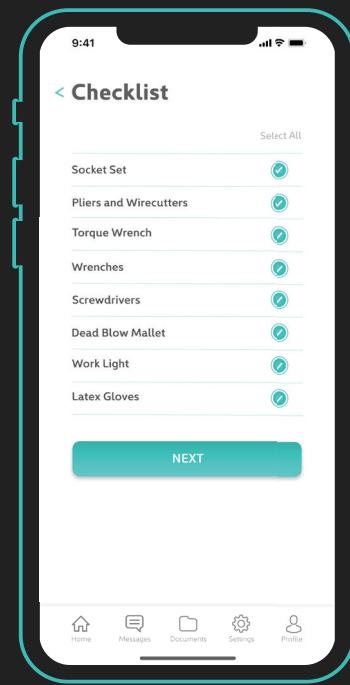
Fig 38: Checklist Screen

Once the user has selected the scenario that needs to be carried out, the user is directed to a new screen that was added, Checklist. This screen provides the user with information of the tools that are required to carry out the specific task. The checklist varies depending on the scenario that the user selects which can be configured by the technical authors who create Augmented Reality content that is used by the field technician. Checklist can also reduce time technicians spend on the field in the case of forgetting a vital tool that is needed. Having all the tools required make the technician more efficient and prevent downtimes on machines in-case of inspections. The user can always click the back button to return to the home page where selection of other scenarios is made possible.

Fig 39: Tracking Screen - Draft 1

Fig 40: Tracking Screen - Draft 2

In the first draft of the prototype the user was directed to the tracking screen after selecting the scenario. Iterations carried out in the second draft include a tool bar with an additional icon that informs the user exactly where they are on the application, the information container was changed from white to a more transparent overlay which enables better field of vision and implementation of white label solutions could be achieved more effectively by changing just the color overlay surrounding the information container.

The new draft does not include any information on the top of the screen unlike the first draft. This was done to remove unnecessary use of information and to provide the user with more room to view Augmented Reality content while carrying out a task.
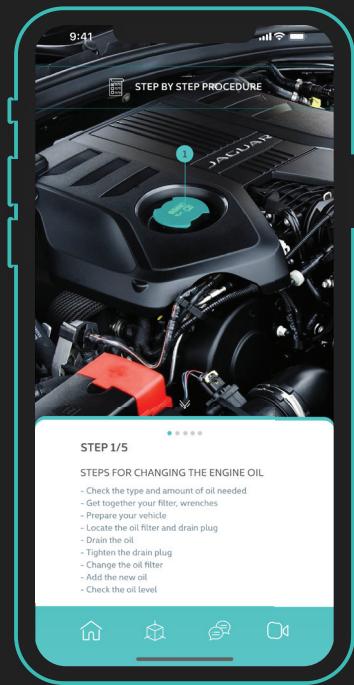
Fig 41: Step 1 - Screen3 - Draft 1   Fig 42: Step 1 - Screen 3 - Draft 2
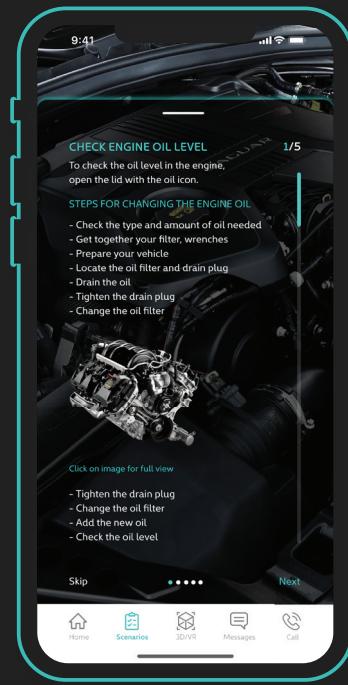
The screens above show the comparison between the first and second draft of the scenario page which included further details for the user to benefit from. The iterations are the inclusion of options such as skip and next, Ability to swipe the screen to the top for more information, scroll option in the information container if the step consists further information, Better visual queues to minimize the overlayed information, more prominent indications that there are more steps involved in the scenario along with naming that is placed on the top.

The benefits of removing information on the top of screen such as headings in the augmented reality mode are evident with this iteration enabling for more room for valid and precise information for the user.

Fig 43: Message Confirmation

Fig 44: Call Confirmation

In the event of a technician accidentally or intentionally clicking on the message icon on the tool bar, the user is given a choice to either confirm if they want to contact and expert using the chat option or cancel the chat. The information still contains the step being carried out to provide the user with visual confirmation of the current step and also used for creating the default chat if the chat is confirmed.

Similarly in the event of a technician accidentally or intentionally clicking on the call icon on the tool bar, the user is given a choice to either confirm if they want to contact and expert using the call option or cancel the call. The information still contains the step being carried out to provide the user with visual confirmation of the current step in the scenario.
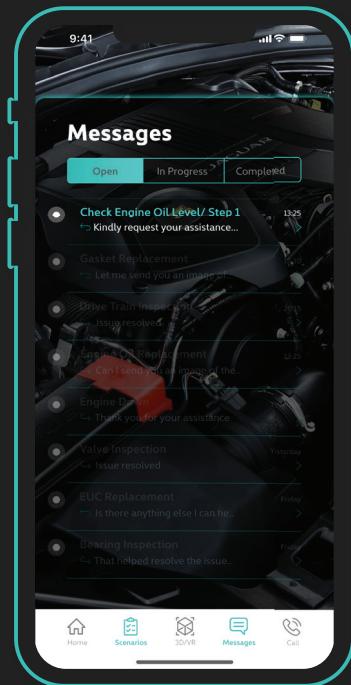
Fig 45: Message - In Scenario

Fig 46: Message - End Notification

Once the user confirms on wanting to chat/message an expert, the message section is opened up which is indicated by the highlighted message icon in the tool bar. In contrary to the first draft, the application generates a default message that would be sent to the expert based on the name of the scenario and the current step that the user is in. In this way the field technician does not have to send a lengthy explanation.

Iterations were also made to the way the messaging appears in comparison to the first draft which was very abrupt making the user leave the augmented reality space. Once the user has completed the chat, he is given a choice to either confirm if the chat resolved the issue. This is done for accountability, where-in the application would auto-matically change the status of the chat from open to closed/resolved.
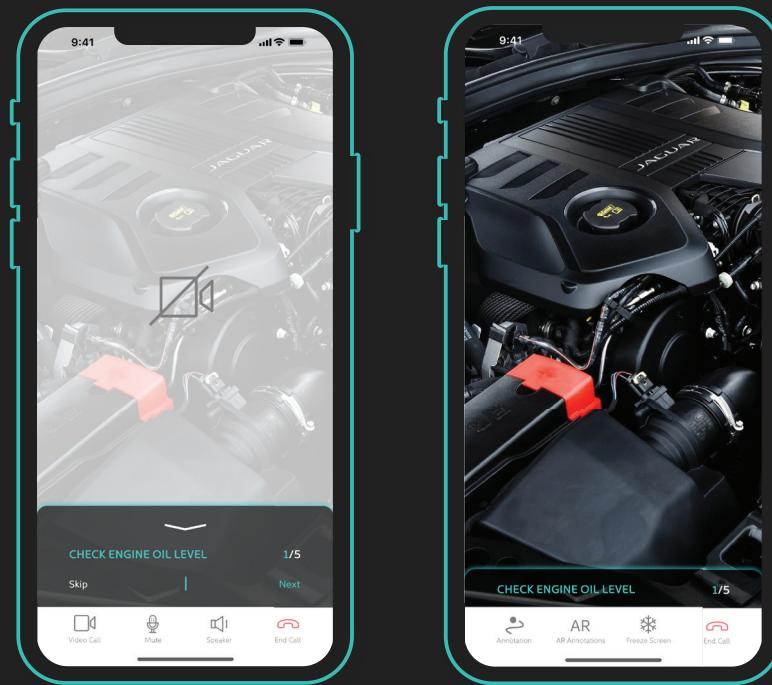
Fig 47: Audio Call Options

Fig 48: Video call options

In the event of the user confirming a call with an expert, the call would initially begin as a voice call that can be changed to a video call if needed by either using the icon in the tool bar or by taping the screen. The user is still provided with information such as step that he is in which can be swiped down. Some of the options available during a voice call are, Video call, Mute, Speaker and End call.

The user could have the issue resolved over the voice call, if there is a need to switch to a video call, the options in the tool bar change enabling the user to benefit from various options. Some of the options are normal annotations, Sticky or Augmented Reality annotations, freeze mode and end call. Destructive actions are indicated with a red color.

Fig 49: Annotation - Drat 1

Fig 50: Annotation - Draft 2

The screens above show the differences between the first and second draft on the annotations page. The first draft had options such as undo, redo annotations stacked over the tool bar which many users who tested the first draft found very confusing. The presence of the delete option on the top of the screen also brought about reachability issues.

In order to address these issues, iterations were made in a way that all the options needed to carry out normal annotations would occupy the tool bar. The tool bar as mentioned in the beginning is designed to adapt/change according to where the user is in the process of carrying out a task. The need to have the expert displayed on the top of the screen was eradicated as it would reduce development issues.

Fig 51: Sticky Annotations
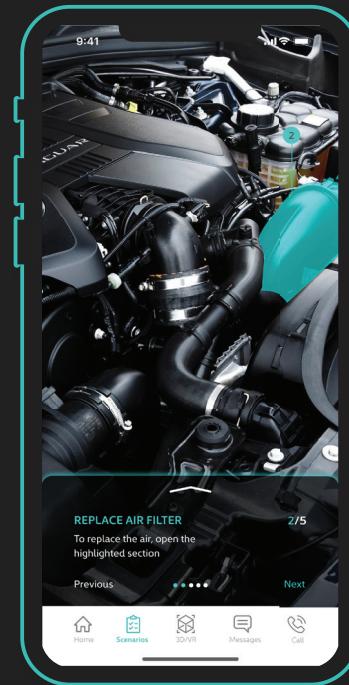
Fig 52: Next Step

Sticky/Augmenter Reality annotations can also be carried out during a video call where the user can place annotations on to the real world environment to indicate where the exact issue is to the expert. Options in this mode are similar to that of normal annotations such as undo, redo and delete. The additional option is the freeze mode. Users can choose from various annotations and place them as the desired location.

On completing the call, the user is brought back to the initial step that the call was initiated from. Once the user has had the step resolved he can carry on to the next step by clicking on the next option that brings the next step as visualized above. The user can carry on with the various steps and complete the scenario/task. The user always knowns the current steps using visual queues such as the dots and number.

The iterations carried out from the feedback that was received are as follows.

Clear user flow ✅

Reduce number of steps ✅

Make interactions clear ✅

Search option for scenarios ✅

Scalability of scenario page ✅

Better way to show information ✅

Full screen documentation ✅

Checklist for each scenario ✅

Confirmation on Chat/Call ✅

Privacy regarding video call ✅

Filter for chat ✅

No sudden break for chat ✅

Addition of sticky annotations ✅

Change of icons ✅

Avoid stacking options ✅

Confirmation after chat /Call ✅

**Prominent disruptive CTA'S** ✅

PROTOTYPE -DRAFT 1 - OVERVIEW

ON BOARDING

TRACKING

SCENARIO

MESSAGE

VIDEO CALL

Fig 53: Overview - Draft 1

https://xd.adobe.com/view/9c4929e6-6db1-4ea1-49b5-f842d563e16b-ea78/

100
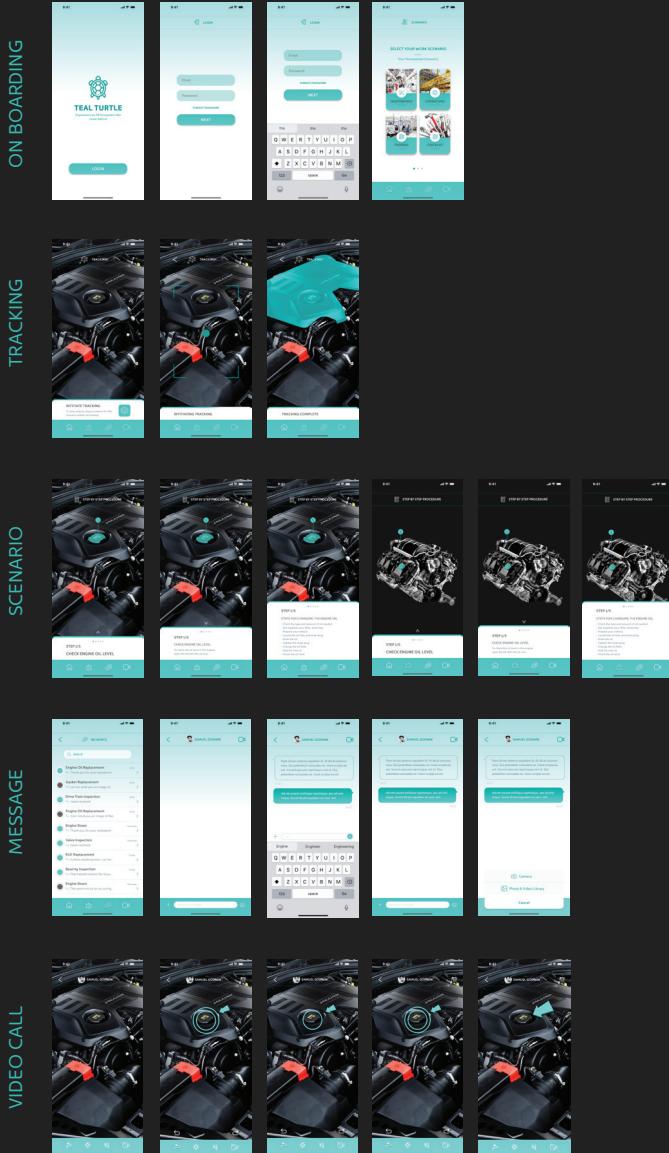
PROTOTYPE -DRAFT 2 - OVERVIEW

ON BOARDING

TRACKING

SCENARIO

MESSAGE

VOICE & VIDEO CALL

Fig 54: Overview - Draft 2

https://xd.adobe.com/view/04898e5b-3cea-4c74-5e02-4959721b3da2-72b8/

101
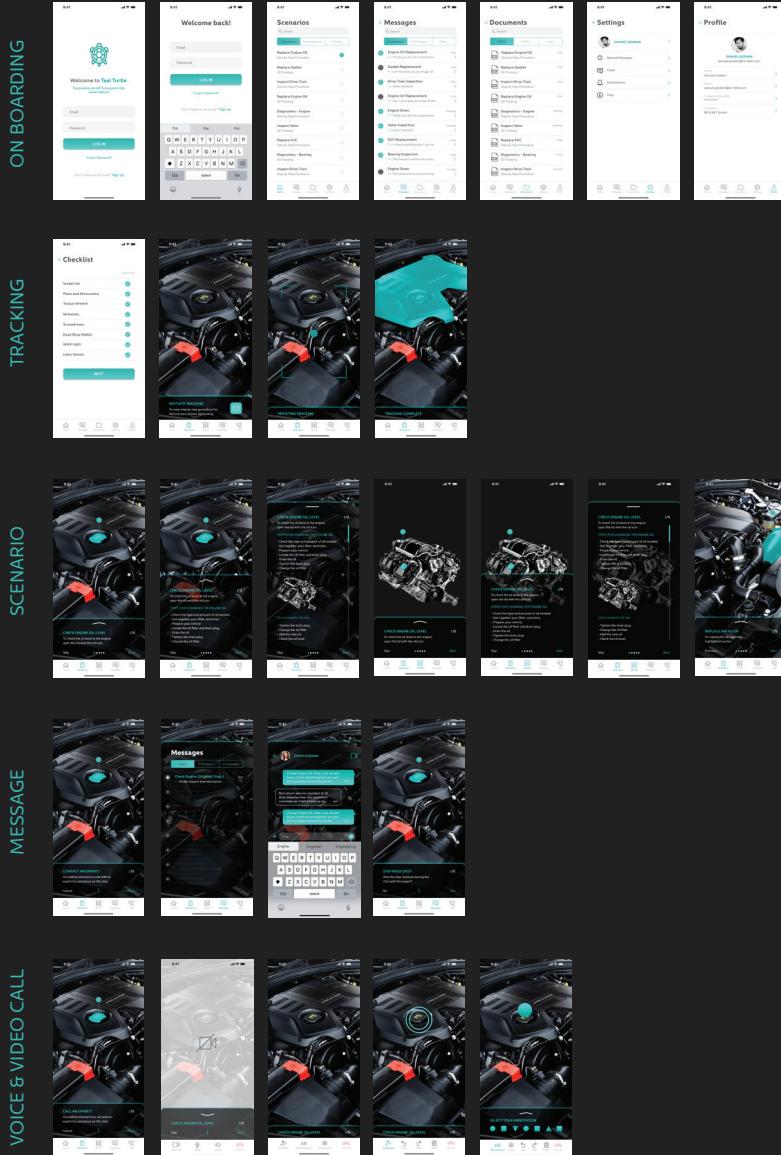
Conclusion

The following chapter outlines the key learnings that were obtained through each phase of the design method, Next steps and limitations that need to be considered.

8.1 Key Learning

A practice based research approach was considered for this thesis as it involved gaining new knowledge by putting the design innovation model into practice which resulted in the creation of the artifacts such as the prototypes who's significance and context were explained in the above chapters. And as the artifact is the considered as the basis of contribution to knowledge, the research is practice based (Linda, 2006).

The main objective was to identify how the seven modes of design innovation can help combine the User Experience of two Augmented Reality product together.

The first mode, Sense insight enabled the identification of the topics relevance and the background that was needed to carry out the project. The second mode, Know context provided a detailed understanding of the products under scrutiny, currents trends in Augmented Reality, product and service offerings of competitors that enabled the evaluation of value offerings that we intend to offer with our products and services. The third mode, Know people provided deeper understanding, explanations and the nature of users through the eyes of the experts from which the jobs to be done were extrapolated.

The fourth mode, Frame insights provided comprehensive knowledge on the attitudes, behaviors and motivations of the users, enabling the identification of pain and gain points through examining the existing products using user experience maps. The fifth mode,

Explore concepts facilitated in the identification and definition of user needs which were further used to create user flows for the new product that brings the user experience of both existing products together which was the result of a co-design workshop. The sixth mode, Frame solutions brought about the realization of user flows through prototypes which were extensively scrutinized by various stakeholders who provided valuable feedback. The importance of feedback in a design process was recognized as it facilitated the betterment of the user experience, user interface and the overall experience of the product. The seventh mode, Realize offerings enabled the identifications of the limitations and the next steps that need to be considered for the successful implementation of the prototype. The key findings prove that the design innovation process and methods outlined in the thesis could be practiced in organizations for the innovation of new products and services.

8.2 Next Steps

The proposed next steps are the creation of a working prototype, adoption of the prototype across various platforms such as head held devices. As feedback is crucial, prototypes should be tested with existing user groups which enable further insights into the betterment of the product. Finally a new business model has to be created as the solution brings both the existing products together.

8.3 Limitations

The limitations identified were finding appropriate use cases that the new proposed solution could address, even though Augmented Reality solutions are being integrated into various infrastructures across industries and businesses, the adoption of technology is still something that users and clients find cumbersome as it involves integration of several hardware and software devices that lead to interfacing issues that question the stability of the system (Wu, Lee, Chang, & Liang 2013).

Appendix

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8.2 Questionnaire

1. Opinions of AR and its future
2. Is there a need for an AR ecosystem?
3. Why and the Advantages of an ecosystem/value?
4. What is the best AR Product that he has used?
5. Why was it the best?
6. What do you think about the current products?
7. How important are UX and UI of a product according to you?
8. What are the pain points according to you (UX - Usability wise)?
9. How would you go about solving this issue?
10. Could you elaborate on the vision - in terms of our products?

1. Opinions of AR and its future
2. Is there a need for an AR ecosystem?
3. Why and the Advantages of an ecosystem/value?
4. What is the best AR Product that he has used? Why?
6. What do you think about the current products?
7. How important are UX and UI of a product according to you?
8. What are the pain points of our customers according to you?
9. What are customers expectations when we pitch the product to them?
10. How would you go about solving this issue?

8.3 Ipad Version - Prototype
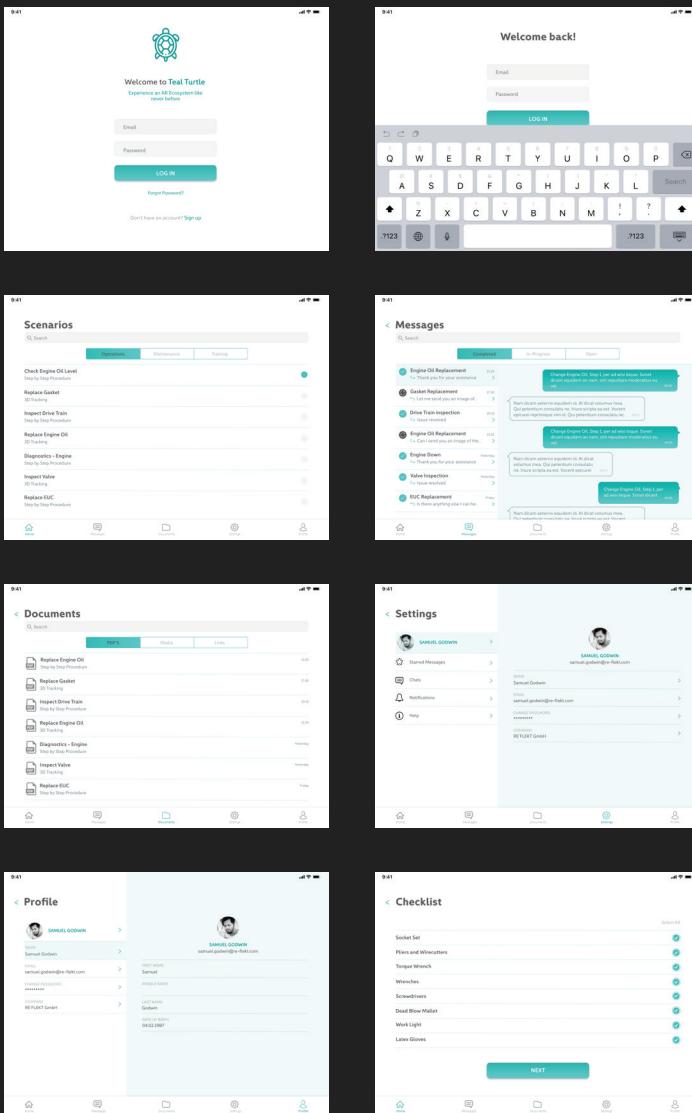
Complete prototype can be found on the USB stick provided..

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Sworn Statement

I, __Samuel Godwin__

born on __04.02.1987__

hereby declare that I have prepared this Master´s thesis independently and without external assistance. In doing so, I have not used any aids other than those mentioned in the enclosed list of sources.

All points that have been taken from publications literally or adapted form have been identified as such by me.

Munich   29.05.19
...................................., ...
         [Place]   [Date]   [Signature]