LAHDEN AMMATTIKORKEAKOULU
Lahti University of Applied Sciences

MOBILE AUGMENTED REALITY SUPPORTING MARKETING

Using mobile's augmented reality-based marketing applications to promote products or services to end customers

LAHTI UNIVERSITY OF APPLIED SCIENCES
Degree programme in
Business Information Technology
Bachelor's Thesis
Autumn 2014
Kengne Paul Arol

Lahti University of Applied Sciences
Degree Programme in business Information Technology

KENGNE, PAUL AROL:

Mobile augmented reality supporting marketing.
Using mobile's augmented reality-based marketing applications to promote products or services to end customers

Bachelor's Thesis in Business Administration, 49 pages, 2 pages of appendices

Autumn 2014

ABSTRACT

Imagine a technology with which you could see more than others see, hear more than others hear and perhaps even touch, smell and taste things that others cannot. Augmented Reality (AR) is this technology to create a "next generation, reality-based interface".

This thesis explores the augmented reality technology as a whole while presenting its potentials to SMEs for an adoption to support their marketing strategies. The research was conducted qualitatively, and it is solution centric in nature. The design science framework was adopted as well in order to draw conclusions after designing and testing an augmented reality solution.

Several benefits to SMEs for an adoption of the technology to support their marketing strategies were pointed out as a result of the study. It became clear that mobile augmented reality can be used to improve business processes as well as to create or extend new business opportunities due to the power of smart devices. Moreover, mobile augmented reality increases engagement, interaction and provides a richer user experience. In addition, the results from this survey clarified that the number of mobile augmented reality's regular users is at a low percentage although its impressive effect is confirmed by many. Further studies to tackle this issue are also suggested in the discussion section.

Key words: Augmented Reality, Mobile Device, Mobile Augmented Reality, Marketing

CONTENTS

LIST OF FIGURES

ABBREVIATIONS

AR	Augmented Reality
AREM	Augmented Reality Experiential Marketing
PC	Personal Computer
SME	Small and Medium Enterprises
VR	Virtual Reality

1 INTRODUCTION

The following section describes the problem at hand after presenting some background information on augmented reality technology. In addition, the research objectives of the research are discussed as well as its motivational ground. In order to help readers to a better understanding of the research, definitions of key concepts are also presented in this section.

1.1 Background

In recent years, mobile Augmented Reality (AR) has become very popular. Using a video see-through AR interface or smartphones, a user can see virtual graphics superimposed on live video of the real world.

Imagine a technology with which you could see more than others see, hear more than others hear and perhaps even touch, smell and taste things than others cannot. What if we had a technology to perceive computational elements and objects within our real world experience, entire creatures and structures, even which help us in our daily activities, while interacting almost unconsciously through gestures and speech? With such technology, surgeons could see ultrasound scans of organs while performing surgery on them, mechanics could see instructions of what to do next when repairing an unknown piece of equipment. Augmented Reality (AR) is this technology to create a "next generation, reality-based interface".

Augmented Reality can be categorized into two different forms: (1) Location-based and (2) Vision-based. Location-based AR presents digital media to users as they move through a physical area with a GPS-enabled mobile device. The media augment the physical environment with narrative, navigation and/or information relevant to the location. In contrast, vision-based AR presents digital media to users after they point the camera on their device to an object predefined as target (e.g., QR code, 2D target). Juniper research's recent survey on mobile AR (juniper research, 2013) claims that mobile augmented reality apps currently generate nearly $300 million in revenue and will grow to $5.2 billion by 2017. In addition to that, Hidden Creative's research revealed a 135% Increase in buyer's likelihood to buy when they saw an AR version of a product. It also uncovered that AR has a

positive impact on value perception. Participants valued products with AR 33% higher than those without (Juniper research, 2013). Engine Creative's research (2012) claims that AR is an inexpensive alternative to other media platforms as no specific media needs to be purchased.

In line with the advance in technology now a day, the easy access to smart devices by individuals can be seen as the main driver of AR technology. As the Smartphone market continues to grow, consumers are using their devices to interact with all kinds of digital information. The experience of using your smartphone to connect the real and digital worlds is becoming more familiar to consumers, making them more likely than ever to engage with interactive experiences by scanning with their phone. In relation to the previous predictions by Juniper Research center, the IT Research company Gartner predicted that smartphone and tablet sales will increase to 1.2 billion by 2013 and will top 2 billion by 2015 (Layer, 2013).

This research at hand is aiming to identify by means of a qualitative research approach, major benefits for companies when using AR-based marketing solutions to promote their products.

1.2 Research Problem

While the use of AR in the retail and marketing is increasing, there are still several obstacles preventing its mass adoption. Specially, only a fraction of the organizations is aware of the potentials of Augmented Reality and not every product is outfitted with the ability to display the interactions (Avestia Publishing, 2014). In order to tackle these issues, this paper will provide an explanation as to why it is important for SME to consider an adoption of AR-solutions for advertising by addressing the following research question:

What are the benefits to SME for using Hand-held AR applications when promoting products or services?

In order for this research to come up with some benefits of mobile augmented reality solutions for SME, the above mentioned research question is to be

examined in more details and therefore several propositions have been developed for a solid discussion on the phenomenon.

- How frequently do peoples use mobile augmented reality applications?
- Can mobile augmented reality be used to lower coordination and transaction cost and thus used to improve the decision process for complex and expensive products?
- Can mobile augmented reality be used to create or extend business opportunities because of the technical functionalities a smart phone has?
- Can mobile augmented reality increases engagement, interaction and provides a richer user experience?

1.3 Research Objectives

The intended purpose of this research is to clarify to managers the utility and opportunities presented by Hand held AR softwares from the marketing point of view. Despite the availability of many researchers in AR future and its benefits, the amount of adopters for advertising their products or services is still few. Mridul Dohtutia's study on AR as a marketing tool (2012) illustrates that AR Experiential Marketing (AREM) is beneficial for companies and brands in creating customer satisfaction. It also leads to increase in customer loyalty, their intention to repetitive purchasing and positive word-of-mouth, which creates greater market share. This study will examine the AR concept as a whole, and its usability from the marketing point of view. It will further find some important benefits for companies for an adoption, after developing and testing an augmented reality solution in the construction industry.

1.4 Motivations

As the mobile device market becomes concentrated, technology firms began exploring options to generate revenue for the future including the potential of AR. When you take handheld devices and connect them to a body, whether as a wrist-watch or a headset, it follows that developments can be made to improve the interactivity of the device. Although the first fully functional AR system dates back to the late 1960s (H. Tobias & K. Steven, 2004), its re-adoption in the last

past decade has raised many questions around the topic as a mega trend to boost revenues from the Information Technology field in the future.

The Technology Market Intelligence Company's recent research (ABI research center, 2014) found that AR technology is poised to grow from generating $6 million in revenue in 2008 to $350 million in 2014. ABI credits advanced smartphone capabilities such as video cameras, GPS data and compasses as key to unlocking the power of augmented-reality advertising. ABI's research director Larry Fisher mentioned in a research's results that "the key finding is that the augmented reality market will diversify into multiple markets, which will generate nearly $190 million in mobile applications, games and customized augmented-reality revenue, and nearly $170 million in mobile augmented-reality advertising revenue, by 2014". In addition, Juniper research's recent survey (Juniper Research, 2013) on mobile AR claims that mobile augmented reality apps currently generate nearly $300 million in revenue and will grow to $5.2 billion by 2017. Hidden Creative's research revealed a 135% Increase in buyer's likelihood to buy when they saw an AR version of a product.

According to Ronald T. Azuma's survey on Augmented Reality (1997), there are several classes of potential applications of AR already explored such as the annotation and visualization class in which AR could be used to annotate objects and environments with public or private information. For instance, a hand-held display could provide information about the contents of library shelves as the user walk around the library.

The awareness of AR's opportunities by few organizations and the reticent behavior of its adoption by many give the interest to the present research to focus on clarifying utilities of AR-software's adoption to promote products or services to companies' end users.

1.5 Scope & Limitations

This research is not intended to explore the AR in everyday advertisement, but will keep the focus on specific scenarios in which individuals are interacting with the company' products using an AR- interface. The marketing medium used for

this research is the distribution of the company's catalog, which will also serve as marker in order to try out the AR solution. In addition, the research is intended to small and medium size companies (SME). The application of the defined case is planning to find some benefits for companies offering products or a combination of both: products and services, but not for those offering only services.

The AR-solution used in this research is an application which will target only the android Hand-held devices due to the resources available and the time limit in which the researcher is intending to carry out the research. In this thesis, hand-held AR is defined as a setup where the user holds the mobile device actively in his hand. Hand-held AR is different from AR using wearable computers with HMDs where users have both hands free. A phone-based AR setup allows the user to use his phone as an AR interaction device; although some of the processing or application intelligence might not be implemented on the device itself.

1.6 Definitions of Key Concepts

The following gives a clear understanding of key concepts standing at the base of this research.

1.6.1 Augmented Reality

Augmented reality (AR) is the integration of digital information with live video or the user's environment in real time. Basically, AR takes an existing picture and blends new information into it (Definitions database, 2014).

The term "augmented reality" was first coined in 1990 by a Boeing researcher Tom Caudell (H. Tobias and K. Steven, 2004, p3), to describe a digital display used by aircraft electricians that blended virtual graphics onto a physical reality. Different from virtual reality as in virtual reality the user interacts only with virtual representations, the augmented reality combines both, the virtual and real world representations.

The AR can be used with a PC or with a smartphone. The camera recognizes defined images (picture recognition) and displays a digital content on the image

tagged. The digital content can be information, pictures or videos that supplement real situations and, depending on circumstances, create a useful addition.

1.6.2 Mobile Device

A mobile device is a handheld tablet or other device that is made for portability, and is therefore both compact and lightweight. Data storage, processing and display technologies have allowed these small devices to do nearly anything that has previously been traditionally done with larger personal computers (Technopedia, 2014).

The rapid growths of the technology over the past years enable us to group mobile device in different classes. The primary class of devices became known as personal digital assistants (PDA) as many of these share common features, such as touch screen interfaces, software programs, and access to wireless platforms. Later, as wireless networked evolved, makers started to offer another class of mobile devices called smartphones combining the utility of a cell phone and a PDA into one device (Technopedia, 2014).

1.6.3 Mobiles'Augmented Reality Applications

Mobile applications, also known as mobile Apps are internet applications that run on smartphones and other mobile devices. Mobile applications usually help users by connecting them to internet services more commonly accessed on desktop or notebook computers, or help them by making it easier to use the internet on their portable devices (Webopedia, 2014). In this definition, the author defines mobile Apps as applications that use the connection to the internet to provide its services. Although almost all Apps need internet connection to be installed on a device, there are tons of Apps that can be used offline as well (without internet connection).

In addition, we can understand the term mobile Apps as softwares developed for small handheld devices and which can come preloaded on the handheld device as well as can be downloaded by the user from App stores or the internet. Mobile apps can be found on both feature phones and smartphones. The most popular

smartphone platforms that support mobile apps are: Windows Mobile, Android, Java ME, Palm and IOS.

Mobile Augmented Reality Apps are Mobile Apps designed to equip mobile phone users with rich services, applications and functionality, which are applied on top of physical reality. Such applications use the phone's camera, GPS, touch screen elements and other sensory and motion detectors to integrate real images, videos or scenarios within them (Technopedia, 2014).

1.6.4 Marketing and Advertising

Marketing can be defined as the management process through which goods and services move from concept to the customer. It includes the coordination of four elements called the 4p's of marketing (Business Dictionary, 2014).

The 4p's of marketing (Product, Price, Place, Promotion) simply refers to respectively the identification, selection and development of a product, the determination of its price, the selection of a distribution channel to reach the customer's place, and finally the development and implementation of a promotional strategy (Business dictionary, 2014).

Although one can argue that advertising is part of promotion, advertising is a one way communication of a persuasive message by an identified sponsor, whose purpose is for non-personal promotion of the product or service to potential customers while a promotion usually involves an immediate incentive of a buyer (intermediate distributor or end customer). Promotion can also involve disseminating information about a product, product line, brand, or company.

The Advertising Association of the UK in a research defined the advertising as a means of communication with users of a product or service. Advertisements are messages paid for by those who send them and are intended to inform or influence people who receive those (The Economic Times).

1.7 Structure of the Thesis

The present research is divided into five chapters. The background information is given in the first chapter in order to raise the topic. In addition, this chapter illustrates the research problem as well as presenting the research's objectives and its motivational ground. The scope of the research and the definitions of the key elements are also presented in order to help readers to a better understanding of the research at hand.

In chapter 2, the literature review is addressed as the theoretical framework of this thesis. The literature review presents solids background information on Augmented Reality concept, its history and some applications of the aforementioned technology (AR) in the real world. The present chapter also gives previous knowledge around the mobile augmented reality concept by presenting its definition as well as its market size. Finally, the marketing concept is also discussed.

The research methodology of this thesis is discussed in chapter 3. This chapter justifies the selection of the research approach as well as the method used to conduct the research. Since our research results will emerge from building and testing an augmented reality solution (software) in a real case company, the design science is also discussed in this section. For a better clarity, the data collection methods as well as the data analysis phase will also be presented in this section. As the theory is acquired, the chapter 4 will present into details the background information on the case company adopted for this research as well as the way the case was conducted. The researcher also intends to present in chapter 5 the key components used to realize the application standing at the base of this research to carry out the case study.

Finally, after gathering all the data and conducting the analysis phase by decoding available data and drawing patterns, the results of the present research are to be discussed in chapter 6. Having the research results at hand, conclusions and further research questions are to be discussed in chapter 7.

2 LITERATURE REVIEW

This chapter presents background information on augmented reality, its history and some of its applications in different fields. Moreover, this section examines the mobile augmented reality and the marketing for a better understanding around the topic at hand.

2.1 Augmented Reality

Abbreviated as AR, Augmented reality is a type of virtual reality that aims to duplicate the world's environment in a computer (Webopedia, 2014). The following describes the concept into more details.

2.1.1 Augmented Reality Concept

Augmented reality is related to the concept of virtual reality (VR). VR attempts to create an artificial world that a person can experience and explore interactively, predominantly through his or her sense of vision, but also via audio, tactile, and other forms of feedbacks. AR also brings an interactive experience, but aims to supplement the real world, rather than creating an entirely artificial environment. Physical objects in the individual's surroundings become the backdrop and target items for computer-generated annotations (H. Tobias & K. Steven, 2004).

Ronald Azuma (1997) defined the AR as "an environment that includes both virtual reality and real-world elements. For instance, an AR user might wear translucent goggles; through these, he could see the real world, as well as computer-generated images projected on top of that world". Following this definition of AR by Azuma it is clear to understand that in order for a system to be recognized as an AR-system, it has to fulfill at least three requirements which are: First, the system should combine the real and virtual which is the fundamental description of AR in that it combines the real world with virtual content. The second requirement which is the registration in the real world in 3D separates augmented reality from the more general concepts of mixed reality by requiring that the virtual content must be registered in 3D within the real world. Finally, the third requirement "interactive in real time" requires the system to react to the user

and update in real time, which differs from all off-line augmentations such as the use of computer graphics in movies.

2.1.2 Historic

The term augmented reality was first coined in the 1990s by a former Boeing researcher Thomas Caudell (H. Tobias & K. Steven, 2004, p3). However, AR technology has been around for few decades. The first application of AR appeared in the late 1960s and 1970s. Among all successful AR-systems late in the 60s we can enumerate: The first head mounted three-dimensional display (HMD) created in 1966 by Ivan Sutherland and the Videoplace by Myron Krueger that allowed users to interact with virtual objects for the first time in 1975 (H. Tobias & K. Steven, 2004). Even though the HMD application of Sutherland was conceived with the goal of mobility in mind, true mobile graphical AR was out of reach for the available technology until a few years later.

During the 70s and 80s, AR was a research topic at some institutions, such as the U.S Air Force's Armstrong Laboratory, the NASA Ames Research Center, and in many Universities in the U.S. Wearable computing (Mann, 1997; Starner et al, 1997a), took off in the 1990s, when personal computers were becoming small enough to be carried or worn at all times. On the commercial front, palmtop computers embody the trend towards miniaturization. They became commonplace with the introduction of the Apple Newton MessagePad in 1993 and the Palm Pilot in 1996. Wearable computing has received since mid-1990s, a considerable increase in commercial backing and the miniaturization. All these changes resulted in several companies now offering commercial wearable computing products.

In 1999, Hiroksu Kato of the Human Interface Technology Lab at the University of Washington released the ARToolKit, a software library for developing AR applications. The release of the library opened the door for widespread use and development of augmented reality applications under the toolkit's non-commercial license. Allowing a camera to track a 2D marker, such as a sequence of simple black and white squares, so that 3D digital models can be displayed on a screen in real time, ARToolkit was ported onto the Adobe Flash platform in 2009

under the name FLARToolKit. A few years ago, in correlation with the rapid growth of smartphones, a new breed of AR has entered the marketplace. Mobile AR applications allow users to hold up their phone and see a heads up display-style AR image of data associated with their local surroundings.

2.1.3 Applications

A high percentage of conference submissions on AR come from industrial research labs or joint work between universities and industry. Many of the early AR publications are describing applications of the new technology in varied fields. This section gives an overview of potential uses for mobile AR systems.

2.1.3.1 Education

AR has strong potential to provide powerful context, on-site learning experiences and serendipitous exploration and discovery of the connected nature of information in the real world. AR has been experimentally applied to both school and business environments, although not as much as classic methods of education during the last two decades. Furthermore, now that the technologies that make AR possible are much more powerful than ever before and compact enough to deliver AR experiences to not only corporate settings, but also academic venues through personal computers and mobile devices, several educational approaches with AR technology are more feasible.

Developers and researchers have striven to apply AR to classroom-based learning within subjects like mathematics, physics, biology and many others. However is argued that the adoption of the technology by educational institutions has not been much integrated due to less financial support from the government and the lack of the awareness of needs for AR in academic contexts (AR in Education and Training, 2012, P14). Although the slow adoption of AR technology in institutions, there are several AR-systems which brought positive impacts in the education field such as: The MagicBook developed by Mark Billinghurst and Hirokazu Kato. The book itself is a book just like any other, complete with a story written on pages that could be read without the help of AR technology. However, the pages also contain virtual animated figures, which once viewed with a head-up

display would act out the story in 3D space above the pages. MagicBook has the additional ability to completely immerse a reader in the land of the characters so that a reader could become a virtual object within the virtual environment of the story.

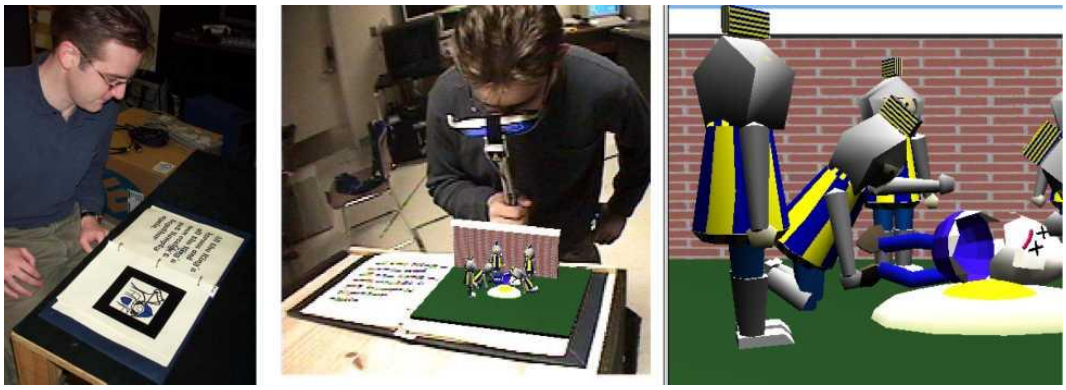

Figure 1: Using the MagicBook to move between Reality and Virtual Reality

2.1.3.2 Healthcare

AR has important application possibilities in medicine. For instance, nurses and doctors could benefit from important information being delivered directly to their glasses. It may be possible to collect the 3D anatomical data and health aid for medical diagnosis of a patient, using non-invasive sensors such as Magnetic Resonance Imaging (MRI), Computed Tomography scans (CT), ultrasound imaging or thermometer (Silva R., Oliveira J.C. & Giraldi G.A.). All these data could then be rendered and combined in real time with the view of the patient. In effect, this would give a doctor an anatomical vision inside the patient. Medical AR applications may receive the 3D dense objects, which represent the patient's organs. For realistic modeling and rendering, virtual organ data may consist of several millions of triangles, high resolution textures and animation. However, these data cannot be transmitted in real time under the limited network resources. The overall process for the medical augmented reality can be summarized as the following image.

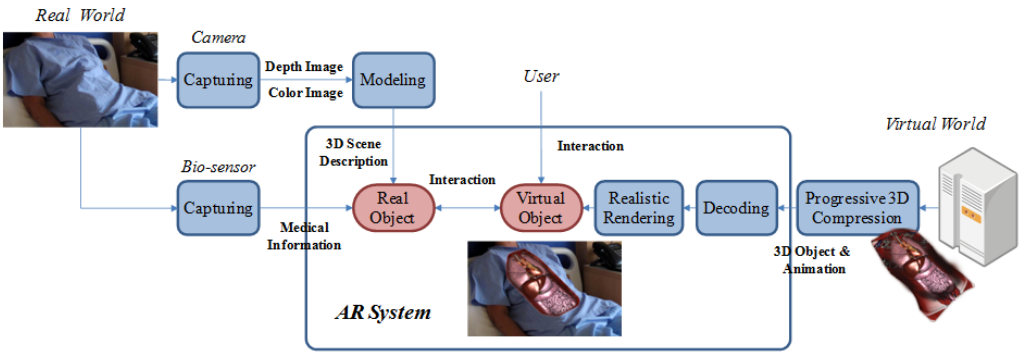

Figure 2: Overall process of medical augmented reality system

Many medical professionals are however still unknown of the benefits of this technology. The lack of information is making the use of AR a slower process in the medical field.

There are many AR approaches being tested in medicine with live overlays of ultrasound, medical records (MR) scans and others. Vogt et al uses video see-through HMD to overlay MR scans on heads and provide views of tool manipulation, hidden beneath tissue and surfaces, while Merten gives an impression of MR scans overlaid on feet (Milgram, P. & Kishimo, F., 1994).

2.1.3.3 Marketing

AR has a wide range of application areas and there are many examples of how an AR application can improve a work environment. But since AR is still new, it still has this ‘Wow’ effect. Therefore, it is also used in advertising industry to promote a product. According to Larry Fisher at ABI Research, a marketing intelligence company specializing in technology, “The augmented reality market will diversify into multiple markets, which will generate nearly $190 million in mobile applications, games and customized AR revenue, and nearly $170 million in mobile AR advertisement revenue, by 2014” (Mobile Marketer, 2009).

There are several examples of augmented reality based promotion campaigns, where a new product is introduced to the user. In fact, the user has the chance to experience the product first hand in a virtual way. For instance, in the automobile industry, BMW introduced the new Z4 with an interactive web application to showcase their new car. First, the user defines a path with a marker. Afterwards,

he can see a virtual Z4 car drive this created path. In the path-creation process, the user can also create and abstract image can later on publish it on social media (BMW AR, 2009).

Figure 3: BMW Z4 Augmented Reality

Furthermore, a good illustration of the AR usability on marketing is the Virtual Box Simulator app which is more than just a showcase of a selection of products. It has a practical benefit. After printing out the marker for the web application, the user can then trough the AR system choose different package types, move and change their transparency. The application allows users to find the right package type for their shipment, which can be ordered afterwards (VirtualBox AR, 2009).

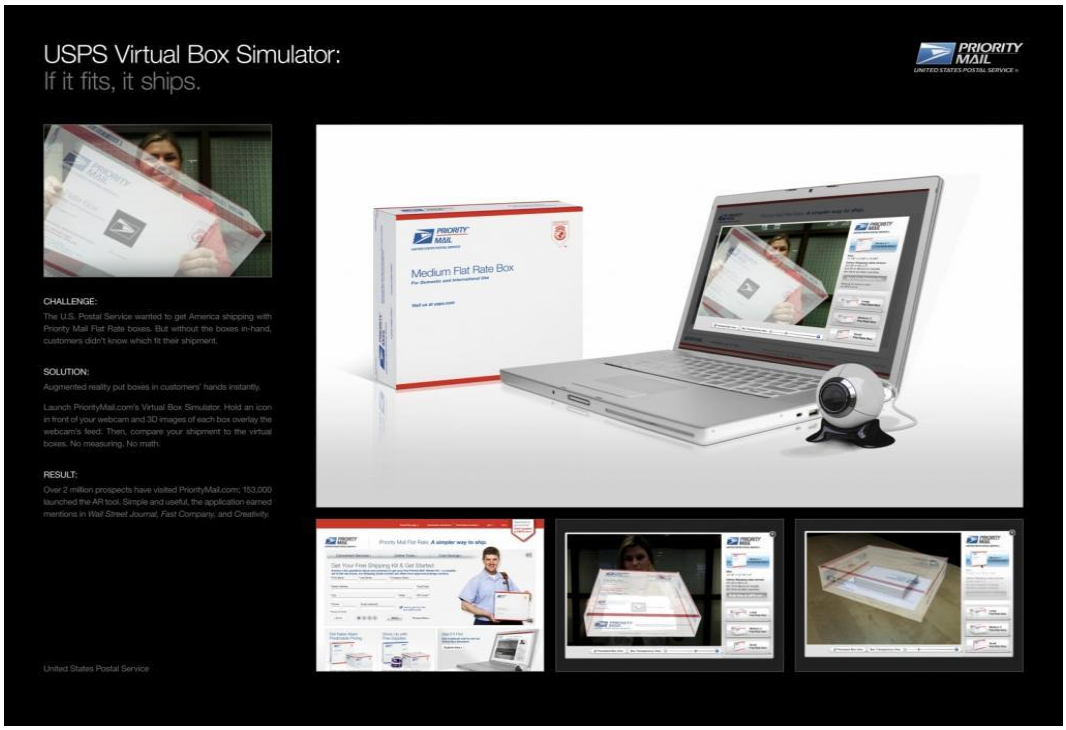

Figure 4: VirtualBox AR app

2.1.3.4 Tourism

Taking navigational UI one step further by including information about objects in a mobile person's environment that might be of interest to a traveler, leads naturally to applications for tourism (Feiner et al, 1997). In this case, AR is not only used to find places, but also to display background information. For instance, instead of looking up a description and historic account of a famous cathedral in a guide book, AR can make the air around the church come alive with information (3D models of the related art or architecture etc.…). The possibilities of information supply are endless and only limited by the amount and type of information available to the AR-enabled individual and the capabilities of the AR device.

The tourism industry has been fast to adopt AR technology and there is a ton of downloadable tourism app available. Tourists are increasingly choosing to travel independently and want up-to-date information. Markerless AR technology offers an alternative to printed tourism guides, identifying points of interest, attractions, transport links, directions, etc. This information can be constantly updated and layered with additional images, rating and reviews. Markerless AR has also been used to recreate historic events, architecture, characters and landscapes, augmenting a visitor's real world view with overlaid 2D or 3D images, sound, simulations or video enhancing your visitors' experience. An example of marker based AR on tourism would be the installation of QR codes at sites of interest to allow users to view site specific content as a tourist uses a handheld device to scan the QR code.

Figure 5: Augmented Reality App in tourism

2.2 Mobile Augmented Reality

As computers increase in power and decrease in size, new mobile wearable and pervasive computing applications are rapidly becoming feasible, providing people access to online resources always and anywhere. This new flexibility makes possible new kind of applications that exploit the person's surrounding context.

2.2.1 Definition and Concept

AR systems integrate virtual information into a person's physical environment so that he or she will perceive that information as existing in their surroundings. Mobile AR systems provide this service without constraining the individual's whereabouts to a specially equipped area. Augmented Reality Company Metaio for example, provides such a service in the form of mobile phone application, which shows you how to change a printer cartridge. By using the mobile device's camera it scans the structure of the printer to recognize the correct model. The software places augmented reality objects over the camera view of the printer in

real time and uses the right scale in order to show the user how to change the cartridge.

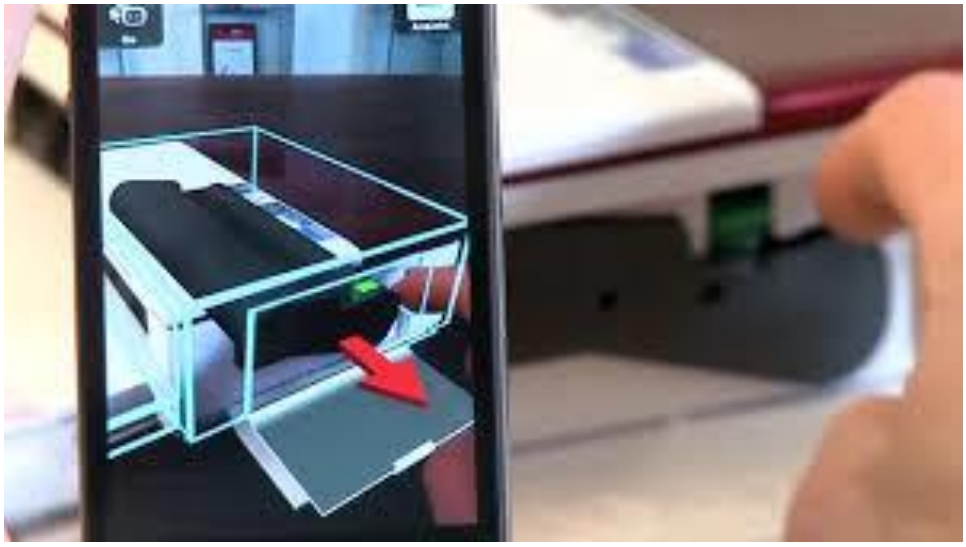

Figure 6: Mobile AR printer application

According to Blimber and Raskar (2005, p6), AR Apps are constructed on three major building blocks: tracking and registration, display technology and real-time rendering. However, these blocks also stand for the challenges one has to face when developing an augmented reality application. Augmented Reality is a technology that should happen interactive in real time and be registered in three dimensions. When trying to achieve a believable augmented image, accurate tracking and registering is important (Blimber and Raskar, 2005), this because the system will have to constantly determine the position within the environment of the user surrounding the virtual object which should appear to be fixed. These authors further see both display technology and real-time rendering as basic building blocks and challenges in the future. The first being connected to limited optical (e.g., limited field of view), technical (e.g. Resolution) and human-factor (e.g. Size and weight) limitations. The second, real time rendering is connected to the ability of augmented reality devices to place a layer of graphical elements on top of the real environment in a fast and realistic way.

Although there are other ways of achieving an augmented reality experience (as head-mounted or spatial displays) one has to point out that mobile technology (as on smart-phones) is achieving important results in outdoor augmented reality applications. Mobile devices with increasing processing power seem to have a

converging effect on different types of modern technology as they combine high speed wireless data exchange (Wifi, 3G, and 4G), integrate high-end camera sensors and low-cost GPS receivers. The combination of both inside-out and outside-in tracking devices has made tracking and registration of the speed and the location of the user, as well as the direction that the device is pointing a possibility. With the rising in processing power of smart-phones, both display technology and real-time rendering of objects would seem to be of substantial power to get a believable image across. For all the above mentioned reasons, one could argue smart-phones to be the best medium for augmented reality applications.

However, mobile computing devices (smart-phones) have another clear advantage over stationary devices (desktop PCs), which is the ability to move with its user. In an AR application has to be developed for the user to interact with its physical environment in any given context, it would be the logical thing to do so through a device that can be moved around with the user at any given moment (Diez-Diaz et al. 2007).

2.2.2 Mobile Augmented Reality Market

Nowadays, using a phone to find rich digital information connected to a physical object by using augmented reality has dramatically changed the way marketers present their products to end users through several smart-phone applications. Analysts predict that these possibilities for finding rich digital information will continue to grow and set the market value on $3bn by 2016 (ABI Research, 2011). Some even go as far as pointing out that a paradigm shift is occurring in the way we consume information. In line with ABI Research (2011) mobile augmented reality as an interface has the potential to become the “zero-click interface” of the “Internet of Things”. Meaning that one doesn’t have to click anymore in order to receive information connect to an object, for instance through visual recognition.

Form user perspective on mobile AR market, continuing with what current smart device users think on AR there is very little research to be found. A recent poll on Tweakers.net was used to ask for visitors if they ever used mobile augmented reality applications. Although the question specifically directed to two major

suppliers of AR solutions, the biggest conclusion (27, 7%) was “I have looked at it, but use AR rarely”, another interesting conclusion (19%) is that it is viewed a not a useful gimmick which simply means in marketing a useless feature making something stand out from its contemporaries. In the other hand, a total of 18% of the respondents said they couldn’t do without AR and 1, 7% said they would use it regularly.

2.3 Marketing

Marketing an important part of the business organization, it is more than promoting and selling a product. Marketing is satisfying the changing needs of the customer. If the marketer understands consumer needs; develops products that provide superior customer value; and prices, distributes, and promotes them effectively, these products will sell easily. In fact, according to Peter Drucker, “The aim of marketing is to make selling unnecessary.” Selling and advertising is only part of a larger “Marketing mix”. Kotler & Armstrong (Principles of marketing, 14 Ed.) defined marketing as the process by which companies create value for customers and build strong customer relationship in order to capture value from customers in return. This broad definition of marketing by the authors illustrates, marketing as a social and managerial process by which individuals and organizations obtain what they need and want through creating and exchanging value with others in a business context.

Although there is a huge variety of marketing strategies and marketing has come a long way to include new technical improvements, they all follow the same simple rules, which can be summarized in a model. The AIDA principles are a simple model in advertising and marketing that describes the four steps of the complete sales process. It stands for attention, interest, desire and action. First, the awareness of the brand, product or service has to be raised to attract the attention of the customer. Then interest has to be raised by more demographic-related information on the product. Third, it is important to convince the user to desire the product and that it will satisfy their needs. Lastly, the customer should have the opportunity to take action and actually buy the product. The AIDA principles capture the essence of good marketing. However, it is still just a simple model

widely used as a guideline for marketing campaigns. Since the artifact in the present research is a marker-based (company's catalog) augmented reality app for mobile devices, it is important to look at specific marketing areas, which focus on printed materials intended for distribution and mobile applications. That is print marketing and mobile marketing.

2.3.1 Print Marketing

As technology continues to develop and change the way we do business, many have considered print a dead medium and online marketing the wave of the future. Nevertheless, the print industry is far from dead; in fact print marketing has only continued to grow and evolve alongside the upsurge of new technology. Direct mail continues to be used heavily, with a 43% share of total local retail advertising. According to a Pitney Bowes survey (2012), 76% of small businesses say their ideal marketing strategy encompasses a combination of both print and digital communication.

There are many reasons why print is an effective tool for delivering messages to a target audience. As smartphone and tablet technologies continue to grow and the amount of users considerably increasing over the time, as too has the interactivity of print media. As previously mentioned, AR can be categorized in several forms, including the marker-based form which makes it possible for the print media (marker) to directly connect the user to digital information predefined. The marker can be customized with colors and patterns to better integrate into the print marketing designs and to give an opportunity to add branded elements. Second, print can be seen as an effective tool due to its least-expensive Cost per Impression. Small businesses need more bang for their buck, which is why a low cost per impression is essential for running an effective marketing campaign: one that can reach the greatest number of people at a low cost. In fact, according to the Advertising Specialties Study (ASI, November 10, 2008), the most popular promotional items; such as pens, shirts and caps have an average Cost per Impression of $0.002 lower than the average for online marketing, which tend to be $0.0025 per impression. Furthermore, a 2010 study by the Direct Marketing Association found that $1.00 spent on print advertising expenditures can generate

an average of $12.57 in sales. That high ratio was found to be universal across all industries.

2.3.2 Mobile Marketing

In today's world, people usually never leave from home without cash and their cell phones. These are the two necessary things needed to get by whenever we step out of the door. We need cash in case of emergencies, and cell phones to remain connected to everyone. Mobile phones have become an integral part of people's lives. With the continuous development in cell phone technology, it has become more than just a tool to make calls. That is why mobile marketing is an effective marketing tool in today's times.

According to the technology company Pitney Bowes's research (2012), mobile marketing refers to any marketing activity designed specifically for an audience using a mobile device, like a cell phone, smartphone or tablet computer. This means of marketing has been around for over a decade, evolving from mobile advertising via SMS (text messages) into the wide range of mobile marketing tactics. These activities include: mobile websites, QR code marketing, mobile surveys and mobile video.

Lately, there has been a move to more exciting media like real-time augmented reality, and payment systems that work directly from someone's phone. Traditionally, mobile marketing covers several key areas in marketing such as: advertising, SMS and Email marketing as well as App marketing. Several surveys from eMarketers have been predicted that in 2014, (now!) mobile will overtake desktop internet usage meaning that the bulk of companies' brand fans will view their social content on mobile devices most of the time and 78% of retailers planning on investing in mobile this year (Warden, Chris 2014). The definition of mobile marketing has then changed from 'novelty' to 'must-have'.

Mobile marketing is a powerful way to increase sales and market to customers. It differs from other marketing initiatives in that mobile customers are "on the go" and often using their mobile device while actively researching or planning a purchase. In addition, due to the vast majority of customer now carry a mobile

phone at all times, mobile marketing is also instant and very personal. For instance, a mobile-optimized email program allows marketers to send a message directly to their customers' device. Finally, mobile marketing also differs from other forms of digital marketing in a sense of device's size and internet bandwidths often less than desktop computers' own.

2.3.3 Target Audience

In order to find the right strategy for promoting a product, marketers have to consider, who the target audience is they want to reach. Each product or service has a specific target audience, with a detectable demographic and characteristics.

Target audience is a particular group of people, identified as the intended recipient of an advertisement or message. The target audience is usually defined in terms of demographic (and sometimes psychographic) characteristics, such as age, sex, education, income and etc.…. An advertisement's target audience can be the same as the brand's target market, but a target market can be better defined. For instance a company's target market might be "owners of houses aged more than 10 years", whereas the target audience for one of its ads may be "owners of houses aged more than 10 years in Lahti, Finland."

Since the target audience defines a brand's market, it is necessary to narrow down the target market just to a certain kind of group. The marketers have to know the group inside out well enough. Therefore, an extensive market analysis for identifying the target audience and for delivering data is a must before any marketing action.

3 RESEARCH METHODOLOGY

The research methodology is a systematic way to solve a problem. It is a science of studying how research is to be carried out. Essentially, the procedures by which researchers go about their work of describing, explaining and predicting phenomena are called research methodology. It is also defined as the study of methods by which knowledge is gained. Its aim is to give the work plan of research (Rajasekar & Philominathan, 2013).

3.1 Research Approach

Despite the fact that there are only a few theories on Augmented Reality, there have been several researches on the aforementioned technology for the past decade. According to a recent insight on Augmented Reality's benefits of an organization in the UK (Engine Creative), AR can provide a number of key benefits to brands and organizations: (1) AR increases engagement, interaction and provides a richer user experience. (2) AR increases the perceived value of products and brands. (3) AR is an inexpensive alternative to other media platforms as no specific media needs to be purchased. All these hypotheses claimed by Engine Creative organization will stand as theories which the research is trying to verify and therefore the current research is conducted using a deductive approach.

A deductive approach is concerned with developing a hypothesis (or hypotheses) based on existing theory, and then designing a research strategy to test the hypothesis. Monette et al (2005, p. 34) further explains the deductive approach by the means of hypotheses, which can be derived from the propositions of the theory. In other words, deductive approach is concerned with deducting conclusions from premises or propositions. "Deduction begins with an expected pattern that is tested against observation, whereas induction begins with observations and seeks to find a pattern within them" (Babbie, 2010, p. 52). Snieder and Larner (2009) went further until drawing a simple representation of the deductive approach informing that in deductive approach, reasoning starts with a theory and leads to a new hypothesis, which is going to be confirmed or

rejected as a result of the research

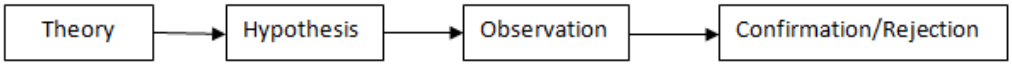

Figure 7: Deductive Approach

3.2 Research Methods

Burns and Grove (2003:19) describe a qualitative approach as a "systematic subjective approach used to describe life experiences and situations to give the meaning". Holloway and Wheeler (2002:30) refer to qualitative research as "a form of social inquiry that focuses on the way people interpret and make sense of their experience and the world in which they live". It can be argued that quantitative research provides better findings. However, qualitative research can be used to explore several areas such as behavior, perspectives, experiences and feelings of people which cannot be quantified. Since the implementation of our case study will be designed to collect users' opinions and behaviors when interacting with the software which again cannot be quantified, our study will therefore use a qualitative research method.

Miles and Hurberman (1994) prefer not to specifically define qualitative research, but focus their understanding of qualitative research on data in the form of words, such as observations, interviews or documents. They mentioned that data collection activities are typically carried out in a well-defined manner and the data is not usually accessible for immediate analysis, requiring some processing.

This research is built around an AR-solution (software) which will serve as a tool for data collection during the testing phases. As the central issue to be studied in this thesis is represented by a software, the most appropriate approach for this case is the design science.

The design science paradigm has its roots in engineering and the sciences of the artificial (Simon, 1996). It is fundamentally a problem solving paradigm. It seeks to create innovations that define the ideas, practices, technical capabilities, and products through which the analysis, design, implementation, management, and

use of information systems can be effectively and efficiently accomplished (Tsichritzis, 1998).

Hevner (2004) introduced the research-design framework as a method that combines two paradigms: behavioral science and design science. Behavioral science tries to develop and verify a theory that explain and predict the business needs. Meanwhile, design science produces a useful thing to solve a problem. In addition, Simon, 1996 claims that the design science research is motivated by the desire to improve the environment with the introduction of new and innovative artifacts and the process of building these artifacts. The output from the design science must be returned into the environment for study and evaluation in the application domain.

3.3 Research Framework

In relation to the design science principles established by Hevner et al. (2004, 80), whereas it includes the three main components of the Information Systems Design Framework (Environment, Information System Research and Knowledge Base), the following figure shows into details the framework adopted in the present research.

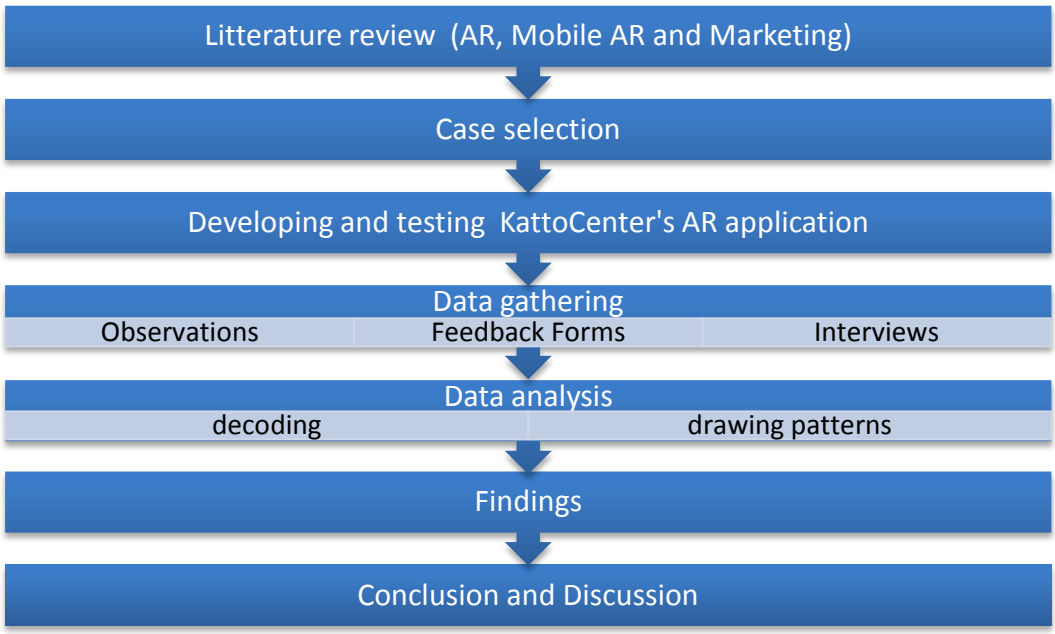

Figure 8: Research Framework

3.4 Data Collection

The main data techniques used in this research are online forms, semi-structured interviews and observations. Personal interviews and forms will constitute the most important and valuable sources of information. The corresponding link for the questionnaire will be sent to participants who are willing to contribute to this research and also to members from inside the company (management level) who accepted their full commitment throughout the research's period. Bless (2000:103); claims that the main types of qualitative data collection methods include non- participant observation, participant observation, interviews and questionnaires. The online form has as objectives to evaluate the user's perceptions on the actual software and also collecting people's opinions about augmented reality solutions. As agreed with our representative in the company, a small event will be organized in the company's premise in order for the staff members to interact with the software and give feedback to the researcher via the online form which can be found in the Appendices section of the present paper, under the name Appendix B.

The researcher present on the site will carefully observe users' behaviors when interacting with the software and notes will be taken down for a later analysis. In addition to data collected through forms and observation, few interview sessions will be held and documented by the researcher for a better clarity of data. The questions to be answered during the interviews can be found in the Appendices section and under the name Appendix A. The interviewees will be selected on the basis of their closeness to the project and their role in the company. In order to produce a quality data, the researcher during interviews will ask a set of specific questions which will help in the analysis phase.

3.5 Data Analysis

Interpretive researches attempt to derive data through direct interaction with the phenomenon being studied. An important aspect of data analysis in qualitative case study is the search for meaning through direct interpretation of what is observed as well as what is experienced and reported by the subjects. Bogdan and Biklen (2003) define qualitative data analysis as "working with the data,

organizing them, breaking them into manageable units, coding them, synthesizing them, and searching for patterns". The aim of analysis of qualitative data is to discover patterns, concepts, themes and meaning.

All the data gathered in this case study will be saved in a private repository and will be carefully analyzed and decoded by the researcher at the appropriate time. The process of data analysis begins with the categorization and organization of data in search of patterns, critical themes and meanings that emerge from the data. Since all the data gathered will be most peoples' opinions from open-ended question type, decoding the data will consist of interpreting and drawing similarities between the data, in correlation with theories supported in the research. Due to the fact that the application to be used will be tested by individuals from inside the company with strong technical know-how on the company's operations as well by individuals from outside the company, and feedback is to be collected from theses testing phases, the researcher considers the data to be reliable and valid. It is argues that 'qualitative studies achieve higher validity', that is because, in the qualitative research the 'data are closer to the research field', than in quantitative research, and in qualitative research, 'opinions and view of the research subjects are considered; data are closer to reality; and a successive expansion of data is possible'.

4 CASE COMPANY – KATTOCENTER OY

This section presents the case company in which the research was implemented. It will further give a general description of the software developed by the researcher as well as some background information about the group of people chosen during the testing phases of the application.

4.1 Company's background

KattoCenter Oy is a leading company in the southern Finland specialized in exterior house renovations and mainly house roof renovation. The company was established in Lahti, Finland in 2009, when the low-rise roof renovations reached its peak. The company employs more than 200 roofing professionals around the country and is nowadays expended in more than 15 centers around the country (KattoCenter, 2014).

KattoCenter Oy has taken more than a thousand of roof renovation per year in the past and the pace will remain intense in the future and even expected to increase its sales by 40% in 2014. The company offers to houses' owners and to housing companies a complete package, including additional materials and supplies. Awarded in 2013 by Kauppalehti Finland and being part of Finland's strongest group (SUOMEN VAHVIMMAT) made the company reliable toward its customers (KattoCenter, 2014).

During the internship period of the researcher as software developer in Korpimedia Oy, the researcher became familiar with a technology called augmented reality. After working on several projects using the AR technology and based on several researches on its opportunities and its slow adoption by companies, the researcher end up with an idea of raising the awareness of AR potentials to Small and Medium Enterprises (SME). Since the company responsible for KattoCenter's marketing catalogs was located in the same premise in which the researcher was as a trainee, the idea of building and testing an AR application, in order for KattoCenter to promote its services to end customers was initiated and approved by KattoCenter's management staff.

4.2 KattoCenter’s AR App

The artefact Build for this research is an augmented reality application in the construction industry. The software has as the main idea to help potential customers to use their mobile devices to design a complete outlook of the house they owned and which can be ordered in the future if they are willing to. In line with mobile AR system which is a system that integrates virtual information into a person’s physical environment when the mobile camera is pointing on a target, so that he or she will perceive that information as existing in their surroundings, the software’s user interface (UI) is designed to coordinate an easy interaction between the user and the software itself.

Since the software is an augmented reality marker-based application, KattoCenter catalog’s cover will serve as image target (marker) while interacting with the software. When the application is launched, the UI’s main page prompts a text area requiring a username for an easy identification if the order will be sent to KattoCenter.

Figure 9: Application' main page

Secondly, the user has the choice to select the type of house he or she owns.

Figure 10: AR app's house selection

The final page, in which the main idea of the software is concentrated, is initiated when a user chooses the house type he possesses. The camera of the device is then initialized. Pointing the camera view on the KattoCenter catalog' cover, a 3D model (house) will be drawn on top of the catalog as a real object with which the user will interact and perceive it as a real house in a real world. The user can perform several actions such as: change the roof tiles, change the roof's color, change walls and pipes' colors and finally save the complete design as an image. Since the user is asked to enter his email address when the button for saving the design is clicked, the completed design will be sent to him by email and also if desired to KattoCenter for an ordering.

Figure 11: Device camera' view when no target is detected

4.3 Test Group (Case selection)

The following describes background information about the group of peoples which interacted with the software during the testing phases. Although the software was tested by many workers from KattoCenter and from different cities, the test group used for this case study was limited to only thirteen peoples due to the time limit, their availability and interest in this research. Of the thirteen respondents, two of them were from Mageena Oy which is a small advertising company responsible of KattoCenter's marketing strategies. One out of the two participants from Mageena Oy was the Account Manager mainly responsible for the communication with KattoCenter. Among the eleven others participants, ten of them are Roofing experts mostly working with customers when a decision is to be made for a house renovation. The last participant from the company was the regional manager (Lahti region) which is responsible for most decisions when is coming to new acquisitions in the company.

During the testing phases of the software, many personal feedbacks were given back to the researcher via email. All participants who agreed their commitment of this research filled the online survey established by the researcher and three out of them were interviewed. The interview session was conducted in the company's premise and only two of those were recorded on tape with the permission of the

interviewees. All the data gathered during these interviews and the online form data were saved in a private repository for a later analysis.

5 REALIZATION – DEVELOPING THE AR-APP

In this section, we define briefly the steps followed using the Augmented reality technology in order to achieve the software defined at the beginning of the research in accordance with the company's requirements and expectations.

5.1 Application initiation

The initial idea of the entire research became obvious to the researcher after working on several projects with the augmented reality technology. The AR technology implemented in this case is based on the vuforia SDK library. Vuforia SDK is a software library written in the Java programming language for creating AR applications. It is distributed free for commercial and non-commercial applications. The following diagram provides an overview of the application development process with vuforia platform.

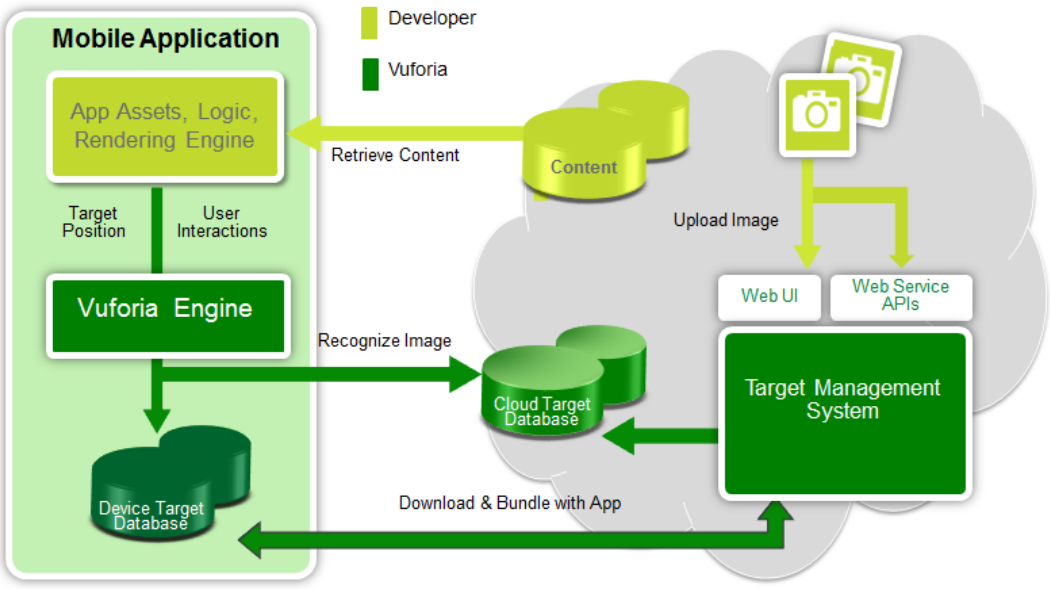

Figure 12: Application development process with vuforia platform

The platform consists of the vuforia engine (inside the SDK), the Target Management system hosted on the developer portal (TM), and optionally, the cloud Target Database. For the application built on this research, KattoCenter catalog's image was uploaded to the Target Management system via the researcher portal and which currently serve in the application as target (marker). Furthermore, Vuforia engine provides extensions allowing developers to build

Apps on several platforms such as Android, IOS and Unity3D. The software used for this research was built on unity3D platform and C# standing as programming language. Once the environment is successfully configured, the platform offers several classes easy to invoke for augmentation actions.

5.2 Classes and Events Handlers

In order to create the Augmented Reality scenario for the application in unity3D, a class called “ImageTargetBehavior” was invoked which has the following diagram structure.

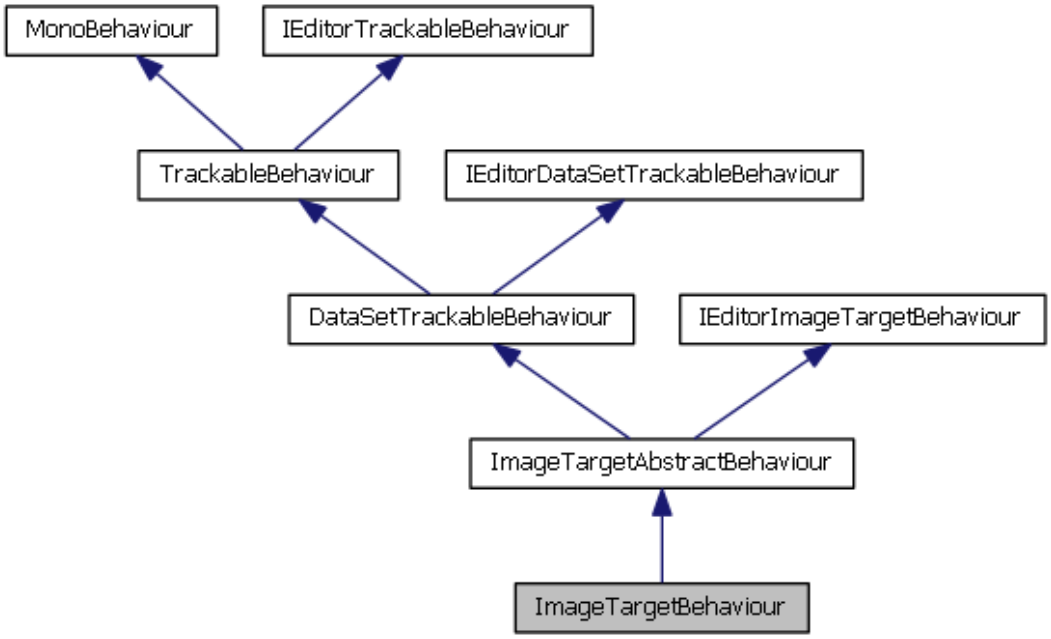

Figure 13: Inheritance diagram for the ImageTargetBehavior

Looking carefully the above diagram from bottom to top and focus only on the arrows pointing to the left, we can then understand the overall implementation of the image target (image previously loaded to the TMS). The ImageTargetBehavior class extends the DataSetTrackableBehavior class responsible for all trackables that are part of a dataset (image in the device database). Rectangles on the diagram represent the names of classes. In addition to the ImageTargetBehavior, an interface called “ITrackableEventHandler” was implemented to allow devices to detect whether the image target is found or not.

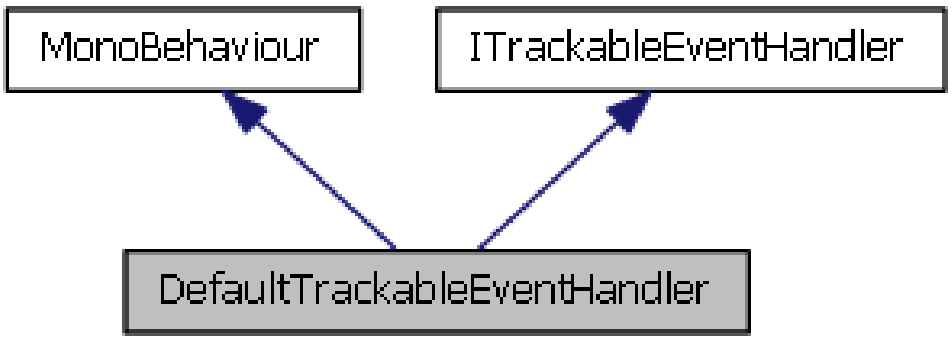

Figure 14: Inheritance diagram for DefaultTrackableEventHandler

Once the image target is found through the device's camera in which the software is installed and started, a house's 3D model is then drawn on the company's catalog and the user can interact with the augmentation.

5.3 Image Target and Target Tracking

Image targets are images that the Vuforia SDK can detect and track. Unlike traditional markers, data matrix codes and QR codes, image targets do not need special black and white regions or codes to be recognized. The Vuforia SDK uses sophisticated algorithms to detect and track the features that are naturally found in the image itself. Image targets can be created and used in three different ways: with the Target Manager to be used in device databases, with the cloud recognition databases for its availability in the cloud and finally at runtime from selected camera video frames and dynamically added to a device database (Qualcomm Vuforia, 2014).

In KattoCenter's App case, the company's cover catalog was chosen as image target and was uploaded to an online Target Manager. Features extracted from this image were stored in a database which was downloaded and packaged together with the application. The Creation of the image target required special care by the developer such as the image file type (must be 8- or 24-bit PNG and JPG formats), the size (less than 2MB) and contrast colors in order for the application to successfully acquire the target.

With everything in place and the device camera staring at the company's catalog cover, a comparison of the image features against a known target resource

database is then performed, allowing the tracking event handler to return true if the target is found and false if not.

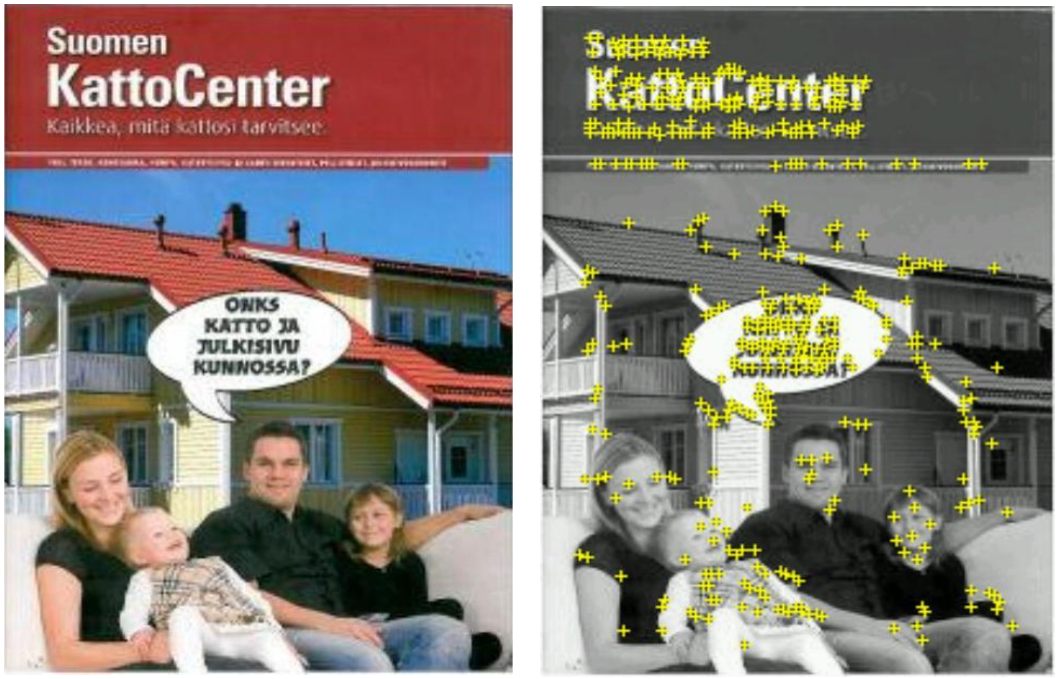

Figure 15: -a) KattoCenter image target -b) KattoCenter image target with features used for tracking

5.4 KattoCenter's augmentation scene

As mentioned above the augmented scene is initiated when the device camera's view is pointing to the image target. If the tracking events handler returns true (target found), a 3D model (House type selected by the user) are then drawn on the target and a set of controls is also active on the device's screen, allowing users to customize the 3D model as they wish. A good feature of vuforia recently added to the vuforia SDK library and called "extending tracking" is allowing the device camera to continue tracking the 3D model even when the camera's view is out of the target, but just to a limited extend. Above that limit, the tracking events handler return false (target lost) which disable the whole augmented scene. With the set of controls available when the target is found, the user has the option to save the design accomplished as an image which can be emailed to the company for a future ordering.

6 FINDINGS

An evaluation of the designed case should document the results of how the users experienced the augmented reality technology. This chapter will first introduce the survey and its categorized questions to demonstrate the survey's proposition as well as for the interviews' sessions. In addition, the paragraph results summarize the survey outcome as well as the semi-structured interview outcome in order to point out in the discussion phase some benefits to the SME for adopting mobile augmented reality solutions to support their marketing strategies.

6.1 Online survey

The online survey, which is the main source of data, consisted of two categories with a total of thirteen questions to collect users' opinions about the software and potentialities presented by augmented reality technology. The survey was built on a Google Doc form, which is a free tool to build online surveys. This tool used to collect data offers different types of survey questions like multiple choice, checkboxes, and list or paragraph text. The results were written in an excel file, which can be interpreted with visual graphics like histograms, run or pie charts.

The first set of questions in the online survey focuses on finding out how familiar users are with the augmented reality as well as how easy to they find using this solution. Since the online survey were filled by roofing experts after trying out the AR solution, the second set of questions in the survey has as objectives to find out their opinions on the opportunities presented by the technology used in this specific industry (construction industry). The online survey's questions can be found in the appendix section (Appendix B).

6.2 Interviews

Additional to the online survey, several semi-structured interviews were conducted in the company's premise with several roofing experts in order to for the researcher to get more information on customer acquisition and their decision making process when willing to order a new house' renovation. The interview was done only with three roofing experts due to the language matter (English

language) and also due to their availability. The interview consisted of two categories of questions. The first set covered a general feedback on the software's usability and utility. Customers' acquisition and their decision processes to order the product were discussed in the second set of questions.

All questions together from the survey and from interviews have a certain direction and intention, but each set concentrates on a specific aspect. The following present the results while taking into consideration propositions mentioned when defining the problem at hand.

6.3 Results

The results of this research will be presented by trying to answer to all sub-questions defined in the research problem section intended to create a discussion around the problem.

1. **How frequently do peoples use mobile augmented reality application?**

   In line with what the survey suggests, enabling end-users to save time and money through augmented reality could make a business process more effective and efficient and therefore profitable for companies. In order to find out how familiar users are with mobile augmented reality applications, two questions were asked in the online form as follows: have you ever tried mobile augmented reality applications? And if yes, how often do you use them? The results from the first question, clarify that today's mobile augmented reality applications are well known by end-users. As for the second question, most users confirmed that they do not use these types of applications quiet often. These observations in turn could either mean two things, first end-users are not sufficiently aware of the technology or secondly that most of the current augmented reality applications insufficiently enable user to solve their problems more effectively and/or efficiently than other non-augmented reality applications. The following diagram shows the results when asked to users if they ever used mobile augmented reality.

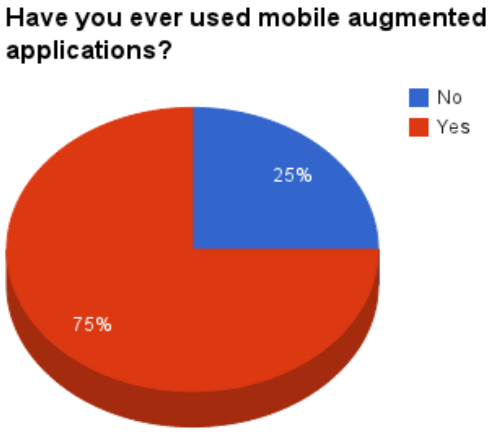

Figure 16: Overview of the answers given when asked if participants ever used mobile augmented reality applications.

As shown on the chart above, 75 from all the participants (n=13) definitely approved that they have used augmented reality before, but most of them do not remember well what kind of application they used. This observation shows that although many are aware of the technology, most of these applications do not sufficiently provide end-users with a solution to their problems. In the other hand, 25% of participants answered a no from using this technology before. Taking into consideration that almost everyone owned a smart phone now a day, and with the availability of tons of augmented reality applications, we can believe that the awareness of the aforementioned technology among end-users is at a very low percentage.

In addition to that, all participants who claimed that they have used augmented reality applications before were asked an additional question on, how often do they use these applications in order to clarify how familiar they are with the technology. The result of this question by many was that they interacted with such solutions only couples of times and mostly during conferences where developers were presenting their work. These observations simply tell us that most of the augmented reality users have tried AR applications not with their personal will but under specific circumstances. Someone could then conclude that AR applications do not supply users with an easy solution to their problem.

In order to make more clarification on participants' opinions, the researcher pushes the survey further by asking the question 'do you find KattoCenter's AR application easy to use?'

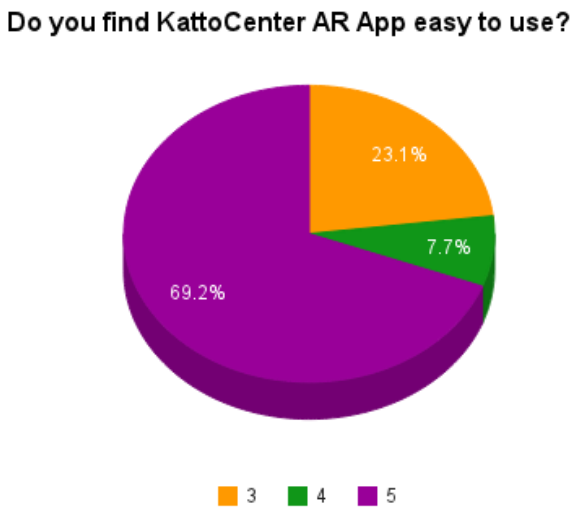

Figure 17: Overview for the answer when asked to participants to rate the application with a range from 1 to 5

The graph above shows the result from the software evaluation by participants. The evaluation scale was defined within the range of 1 to 5 meaning respectively too difficult and really easy. As we can see, the majority (69.2%) gave a grade of 5 which was the maximum value for grading. Since all participants were roofing experts, a manager and marketing specialists, we can then conclude that most of the users were really satisfied with the solution and its support in this particular business. Furthermore, from the 23.1% of participants who gave a grade of 3, many of them mentioned that this result was due to the fact that they tested the software with an old version of android which was not carefully taken into consideration by the researcher when developing the solution. They also mentioned as a comment that, except the issue faced with their devices, the whole idea of the solution has a real point in this business context. The smallest percentage (7.7%) of participants gave a grade of 4 simply meaning that they still have few expectations of the software to be a better solution.

2. **Can mobile augmented reality be used to create or extend business opportunities because of the technical functionalities a smart phone has?**

During the three interviews carried out by roofing experts in KattoCenter's premise (Appendix A), it became clear that mobile augmented reality, as a technique is not only used to fix consumer pains, but also to fix business pains. Augmented reality seems to be the way of making processes in the value chain more efficient, in some cases as a way of visualizing multiple streams of data in such a way that business processes ran more efficiently and effectively. This way, "augmented reality is a technical part of something that is a lot bigger and it basically is about improving business processes in a very innovative way."

After all the session interviews were accomplished, an open discussion took place with all the interviewees and the general manager of the company. The power of smart devices as a main driver for this technology was mentioned by many. Augmented reality in this specific context is all about using the device's camera to access information on surrounding objects in a real world. Since smart devices are now a day comparable to personal computer and also due to the fact that almost everyone owned one, mobile augmented reality tends to be the most effective way to reach a maximum amount of users and provide them with product information which can result in greater market share for companies. The entertaining effects presented by mobile augmented reality to end users as confirmed by all participants can be also seen as beneficial to businesses.

As discovered, all participants who used augmented reality for their first time confirmed that this technology creates the "wow effect!" (Impressive, and exciting effect) which attract all the focus of users when providing them with product information. In that sense, reason is to be admitted that mobile augmented reality is a beneficial tool for companies willing to advertise complex products to end users.

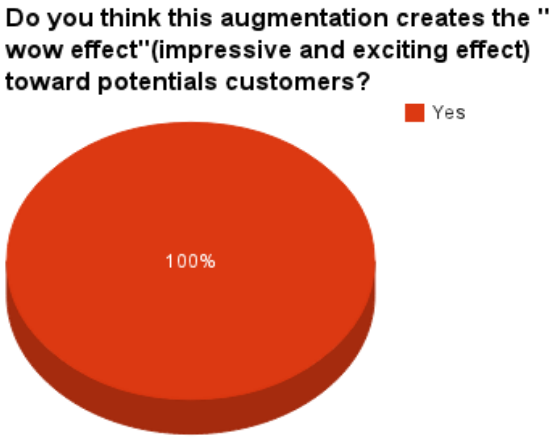

Figure 18: Overview answers to the question do you think it creates the wow effect toward customers?

3. Can mobile augmented reality increases engagement, interaction and provides a richer user experience?

In line with the survey's results, one has to admit that augmented reality increases user's engagement after interacting with this type of solution. Mridul Dohtutia's study on AR as a marketing tool (2012) illustrates that AR Experiential Marketing (AREM) is beneficial for companies and brands in creating customer satisfaction. It also leads to increase in customer loyalty, their intention to repetitive purchasing and positive word-of-mouth, which creates greater market share. During the event organized in the company premise in order for staff member to interact with the software, the researcher present on the site was observing carefully the reaction of peoples during their interactions times. Emerging from that, most of participants who used this type of software for their first time were really excited and full of new ideas around the solution for supporting the business. It can be also claimed as observed that most of them tried the software several times, which basically show how augmented reality tends to increase users' engagement and interaction with such solutions.

With the believe that testers were experts and really familiar with the roof renovation service in KattoCenter, several questions were asked in order to find out if the solution provides enough information on this particular service as well as if implementing such solution provides better and accurate information to end users than a non-AR App. The survey's results from these questions mentioned above were 100% a yes and from peoples in different angles inside the company. All these answers can then lead us to a conclusion that mobile augmented reality increases engagement, interaction and also provides a richer user experience than non-AR applications.

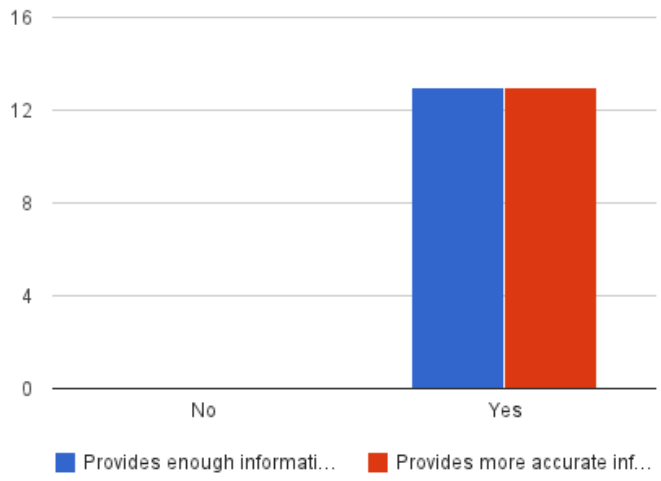

Figure 19: Answers to the questions" do you think this software provides enough information on this service" and "does it provides more accurate data than a non-AR application?"

4. Can mobile augmented reality be used to lower coordination and transaction cost and thus used to improve the decision process for complex and expensive products?

During the interview conducted in KattoCenter's premise and with three Roofing experts, a set of specific questions were asked in order to have a better understanding of the customers' decision making process when willing to order a service for their house renovation. To the question how do customers choose colors for their renovations? Experts mostly

answered that it depends a lot on what already exists and the previous materials used on that particular house. Since most of the customers in this process would like to choose something different the process is becoming more difficult for them and then support from professionals is needed. One interviewee also mentioned that customers always look through online samples and through the colors' catalog available on the company's website which for his opinion does not provide real colors to customers. In order to carry out this process, help from roofing experts is definitely needed and this after several weeks of work together with the customer. From this observation, one can conclude that this process seems to be a hard and time consuming for both clients and roofing experts.

Since KattoCenter's service (roof renovation) has been a really complex and expensive product, a decision from a customer willing to order this service really need to be carefully planned. This is where most participants welcomed the solution implemented by the researcher. The solution is simply a mobile augmented reality application that helps users to use the camera embedded on their mobile devices to customize a complete exterior look of their houses and their results can then be saved and forwarded to the company if they are willing to order the service without spending more time on hiring experts for this task. Also is important to mention that although the solution provides enough information on the service experts can still be contacted for advices but this solution actually reduce the coordination and transaction cost for the decision making process.

In addition to that, a last question in this same set was asked to interviewees if they do think that this solution can improve the decision making process of potential customers and as a result, all of them tightly gave a yes and one of them also mentioned that "this solution doesn't just improve the company's main business processes but also creates a big advantage for the company against its competitors". In the online form, the same question was added in a type of yes or No question in order to get the opinion of all participants and the result is shown on the diagram below.

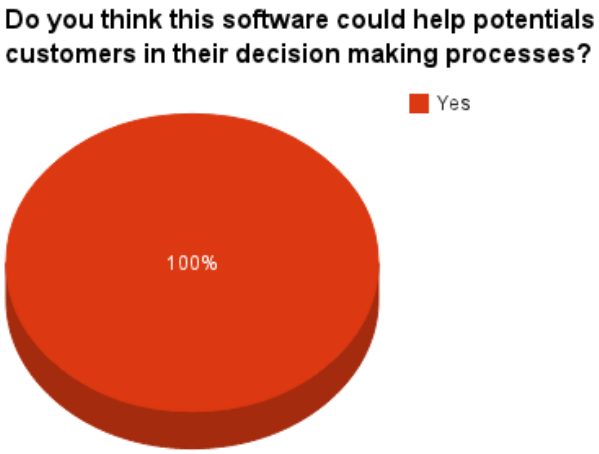

Figure 20: Participants' answers to the question do you think potentialare could help potentials customers when willing to order this service?

7 CONCLUSION AND DISCUSSION

The objective of the research was to find benefits to SME of using mobile augmented reality solutions to support their marketing strategies. In this section, the results and conclusions of the research are discussed as well as the theoretical foundations of the study in accordance with the main research question: What are the benefits to SME for using Hand-held AR applications when promoting products or services?

7.1 Conclusions

This research started with the idea of exploring the augmented reality potentials in order to clarify some benefits to managers for its adoption. In order to achieve our objectives, the researcher developed and tested an AR solution in the construction industry. The case study applied in this research was conducted in a company in the region named KattoCenter Oy. The choice of this implementation was mostly due to the matter of access since experts 'opinions in this particular field were needed to draw reliable conclusions. The research data was collected mainly through online surveys (Appendix B) and through interviews. The data were also analyzed by interpreting people's opinions and drawing similarities between the data.

During the course of writing this thesis, it became clear that it is not only in the business world that there is little known on mobile augmented reality in relation to innovating business processes and improving value chains. Based on the reactions of peoples that actually use and re-use applications, it seems that developers also have a hard time figuring out how to apply and build augmented reality applications in such a way that it provides value for end-users.

In the other hand, the result from the research implies that augmented reality is the future. Many brands now a day correctly want to help consumers to truly experience what their products have to offer, and augmented reality enables them to do that and at a cost of nothing for complex and expensive products. Furthermore, augmented reality helps organizations to quickly gain advantages on their competitors.

7.2 Major contributions

This section provides several contributions identify during our research. As small and medium size enterprises, are struggling in the business world, this thesis furnishes a simple example on how SMEs could benefit from augmented reality technology potentials. Furthermore, this research gives into details the result of a solution implemented and tested in the construction industry while listing benefits which can considerably drive SMEs for innovative results in their business processes. In addition, this study suggests a new way of taking advantage on competitors since it was demonstrated that mobile augmented reality leads to increase in customer loyalty, their intention of repetitive purchasing and positive word-of-mouth, which creates greater market share.

7.3 Summary of the Research Results

As has been shown above mobile augmented reality can be used to innovate separate parts of business processes. Also from the interviews and the survey carried out in this research, it can be admitted that augmented reality is an effective tool supporting companies when planning marketing campaigns or advertises events. This tool enables companies to achieve superior through business process innovation. It has been observed that mobile augmented reality can be used to put complex and expensive products in the hands of potential customers at a cost of zero. The technology also increases engagement, customers' loyalty resulting in creating a better market share and finally, mobile augmented reality can be used to create or extend business opportunities. However, as discovered in the results, this technology seems not to be currently used by many which can be due to the non-awareness of such technology. As for companies, augmented reality seems to be an effective tool to take advantage over competitors since its adoption in organizations is currently at a low percentage.

7.4 Implications

This study has generated a number of implications that would be of interest to organizations. As previously observed, the results indicate that including augmented reality solutions to support marketing strategies can be beneficial to growing companies. The implication of this thesis is first of all to raise the awareness of augmented reality potentials to managers. In addition, a way of presenting complex and expensive products to end customers (using the virtual) while reducing the coordination and transaction cost for decision making process is also presented in this research and this can be effectively applied in all kinds of companies offering products or both products and services to end users. Finally, the research results clarify to small size enterprises how mobile augmented reality can be employed to improve core processes resulting in customers' satisfaction.

7.5 Limitation of the Study

While the research at hand is coming to its end, the researcher discovered several limitations contracted by this research. Firstly, considering the fact that KattoCenter employs more than 200 roofing experts expended in more than 15 centers around the country and the sample size was limited only to 13 participants, there is reason to believe that the survey results would have been more reliable with a higher number of participants. This happened due to the time limits in which the researcher was constrained to carry out the research. Although many were invited to fill out the online survey after interacting with the software, less than half of them responded to the survey. On the other hand, despite the small number of participants, it does provide a bit more accurate result since participants came from different viewpoints (manager, roofing experts and salesmen).

Secondly, the decision of deploying the software only on one mobile platform (android platform) constituted a big limitation for this research. As requested by many, it would have been more effective if the most popular mobile platforms (IOS, Windows) were taken into consideration when carrying out the development phases. All these limitations mentioned above, briefly the sample size, the time limit and finally the mobile platforms make the generalization less reliable.

7.6 Future Research Question

Studies related to designing and developing an augmented reality-based marketing application could be further undertaken. During our research, it has been observed that the impressive effect presented by augmented reality regular users is still at a low percentage, which let us believe that this might be due to the poor communication between marketers and developer when an augmented reality solution is to be implemented. Most of AR solutions available seem to be built from the developers' point of view which might considerably differ from the marketers' point of view. Therefore, further studies could be carried out on the following research issue: how to effectively design and develop an augmented reality application and what factors to consider during the development process.

The main limitation faced during our analysis phase was the availability of our solution on only one mobile platform (android) which resulted in a small number of participants in our survey. There is reason to believe that a bigger number of participants would have resulted in different results and therefore another study could be undertaken on the following research proposition: "exploring mobile augmented reality-based marketing potentials on major mobile platforms". Finally, although we observed that mobile augmented reality is beneficial for SMEs, it wasn't clear enough to conclude that mobile augmented reality can lead to innovative business models and this could be taken as a new research. Moreover, as our study case were conducted only in a specific industry (construction industry), further studies on augmented reality benefits could be explore in other fields such as Education, healthcare and etc…

REFERENCES

Published References

BABBIE, E., 2010, The Practice of Social Research. Belmont, CA: Wadsworth.

Bless, 2000, Fundamentals of Social Research Methods, Zambia: Juta Education.

Blimber & Raskar, 2005, Spatial Augmented Reality: Merging Real and Virtual Worlds. America: A K Peters, Ltd.

Bogdan, R. Y Biklen, S., 2003, Qualitative Research for Education: An Introduction to Theories and Methods. Pearson

Burns & Grove, 2003, Understanding Nursing Research. Third edition. Philadelphia: Saunders.

Feiner et al, 1997, A Touring Machine: Prototyping 3D Mobile Augmented Reality Systems for Exploring the Urban Environment (1997).

Kolter & Amstrong, Principles of Marketing, 14 Ed. Pearson Education

H., Leonard. Hoyle, Jr, CAE, CMP, 2002, Events Marketing: How to Successfully Promote Events, Festivals, Conventions, and Expositions. Wiley,2002.

Hevner, Alan & Chatterjee, Samir, 2010, Design Research in Information Systems: Theory and Practice. Springer,2010.

Mann, Steve & Starner et al, 1997, Wearable Computing: A First Step Toward Personal Imaging, Cybersquare Computer, Vol. 30, no2, 1997.

Miles & Hurberman, 1994, Qualitative Data Analysis: An Expanded Sourcebook. SAGE Publications, Jan 12, 1994.

Monette, DR., Sullivan, TJ,. De Jong, CR,. 2005, Applied Social Research: A Tool for the Human Services, 6th edition. Thomson Brooks/Cole, London.

Snieder, R & Larner, K, 2009, The Art of Being a Scientist: A Guide for Graduate Students and their Mentors, Cambridge University Press.

Simon. A., Herbert, 1996, The Sciences of the Artificial. MIT Press, Sep 26, 1996.

The international journal of virtual reality, 2010. IJVR,2010.

Tsichritzis. 1998. Electronic Commerce Objects. Geneva, Switzerland, University Of Geneva, 1998.

Sherman, William R. & B., Alan Craig, 2003, Understanding Virtual Reality: Interface, Application, and Design. San Francisco: Morgan Kaufmann.

Wang, Youncheng & Pizam, Abraham, 2011, Destination Marketing and Management: Theories and Applications. CABI, 2011.

Electronic References

ABI Research Center, 2014, Mobile Augmented Reality. https://www.abiresearch.com/market-research/product/1006117-mobile-augmented-reality/

ASI, November 10, 2008, A cost analysis of promotional products versus other advertising media. Available: http://www.promopros.net/ASI_Impressions_Study.pdf

Avestia Publishing, 2014, Journal of Multimedia Theory and Application: Drivers and Bottlenecks in the adoption of Augmented Reality Application. Available: http://jmta.avestia.com/2014/004.html

AR in Education and Training (April 2012). Available: http://www2.potsdam.edu/betrusak/566/Augmented%20Reality%20in%20Education.pdf

Azuma, Ronald T. (1997), A Survey of Augmented Reality. Available: http://www.mitpressjournals.org/userimages/ContentEditor/1332945956500/PRES_6-4_Azuma_web.pdf

BMW AR (2009). Available : http://www.youtube.com/watch?v=cTUJKvXIkSU

Bowes, Pitney (2012). Small Business Communication Benchmark Study; Available: http://www.pb.com/pdf/smb/Pitney_Bowes_Communications_Benchmarking_Study.pdf

Business Dictionary, 2014. Available: http://www.businessdictionary.com/

CIOL Bureau (2014, January 2). Top mobile marketing predictions for 2014: FunMobility. Available: http://www.ciol.com/ciol/news/205410/top-mobile-marketing-predictions-2014-funmobility

Definitions database, 2014. Available: http://whatis.techtarget.com/

Engine Creative, Augmented Reality Potentials. Available: http://www.enginecreative.co.uk/insights/unlocking-potential-augmented-reality

Fratrik, Mark, & Passwaiter, Steve (2013, June 19). Local Ad Dollars 2013 – What Business Categories are Spending and Where. Available: http://www.biakelsey.com/webinars/Local-Ad-Dollars-2013-What-Business-Categories-are-Spending-and-Where.pdf

H. Tobias & K. Steven (2004), Mobile Augmented Reality (Chapter Nine). Available: http://web.cs.wpi.edu/~gogo/courses/cs525H_2010f/papers/Hollerer_AR_2004.pdf

Juniper Research (2013); Mobile augmented reality. Available : http://www.juniperresearch.com/reports/mobile_augmented_reality

KattoCenter, 2014. Available: http://www.kattocenter.fi/fi/suomen-kattocenter/

Key, Matthew (2012). Engine Creative, Unlocking the Potential of Augmented Reality. Available: http://www.enginecreative.co.uk/insights/unlocking-potential-augmented-reality

Layar (August 2013); Facts & Figures: What the Market Says about Augmented Reality. Available: http://static.layar.com/web_documents/Facts_Figures_Layar_August_2013.pdf

Mobile Marketer (october 2013); augmented reality set for major growth: ABI Research. Available: http://www.mobilemarketer.com/cms/news/advertising/4475.html

Milgram, P and Kishimo, F. 1994. Augmented Reality: A class of displays on the reality-virtuality continuum. Available: http://web.cs.wpi.edu/~gogo/hive/papers/Milgram_Takemura_SPIE_1994.pdf

Qualcomm Vuforia, 2014. Available: https://developer.vuforia.com/resources/dev-guide/getting-started

Rajasekar, S. & Philominathan, P., (2013). Available: http://arxiv.org/pdf/physics/0601009.pdf

Reitmayr, Gerhard & Schmalstieg, Dieter, Mobile Collaborative Augmented Reality research. Available: http://ieeexplore.ieee.org.aineistot.phkk.fi/stamp/stamp.jsp?tp=&arnumber=970521

Souza, John (2014, January 3). Social Media Impact - The 2014 Definition of Mobile Marketing Explained. Available: http://socialmediaimpact.com/2014-definition-mobile-marketing-explained-mobile/

Silva R., Oliveira J.C. & Giraldi G.A., Introduction to Augmented Reality

Technopedia, 2014. Available: http://www.techopedia.com/definition/23586/mobile-device

The Economic Times. Available: http://economictimes.indiatimes.com/definition/advertising

van Krevelen, D.W.F. and R Poelman (2010); The International Journal of Virtual Reality: A survey of Augmented Reality Technologies, Applications and limitations. Available: http://kjcomps.6te.net/upload/paper1%20.pdf

VirtualBox AR (2009). Available: http://www.youtube.com/watch?v=tp0EyeXayNM

Warden, Chris. 2014. Available: http://www.convinceandconvert.com/mobile/7-mobile-marketing-stats-that-will-blow-your-mind/

Wagner, Daniel (2007, October 1st). Handheld Augmented Reality. Available: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.245.413&rep=rep1&type=pdf

Webopedia, 2014. Available: http://www.webopedia.com/

APPENDIX A - INTERVIEW PLAN

The present research uses semi-structured interviews as one of the main sources of data needed to carry out the research work. The interview will be conducted in KattoCenter's premise and with all the personnel chosen based on their roles inside the company. Most of the interviewees are roofing experts involved in customers' acquisition as well.

The interview will start with the interviewer and the interviewee presenting themselves to each other and the overall opinion of the interviewee about the software he tested will be collected (not more than 10 minutes). During the interview, a set of specific questions will be asked by the researcher and answered by the interviewee as describe below.

Interview questions

I. General Opinion

1. What do you think about this type of software?
2. Do you think it can be useful in this business context?
3. Do you have anything else you would like to see from this solution?

II. Customers' acquisition and decision making process

1. How the company does acquire new Customers?
2. How do customers choose colors for their renovation?
3. What are the supports' means offer by the company to customers in their decision making processes for this service?
4. Can you describe the decision process for previous customers when they wanted to order this service?
5. Do you think this software can improve the decision making process of potentials customers?

APPENDIX B - ONLINE SURVEY

Available:
https://docs.google.com/forms/d/1ZdSkdEquhZqS5hggFYkZK5KagnxDP-9WFbxUje9YKk4/viewform?usp=send_form