

City University London

**Software Engineering
Final Year Project Report**

Academic Year: 2018-19

AR Interior Design App

By

Juan Armond

Tel. 075 1578-9552

Email: juan.armond@city.ac.uk

Project supervisor: Dr. Ross Paterson

[Table of Contents](#)

Abstract.....	4
Acknowledgements.....	5
Chapter 1 – Introduction	6
1.1 Project Overview	6
1.2 Problem to be Solved	6
1.3 Project Objectives	6
1.3.1 Project Objectives	7
1.3.1.1 Database	7
1.3.1.2 Scan and Detect Objects	7
1.3.1.3 Add 3D Objects	7
1.4 Applied Efforts for Objectives Completion	8
1.4.1 iOS Application	8
1.4.2 Scan and Detect Objects	8
1.4.3 Add 3D Objects	8
1.5 Project Beneficiaries.....	9
1.6 Report Summary	9
1.7 Summary of Chapter 1	9
Chapter 2 – Outputs Summary.....	10
2.1 Software Requirements Analysis Document	10
2.2 Swift Source Code	10
2.3 iOS Application	10
2.5 Summary of Chapter 2	10
Chapter 3 – Literature Review	11
3.1 Analysis of Existing Software.....	11
3.2 Project Planning and Design	12
3.3 Tools and Libraries for Development.....	12
3.3.1 Apple’s Developer Tools.....	12
3.3.4 Firebase SDK	12
3.3.5 SimplePDF API	13
3.3.6 CocoaPods	13
3.4 Third Party Resources	13
3.4.1 YouTube.....	13
3.4.2 Stack Overflow	13
3.5 Summary of Chapter 3	13
Chapter 4 – Method	14
4.1 Scrum Methodology.....	14
4.1.1 Pre-Game Phase	14
4.1.1.1 Planning	15
4.1.1.2 High-Level Design / Architecture.....	15
4.1.2 Development Phase	16
4.1.2.1 Sprint Backlog List	16
4.1.2.2 Sprints	17
4.1.3 Post-Game Phase	20
4.2 Summary of Chapter 4	21
Chapter 5 – Results	22
5.1 Pre-Game Phase.....	22
5.1.1 Interview.....	22
5.2 Development Phase	23
5.2.1 Firebase Database	23
5.2.2 Scan, Detect and Add 3D Object	24
5.2.3 User Interfaces with Navigability	25

5.2.4	Welcome Page Create Account, Login, Upload User Avatar and 3D Object file.....	26
5.2.5	Browser, Refresh and Search/Filter Products List.....	27
5.2.6	Save and Share Photo.....	28
5.2.7	Download Progression Bar	28
5.2.8	Shopping List	29
5.2.9	PDF Invoice Generator	30
5.2.10	Popup Messages	30
5.3	Post-Game Phase	31
5.3.1	Task Scenarios	32
5.3.2	Usability Questionnaire	33
5.3.3	Evaluation Results	33
5.3.3.1	Privacy.....	33
5.3.3.2	Simplicity.....	34
5.3.3.3	Technical Impact.....	37
5.3.3.4	Free Form Question	40
5.4	Summary of Chapter 5	40
Chapter 6 – Conclusion and Discussion	41	
6.1	Project Objectives	41
6.1.1	Database.....	41
6.1.2	Scan and Detect Objects	41
6.1.3	Add 3D Objects.....	42
6.2	Future Work	42
6.2.1	Apple's App Store	42
6.2.2	Capitalize	42
6.2.3	Support for Android Platform	43
6.3	Knowledge Gained	43
6.4	Project Management and Control	43
6.5	Conclusion	43
Glossary.....	45	
References.....	46	
Appendix A – PDD	49	
Appendix B – Code Lines	67	
Appendix C – Software Requirements Analysis Document.....	68	
Appendix D – Gantt Chart.....	83	
Appendix E – Feedback Reports.....	84	
Appendix F – Agile Methods	116	

Abstract

The purpose of this project was to successfully implement an open platform concept to customers, professionals and decoration companies. That will allow customers to scan, detect 3D objects and place them into the real world by using AR technology.

The application was created to solve the current problem whereby customers needed to go into showrooms and try to imagine how each furniture would fit into their houses. The application built by the author attempt to solve the problem by creating an augmented reality application which allows customers to insert furniture that looks lifelike into their homes before buying the actual furniture. Also, decoration companies and professionals will be able to promote their collection and services. The following documentation will discuss in more detail how the author carried out the different phases involved in carrying out a project of this scope.

Acknowledgements

Prima facie, I am grateful to the Lord our God for the strength, persistence and comfort that were necessary to complete this dissertation.

I would like to express my sincere gratitude to my supervisor Dr. Ross Paterson for the constant encouragement and support throughout the project. The meetings permitted me to not only make a continuous improvement with the project but also negated having to reconsider sections at later dates.

I place on record, my sincere thankfulness to Aravin Naren, Teaching Support Team Leader of the Department of Computer Science, for the continuous encouragement.

I am also grateful to Remilekun Basaru, colleague, in the Department of Computer Science. I am extremely thankful and indebted to him for sharing expertise, and sincere and valuable guidance and encouragement extended to me.

Furthermore, I appreciate all the assistance from Kiranjit Singh Jorge Dogva Ferre in proofreading my final year project report.

Finally, I must express my very profound gratitude to my parents Luis Armond, Lucinea Armond, to my wife Vanessa Armond and my daughters Giovanna and Rafaella Armond for providing me with unfailing support and continuous encouragement throughout my years of study and through the process of researching and writing this project report. This accomplishment would not have been possible without them. Thank you.

Author.

Juan Armond.

Chapter 1 – Introduction

The AR Interior Design project involved creating an open platform application for the iOS platform [1]. This chapter of the report gives an overview of the project to the reader containing the reasons behind the project and the original problem that the author wished to solve. It also clarifies the project's objectives, the beneficiaries of the project and a short review of the upcoming chapters.

1.1 Project Overview

The project involved creating an iOS application that would allow customers to scan, detect and place 3D objects into the real world by using augmented reality (AR) technology. The project was also undertaken to allow decoration companies and professionals to publicize their collection and services. Successful deployment of the concept application would allow customers to scan 3D objects and see their description and price, contact professionals and decoration companies directly.

1.2 Problem to be Solved

According to 2016 Government statistics, 8,390 companies contributed £11.3 billion to the country's GDP (7.6% up on the previous year), £8.4 billion of this is from UK furniture manufacturing, which equated to 1.6% of manufacturing output. There were 150,000 in specialist furniture and furnishings retail and wholesale, 3,000 in repair, plus a proportion of the 52,000 registered specialist designers. Consumer expenditure on furniture and furnishings in 2016 reached £16.7 billion [2].

Considering this vast market, I identified two problems; Firstly, consumers had a lack of seeing how the furniture fitted in their homes before buying the product. Now days currently, customers go to showrooms and try to imagine how each furniture would fit into their houses. Secondly, companies and professionals have big difficulties to promote their products and services in this competitive market.

The motivation about this project was to make use of augmented reality technology to create an application that connected customers to companies and professionals. Also, to create a completely new shopping experience, by allowing customers to design their homes before buying the actual product. Currently, there is nothing similar to which is being proposed by the author available to users on the Apple Store. There were few applications that offered similar functionality available to users as discussed further in this report, which was not open to other decoration companies or used the augmented reality technology.

1.3 Project Objectives

This part of the chapter gives the reader the objectives that were outlined prior to beginning the implementation of the application. Firstly, taken from the Project Definition Document (PDD), some

modifications have been made to further improve them to suitable the requirements of the end user after multiple discussions. The full PDD has been included with this report in [Appendix A](#).

1.3.1 Project Objectives

The fundamental primary objectives of the project were to:

"Design and build a mobile application for the iOS platform that would permit customers to scan and identify and place 3D objects into the real world by using AR technology. Also, decoration companies and professionals will be able to promote their collection and services."

1.3.1.1 Database

To accomplish the main objective of the project, it was necessary to implement an account creation and management system. Making all users of the application able to register an account with their details and to login/logout securely. Also, it is important to manage the upload and download of image files.

1.3.1.2 Scan and Detect Objects

The implementation of the scanning and detecting 3D objects from the real world made use of Apple's ARKit 2 library to create a data map file of the object [\[3\]](#). This was intended to create a new shopping experience for the customers. Customers could go to showrooms and use the AR Interior Design app to scan and detect furniture to display information about that specific furniture.

1.3.1.3 Add 3D Objects

The implementation of adding lookalike furniture as 3D objects into the real world was the essential feature that gave a great experience to customers. This feature also made use of Apple's ARKit 2 library. This was intended to be the most fascinating aspect of the AR Interior Design app. The insertion of 3D furniture into the customer's room simulates the insertion of the actual furniture's dimensions into the desired space. That immersed the user into a new sense of reality. This project objective also introduced the need to implement different types of features.

- Search / Filter – All customers could start typing the product name in the search bar and the app would automatically filter and search for the correspondent item from the database.
- Pop Up Messages – The app displayed different types of quick messages to help users, like inputting the wrong username and/or password, adding items to the shopping list, etc. This will be covered in more details in chapter 4 and 5.

- Download Bar / Percent numbers – After customers selected the product which they wanted to “add” into the real world, the app would display a download bar and percentage numbers that will increase conform the download progresses.
- Photos / Share – After customers had created a completely new interior design they could save and/or share that picture. Interior design could use these pictures to promote their services to all customers.
- Shopping List – Customers were able to add/remove item/s from the shopping list.
- PDF Invoice – After customers added items to the shopping list, they could generate a PDF invoice and send it to the company.

1.4 Applied Efforts for Objectives Completion

Objectives were divided into three different types in order to outline the work performed to meet the project objectives as follows:

1.4.1 iOS Application

Completion of this objective was accomplished by implementing the connection with the database called Firebase [4]. This was done by researching documentation and installing the Firebase API. This involved storing the data correctly, by dividing the data into two different categories: images and strings. Images were stored in the Firebase Storage and strings were to in the Firebase Database. The achievement of this objective could be measured by creating a user and log in. All the user details were saved including their avatar.

1.4.2 Scan and Detect Objects

Completion of this objective was accomplished by implementing the pattern recognition of each 3D object. This was done effectively through research the documentation and the on existing apps that used Apple’s ARKit 2 library. This also involved constantly adjusting parameters to allow for the accuracy of detecting the object. The achievement of this objective could be measured by determining if the AR was displaying the correct information relating to the furniture which was scanned.

1.4.3 Add 3D Objects

Completion of this objective was accomplished by implementing the capacity to render a 3D object. Similarly, to the previous objective, this required the research of existing apps that used Apple’s ARKit 2 library and its documentation. Also, additional modifications were needed in all parts to create a seamless viewing of the 3D object into the real world. The achievement of this objective could be measured by determining if the AR was displaying the 3D furniture into the real word. To complete

the different features required the research of the Swift library documentation and involved adding and editing the different constraints to visualize all the information correctly on the iPhone screen. This could be measured by feedback received through users of the AR Interior Design app.

1.5 Project Beneficiaries

The outcome of this project would benefit consumers, decoration companies and professionals. The AR Interior Design app would engage consumers through the use of augmented reality technology which would increase the revenue of both, decoration companies and professionals. Consumers would benefit from a completely new shopping experience by seeing how a piece of furniture would fit into their rooms before buying it. Decoration companies and professionals would have an additional platform to advertise their products and services.

1.6 Report Summary

Chapter	Description
1. Introduction	It is a brief introduction of the project describing the problem, challenges and the motivation underlying this project. Also, it provides an explanation of all the project's objectives and the outlining of the work accomplished to meet these objectives.
2. Output Summary	A list of outputs produced in the development of the project's conception. This includes the type of output, a summary description, usage, beneficiary and a link to the corresponding output in the Appendix.
3. Literature Review	A review of important literature undertaken to support the accomplishment of the project. Also, it provides the corresponding full and correct citations to the documents read.
4. Method	Method in which project packages were undertaken. It describes all the requirement analysis, design, implementation, test and delivery process of the project in details.
5. Results	Detailed all the results that were produced while undertaken each method described in the previous chapter.
6. Conclusion & Discussion	An evaluation of the project's achievement, future work opportunities and considerations.
Glossary	Specialist language used within the report's main text.
Reference	Citations of external sources used.
Appendices	Supplementary material relevant to the project.

Table 1 Report Summary

1.7 Summary of Chapter 1

Chapter 1 gives a concise introduction to this project and summarises what the readers should expect in the rest of this report. It included the description of the problem, the project objectives, beneficiaries of the project and a summary of the report.

Chapter 2 – Outputs Summary

This chapter specifies all the outputs of the project, with their overview description, usage, beneficiary and link. The project's primary output will take the form of an iOS application that will provide an open platform to customers, professionals and decoration companies, to virtually place furniture in their space, promote their services and products. Presented on table format from 2.1 to 2.4.

2.1 Software Requirements Analysis Document

Description	This is a software requirements document for the AR Interior Design Concept project and uses user story cards to cover the requirements with the various implementation constraints defined in the initial interview with from the end users.
Usage	This document was carefully and repeatedly used by the author to guide the project in the appropriate direction.
Beneficiary	Project Supervisor and Author.
Link	Appendix C.

Table 2.1 Software Requirements Analysis Document

2.2 Swift Source Code

Description	Source code. The total number of lines of swift code is 1988, of which 1933 were written by me and 55 were re-used. This was viewed and counted by executing a specific command in Terminal inside of my XCode project folder.
Usage	Swift source code used to implement all functionality on the application and presentation layer. Also, it handles data manipulation from the database to it being exhibited on the user's device.
Beneficiary	Project Supervisor and Author.
Link	Source Code at Moodle and Total Number Lines at Appendix B.

Table 2.2 Swift Source Code

2.3 iOS Application

Description	Successful implementation of the project will generate a compiled application that can be uploaded to Apple's App Store and consequently downloaded on iOS platforms.
Usage	Project Supervisor and Author.
Beneficiary	Customers, Interior Designs, Decorations companies and other professionals.
Link	USB.

Table 2.3 iOS Application

2.5 Summary of Chapter 2

Chapter 2 specified all the outputs of the project, Software Requirements, Swift Source Code and iOS Application which included the overview description, intended recipients, how the recipients would use the output and benefit from it and the link which can be found it.

Chapter 3 – Literature Review

This chapter documents the research conducted during the development phase of the project. The author analysed the existing software and was required to be familiar with the iOS environment, tools (XCode) and programming language (Swift) available. The researched various sources used to support each phase of the project lifecycle and intended to explain the reason behind the chosen approach for the project to be successful.

3.1 Analysis of Existing Software

Was researched applications that already existed on Apple's AppStore and offered comparable functionalities to what the project aimed for. Below is an overview of two applications.

IKEA Place lets users to virtually 'place' IKEA's products in their space. The app included 3D and true-to-scale models of every furniture that IKEA sells. This app gave an accurate impression of the furniture's size, design and functionality into the users' home. Though the application offered many advanced features, it was a closed platform to only advertise and sell IKEA products. In contrast with my project that would be an open platform concept that allowed more than one company to add and sell their collection [\[5\]](#).

Houzz helped users to decorate their house and also connect users with architects, builders, interior designers and repair professionals. Users could browse millions of furniture photos, find and hire professionals and read articles from editorial staff and design experts [\[6\]](#).

The main difference between Houzz and my platform was the AR technology, Houzz only uses high-quality images. Unfortunately, these images did not give the same experience as 3D images.

Table 3 below, displays a comparison of two applications which are available on Apple's AppStore that offer similar functionality to that of AR Interior Design application. The AR Interior Design column of the table indicates whether the author desired to include these functions in the application.

Features	IKEA Place	Houzz	AR Interior Design
User Account	-	X	Expected
Different Types of Users	-	X	Expected
Browse Collection	X	X	Expected
Search Item	X	X	Expected
3D Object Augment Reality	X	-	Expected
Scan and Detect Object	-	-	Expected
User Avatar	-	X	Expected
Upload 3D Object file	-	-	Expected
Shopping List	X	X	Expected
Save and Share	X	X	Expected
Generate PDF Invoice	-	-	Expected
Download Bar Progression	-	-	Expected

Table 3 Tabular Comparison of Existing Software

As shown in table 3, Ikea Place lacked the features to a create user account, type of users, scan and detect an object, user avatar, upload 3D object file, generate PDF invoice and displaying a download bar progression. Houzz had the feature to create a user account, different types of users, user avatar but unfortunately, don't have the option to visualize and upload 3D objects, generate PDF invoice and display download bar progression. However, AR Interior Design was expected to include all the Ikea and Houzz features plus the features that they did not have.

3.2 Project Planning and Design

Project planning and design followed the agile development methodology. Information on this methodology was gained through the book Agile Software Development Methods [7]. This literature provided a very thorough explanation on the different types of agile methods and how each stage worked (process, role and responsibilities, practices, adoption and experiences, the scope of use and current research). Some existing agile methods that this book explained can be seen in [Appendix F](#).

3.3 Tools and Libraries for Development

These are all the tools and libraries used for the successful development of this project.

3.3.1 Apple's Developer Tools

The XCode was the only Integrated Development Environment (IDE) to develop an iOS application. Now in version 10, XCode offers all the required functionality to design applications for Apple's ecosystem [8]. iOS applications can be developed by two programming languages, Object C or Swift. Swift was chosen because of the close resemblance to natural English, thus making it easier to read and debug any errors that may occur. Swift required less code and was faster to compile when in comparison to Object C, all of which would decrease the overall size of the application. Writing Swift code was interactive and fun, the syntax is concise yet expressive, and Swift includes modern features developers love. Swift code is safe by design, yet also produces software that ran lightning-fast [9]. The iOS Developer library offered developers reference documents that covered all their operation systems (OS) and pre-existing libraries. Additionally, it offered sample code for all libraries and frameworks and guides on how to make use of them within your own application. The site also presented design documents consisting of constraints and styles that needed to be kept and followed for the application to be approved and consequently released on the App Store [10].

3.3.4 Firebase SDK

The Firebase Real-time Database consisted of a cloud-hosted database. Data was stored as JSON and synchronized in real time to every connected client. When you built cross-platform apps with iOS,

Android, and JavaScript SDKs, all of your clients shared one Real-time Database instance and automatically receive updates with the newest data.

3.3.5 SimplePDF API

SimplePDF was a wrapper of UIGraphics PDF context written in Swift that could add texts, images, spaces, lines, tables, set up a page layout and adjust the content alignment to generate PDF files [\[11\]](#).

3.3.6 CocoaPods

CocoaPods managed library dependencies for XCode projects. It had over fifty-eight thousand libraries and was used in over three million apps. The project's dependencies were specified in a single text file called a Podfile. CocoaPods would resolve dependencies between libraries, fetch the resulting source code, then link it together in an XCode workspace to build the project. CocoaPods was used to install the Firebase SDK and SimplePDF [\[12\]](#).

3.4 Third Party Resources

These are all the third-party resources used to assist in the development of this project.

3.4.1 YouTube

YouTube owned by Google, was the first large-scale video sharing site on the Web, and it is available in nearly every country and in over fifty different languages. They have an extensive list of channels that helped me to learn XCode, Swift and Firebase. These channels contain step by step video tutorials along with the full code [\[13\]](#).

3.4.2 Stack Overflow

Stack Overflow was a forum community website where a user can search, post and respond to a variety of questions regarding software development. They had an extensive collection of pre-existing questions about Swift, XCode and Firebase that had been responded by different users. This forum site was a valuable resource through the project [\[14\]](#).

3.5 Summary of Chapter 3

Chapter 3 summarises the literature research that was conducted to develop this project which helped to form this chapter. It analysed the existing software and included a tabular comparison of the existing software and the AR Interiors Design. The development methodology, the programming language, specific tools and libraries were chosen and defined to support the author to start the project lifecycle.

Chapter 4 – Method

This chapter aims to give a detailed overview of the project lifecycle, from initial analysis to finalizing and evaluating the application. It explains the techniques used to analyse, design, implement and test the application.

4.1 Scrum Methodology

Scrum was chosen because it is simple, straightforward and easy to implement. It is a mature development methodology and project management. This methodology embodies frequent iterations (sprints) and continuous feedback, which helped to make sure that the delivered end product achieved the user requirements. Also, has the capability to change requirements quickly, which ensure the project was not delayed. These peculiar characteristics could be easily applied to this project making simple to divide the amount of workload with sprints and delivering the product on time. The following are the three phases of Scrum development in relation to the project.

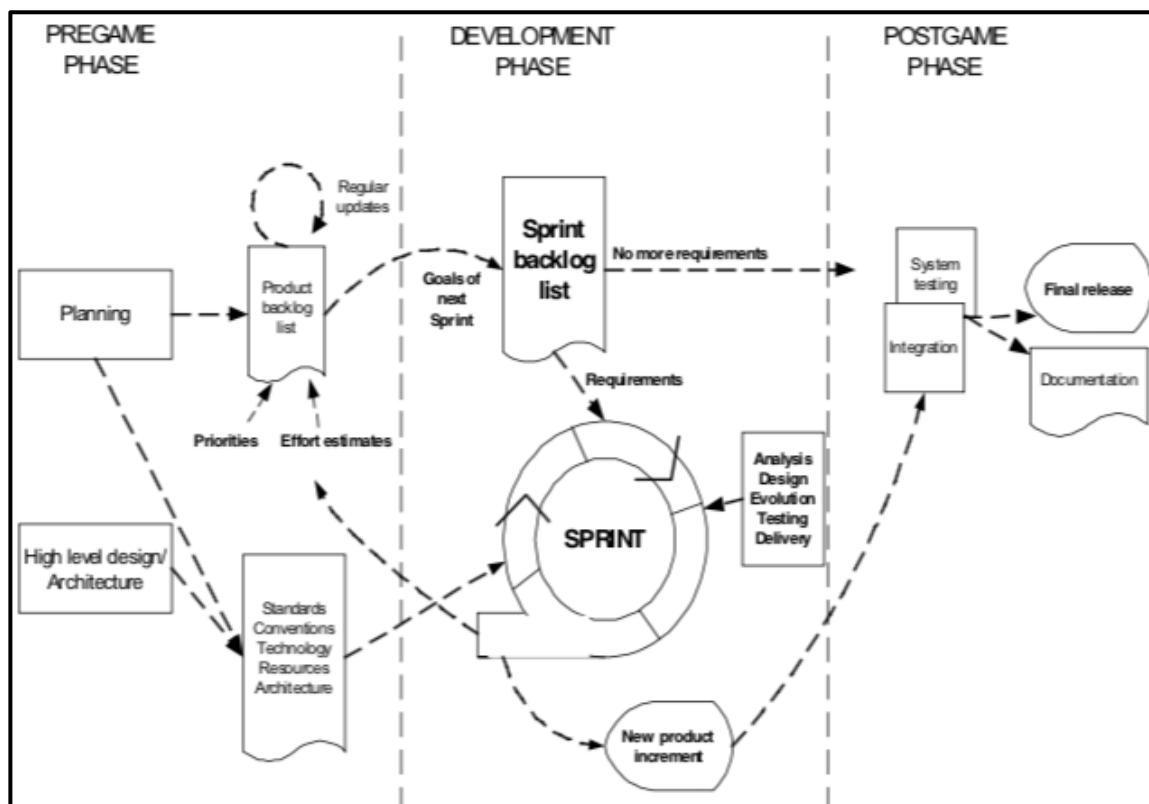


Figure 1 Illustration of The Process of Scrum

4.1.1 Pre-Game Phase

The Pre-game phase includes two sub-phases: Planning and Architecture/High-level design.

4.1.1.1 Planning

The planning of the project occurred in the early stages of the project which was stated in the Project Definition Document see at [Appendix A](#). The Product Backlog list was originated from an initial discussion with end users' as customers, professionals and manager of decoration company called Sofa and More. This list contains all the requirements that were currently known. A work plan list was produced based on the prioritized requirements and the assessed effort required for their implementation. The Product Backlog list was constantly updated with new and more detailed items, as well as the Gantt Chart attached with more accurate estimations and new priority orders, which can be seen see at [Appendix D](#). The work plan also includes the definition of the tool (XCode) and other resources (APIs), training needs (learn a new language - Swift) and different types of user interfaces and feature sets.

4.1.1.2 High-Level Design / Architecture

The high-level design of the system was planned based on the items in the Product Backlog. This will be useful in the future to allow the application for scalability in the sense another version (Android) can be developed at later phases if required by designing a new front end at the same time as making use of the pre-existent back end.

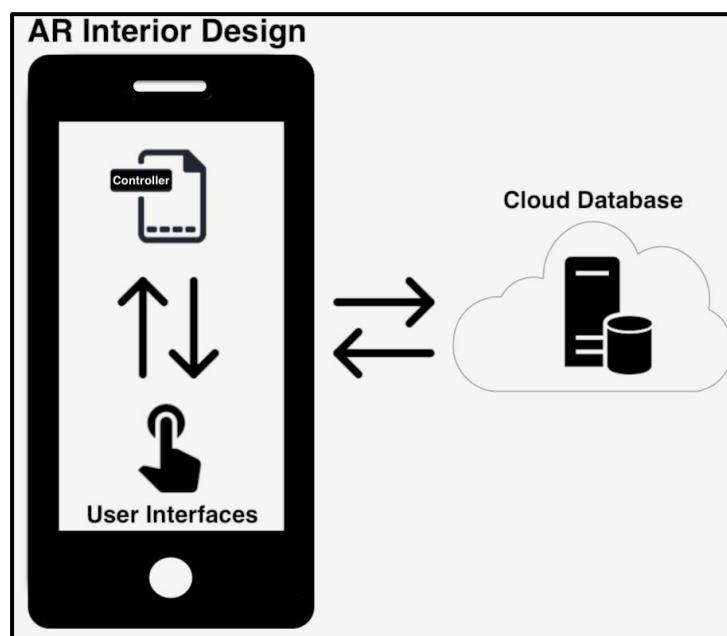


Figure 2 Illustration of AR Interior Design High-Level Design

Figure 2 shows the high-level design of the AR Interior Design app. It has three components: User Interfaces, Controller and Cloud Database. The user interfaces main purpose is to translate the tasks of the controller into something that the user can easily understand and present options for the user to interact within the application. These options are buttons, text fields, shopping list, search items, swapping up, down or left, etc. We can see that the user interacts with the app by touching the user

interface. The controller, which was implemented using swift programme language, contains the functional business logic decisions which process the application's core commands. These core commands are executing the user interaction through the user interface, download, upload images and retrieving products and user details from the cloud dates. The controller moves and process data between the user interface and cloud database. The cloud database stores all the data for the application to execute and function. For AR Interior Design this comes in the Firebase Real-time Database. Image, product and/or user data is inquired by the controller and passed back and forward before eventually delivery to the user interface to display users. The user interfaces is a layer that communicates with the controller and vice versa.

4.1.2 Development Phase

The development phase of the system was developed in sprints. Sprint Backlog is the starting point for each sprint. It is a list of Product Backlog items that were selected, prioritised and goals set for next sprint. Sprints are iterative cycles where the functionality is developed or improved to produce new additions. Taking into consideration, the size of the project and the time constraints in place, each sprint was planned to last from one day to maximum one week and includes the traditional phases of software development: requirements analysis, design, implementation, test and delivery.

4.1.2.1 Sprint Backlog List

Sprint Backlog List				
Sprint	Story ID	User Story Card	Duration Day	Priority
1	15	As an application, I need to connect to database	1	High
2	4	As a customer, I need to virtually 'place' a decoration item in 'my' room.	3	High
	6	As a customer, I need to scan and detect a decoration item.	3	High
3	16	As an authorized user, I need to navigate through the user interfaces.	2	Medium
4	1	As an unauthorized user, I need to register for a new account.	1	High
	2	As an unauthorized user, I need to login and access the options related to my privileges.	1	High
	8	As an authorized user, I need to save my avatar.	1	Medium
	9	As a decoration company/professional, I need to upload a 3D image.	1	High
5	3	As an authorized user, I need to browse all the decoration collection.	1/2	High
	10	As a customer, I need to search/filter for a product.	1/2	Medium

6	5	As a customer, I need to save a photo.	1/2	Low
	7	As a customer, I need to share a photo.		
7	11	As an authorized user, I need to visualise the download progression of the 3D object.	1	Low
8	12	As a customer, I need to create a shopping list.	1	High
9	14	As a customer, I need an invoice.	1	High
10	13	As an authorized user, I need to pop up messages.	1	Low

Table 4 Sprint Backlog List

At this stage all the user story cards were produced and added together to the analysis and requirements document with a complete design (Storyboard) that can be found in [Appendix C](#). Story cards were a very high-level definition of a requirement, which included ID number, As a (role) I need (desire/goal), So that (receive benefit) and Acceptance Criteria (when testing the story card that should have been the expected result to passes the test) so that the developers could implement and test it later to see if it offered all of the agreed functionality with potential end users. The Storyboard was a visual representation of the user interface of the iOS application, showing screens of content and the connections between them. A Storyboard was composed of a sequence of scenes, each of which represented a view controller and its views; scenes were connected by segue objects, which represented a transition between two view controllers [\[15\]](#).

4.1.2.2 Sprints

1. Sprint |Story Card 15| – The CocoaPods was installed to manage all the libraries' projects dependencies. The Firebase API was installed through the CocoaPods, so the app could connect to the Firebase database. After following the Firebase documentation [\[16\]](#), the Google project called AR Interior Design was created and associated with the XCode project. To initiate Firebase into AR Interior Design, Firebase was imported and the configure method was used into the Swift code. The test can be found in [Appendix C](#), under the section Agile User Story Cards Figure 16 – with the application running, the Firebase console showed one active user.
2. Sprint |Story Cards 4 and 6| – The main features scan, detect and add a 3D object into the real world were implemented by using Apple's ARKit 2 API. After following the ARKit 2 documentation, ARKit library was imported and used the related methods to scan and detect, add a 3D object. However, one problem occurred when downloading the 3D object file. That file couldn't be found. This problem was overcome by researching the Stack Overflow forum [\[17\]](#). The test can be found in [Appendix C](#), under the section Agile User Story Cards Figures 5 and 7 – with the application running, it was able to download and insert a 3D object file into the real world and was able to recognize a previously scanned object and display the corresponding information.

3. Sprint |Story Card 16| – All users interfaces with the necessary navigability between them were implemented. These included, welcome, sign up, sign in, profile, company account, try AR, try Scan, item library, item description, shopping list and a thank for shopping. The method segue was used to define the flow between each user interfaces. The test can be found in [Appendix C](#), under the section Agile User Story Cards Figure 17 – with the application running, navigability between all the user interfaces as mention above (go forward and back), images were loading and the correct validation to each text field.
4. Sprint |Story Cards 1, 2, 8 and 9| – The create a welcome, account, login, upload the user avatar and the 3D object file were implemented. After following the Firebase Cloud Firestore documentation [\[18\]](#) to read and write data from the database and Firebase Storage [\[19\]](#) to upload files to on iOS, the author initializes both libraries and inserted the correct methods so the application could save the user details and upload the user avatar and 3D object file. I had a problem when downloading the user avatar, the picture came upside down. After researching, I found that Apple's iPhone saves all images with EXIF data information to rotate the image to be displayed correctly. But when uploading the file to Firebase storage, the image was uploaded without the EXIF data information. This problem was overcome by reusing code that rotated the picture before uploading it to Firebase. The test can be found in [Appendix C](#), under the section Agile User Story Cards Figures 2, 3, 9 and 10 – with the application running, the welcome page shows up, the user details were created and stored in the database. That user was able to login by using his details and go to the related page (as a customer after logging in to browse decoration collection, as a decoration company/professional the ability to insert the products details, upload and download 3D object files). Also, the entries in both Firebase Cloud Firestore and Storage were manually checked.
5. Sprint |Story Cards 3 and 10| –The search/filter, refresh and browse all products were implemented. A method was code to retrieve all 3D object files name, sort and store them in a dictionary. This list was displayed as a table. By inserting a complete word or just a letter into the search bar, the code started to narrow down all the products names and showed only the products that matched in the table. Also, the ability to swipe down to get new items from the database by using the user interface refresh control was implemented. The test can be found in [Appendix C](#), under the section Agile User Story Cards Figures 4 and 11 – with the application running and, in the products list, was able to start typing in the search bar and the list started to get short every time another character was added. Also, one product was manually added to the database and by swiping down the application was able to refresh and show all items plus the new item.

Sprints one to five were successfully implemented the application's connection with the database, the AR features to scan and detect, virtually add 3D objects, all the interfaces needed with their navigability, create a user account with their specific type, avatar and their login access. Figures 3 below shows the implementation code of adding a 3D object into the real world.

```
func previewController(_ controller: QLPreviewController, previewItemAt index: Int) -> QLPreviewItem {
    let documentsURL = FileManager.default.urls(for: .documentDirectory, in: .userDomainMask).first!
    let fileURL = documentsURL.appendingPathComponent("picture.usdz")
    return fileURL as QLPreviewItem
}
```

Figure 3 Add 3D Object Code

```
func renderer(_ renderer: SCNSceneRenderer, nodeFor anchor: ARAnchor) -> SCNNode? {
    let node = SCNNode()

    if let objectAnchor = anchor as? ARObjectAnchor {
        let plane = SCNPlane(width: CGFloat(objectAnchor.referenceObject.extent.x * 0.8), height: CGFloat(objectAnchor.referenceObject.extent.y * 0.5))

        plane.cornerRadius = plane.width / 8

        let spriteKitScene = SKScene(fileNamed: "ProductInfo")

        plane.firstMaterial?.diffuse.contents = spriteKitScene
        plane.firstMaterial?.isDoubleSided = true
        plane.firstMaterial?.diffuse.contentsTransform = SCNMatrix4Translate(SCNMatrix4MakeScale(1, -1, 1),
            0, 1, 0)

        let planeNode = SCNNode(geometry: plane)
        planeNode.position = SCNVector3Make(objectAnchor.referenceObject.center.x,
            objectAnchor.referenceObject.center.y + 0.2, objectAnchor.referenceObject.center.z)

        node.addChildNode(planeNode)
    }

    return node
}
```

Figure 4 Scan and Detect Code

Figure 4 above shows the implementation code of the scan and detecting of a real object from the real world.

6. Sprint |Story Cards 5 and 7| –the ability to save a photo of a 3D object in their desired place like in their phone photo library and share it without leaving the application was implemented. After reading the Quick Look preview documentation [\[20\]](#) from Apple's Swift library, the method QLPreviewController to save a photo and share it on social media was used. The test can be found in [Appendix C](#), under the section Agile User Story Cards Figures 6 and 8 – with the application running and after selecting the 3D object, was able to take a picture and save into the photo library and/or share it on social media without leaving the app.
7. Sprint |Story Card 11| – A download progression bar was implemented. The user interfaces progress view from Apple's Swift library was used and the method downloadTaks.observe from the Firebase Storage library was called. This method allows on to observe the download file and translate it into a percentage which was used to fill the download bar every time it increased. The test can be found in [Appendix C](#), under the section Agile User Story Cards Figure 12 – with the application running and after selecting the 3D object, the progression bar got darker relative to the download percentage of the file.

8. Sprint |Story Card 12| – A shopping list to hold the selected items and to remove these items was implemented. The selected item was saved into a dictionary and showed in a table view. Also, the ability to swipe left to delete a row from the shopping list was enable. The test can be found in [Appendix C](#), under the section Agile User Story Cards Figure 13 – with the application running, all selected items were shown in the shopping list and removed by swiping left.
9. Sprint |Story Card 14| – A PDF invoice generator from the shopping list was implemented. The SimplePDF library was added and the respective methods were used to set paper size, name, insert name, company details and logo and items from the shopping list to generate PDF. The test can be found in [Appendix C](#), under the section Agile User Story Cards Figure 15 – with the application running and the generate PDF invoice selected after having selected to buy the shopping list items, all the items were shown in the PDF invoice and displayed by Quick Look Preview to be saved and/or shared.
10. Sprint |Story Card 13| – Different types of Popup Messages was implemented. These were the popup messages; wrong username and/or password, creating an account without filling all the relevant fields, creating an account with an email address which is already in the database, confirming that an item was added to shopping list, updating item quantity in the shopping list, checking an empty shopping list, trying to add a duplicate item into the shopping list, automatically displaying the total price of shopping list, uploading a product which is already in the database, uploading a product without filling all the fields and terms and conditions description. The user interface alert controller from Swift library was used. The test can be found in [Appendix C](#), under the section Agile User Story Cards Figure 14 – inputting wrong username and/or password, no item selected and trying to go to the shopping list, selecting an item to be added to the shopping list, selecting the item that was already in the shopping list, updating item quantity, creating an account with an email address already in the database, creating account with blank fields, uploading a product with blank fields, uploading a product that is already in the database and terms and conditions description.

Sprint six to ten were successfully implemented the ability to save and share a photo, displaying the download bar progression, shopping list, PDF invoice and the different types of popup messages. After passing each test, the function was delivered and was moved to the next item in the Sprint Backlog list. This was repeated until all the items in the list were implemented. In total, were ten sprints consisting of eight to ten working hours before the system was ready for “distribution”.

4.1.3 Post-Game Phase

This phase was entered when all items in the list were completed and no issues could be found, nor new items could be added to the list. All the functions were integrated into the application and a

system test was agreed with a decoration company called Sofa and More. This test was conducted with eleven end-users, classified as customers, interior designers and the manager of the Sofa and More, and involved using the application to carry out scenarios and also answering the usability questionnaire. This group of end-users were aged from 20 to 55 years old, all of them knew how to use a smartphone but had never heard about augmented reality which covers all the potential future users of this application. Firstly, what augmented reality and how this interactive experience with computer generated furniture could reside in the real world was explained, and then the consent form which they needed to agree before taking part in the test was signed and finally, the questionnaire, showing in Figure 5 below, that need to be answered after using the AR Interior Design application. These answers were then gathered together and evaluated in chapter 5 Results in order to provide an overall successfullness score for the project. After passing the final test the AR Interior Design was ready to be released.

Consent Form <p>Consent form for testing AR Interior Design Concept – Mobile Application</p> <p>I _____ agree to take part in the above-named City University final year project.</p> <p>The project has been fully explained to me and understands both the information given to me by the individual carrying out the research and the information sheet which I am able to keep for future records.</p> <p>I understand that I may be required to:</p> <ul style="list-style-type: none"> • Complete questionnaires asking about my experiences with the application along with potential changes I could suggest. • Make use of a provided iPhone to run the application on. • Make myself available for future interviews should it be a requirement. <p>Furthermore, I understand that any information I provide will be used for the purposes of improving the final build for the project and submitted as part of the final write-up of the project.</p> <p>I also understand that any material that is not required for submission will be confidentially disposed of at the end of the project.</p> <p>I understand that my participation is voluntary and that I have the option to withdraw at any given time and that the whole process will be run under the obligations set out by the Data Protection Act 1998.</p> <p>Participant Name: _____</p>	Questionnaire <p>User: _____ Date: _____</p> <p>Please complete the following questionnaire by placing a cross <input checked="" type="checkbox"/> in the appropriate box.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"></th> <th style="text-align: center;">Strongly Agree</th> <th style="text-align: center;">Agree</th> <th style="text-align: center;">Uncertain / Not Sure</th> <th style="text-align: center;">Disagree</th> <th style="text-align: center;">Strongly Disagree</th> </tr> </thead> <tbody> <tr> <td>1. I found the application permission requests (use the mobile camera) reasonable.</td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td>2. I found the sign-up process simple.</td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td>3. I found the login process to be fast.</td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td>4. I found the user interface to be intuitive.</td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td>5. I could find the information I am looking for with minimal effort.</td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td>6. I could choose and insert 3D objects into the real world.</td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td>7. I could scan and detect 3D objects from the real world.</td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td>8. I intend to buy this furniture after "trying" at my home.</td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td>9. I was able to read the description of the object clearly.</td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td>10. I was able to buy and generate an invoice at the end.</td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td>11. I was able to logout of the app.</td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td>12. I found the upload process simple and sufficient. *</td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td>13. Leave a comment.</td> <td colspan="5"></td> </tr> </tbody> </table>		Strongly Agree	Agree	Uncertain / Not Sure	Disagree	Strongly Disagree	1. I found the application permission requests (use the mobile camera) reasonable.	<input type="checkbox"/>	2. I found the sign-up process simple.	<input type="checkbox"/>	3. I found the login process to be fast.	<input type="checkbox"/>	4. I found the user interface to be intuitive.	<input type="checkbox"/>	5. I could find the information I am looking for with minimal effort.	<input type="checkbox"/>	6. I could choose and insert 3D objects into the real world.	<input type="checkbox"/>	7. I could scan and detect 3D objects from the real world.	<input type="checkbox"/>	8. I intend to buy this furniture after "trying" at my home.	<input type="checkbox"/>	9. I was able to read the description of the object clearly.	<input type="checkbox"/>	10. I was able to buy and generate an invoice at the end.	<input type="checkbox"/>	11. I was able to logout of the app.	<input type="checkbox"/>	12. I found the upload process simple and sufficient. *	<input type="checkbox"/>	13. Leave a comment.																																																					
	Strongly Agree	Agree	Uncertain / Not Sure	Disagree	Strongly Disagree																																																																																
1. I found the application permission requests (use the mobile camera) reasonable.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																
2. I found the sign-up process simple.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																
3. I found the login process to be fast.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																
4. I found the user interface to be intuitive.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																
5. I could find the information I am looking for with minimal effort.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																
6. I could choose and insert 3D objects into the real world.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																
7. I could scan and detect 3D objects from the real world.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																
8. I intend to buy this furniture after "trying" at my home.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																
9. I was able to read the description of the object clearly.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																
10. I was able to buy and generate an invoice at the end.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																
11. I was able to logout of the app.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																
12. I found the upload process simple and sufficient. *	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																
13. Leave a comment.																																																																																					

Figure 5 – Consent Form and End-User Questionnaire

4.2 Summary of Chapter 4

Chapter 4 provided detail and objective report of the work that was undertaken. It described the scrum methodology with its three-phases Pre-Game, Development and Post-Game. The Pre-Game phase discussed how planning occurred and the high-level design of the project. Also, how each sprint in The Development phase was evolved including all the analysis, design, implementation and test activities of the project in detail were explained. Lastly, how the Post-Game phase occurred, including the system test in the decoration company called Sofa and More was described. How many end-users took the test, their age, technology knowledge and the questionnaire answered at the end of the test.

Chapter 5 – Results

This chapter presents detailed descriptions and outcomes gathered at each phase reported in the previous chapter. Not only will it present an overview of the final application to the reader, but it will also explicitly show the results of each of the three phases of the Scrum methodology.

5.1 Pre-Game Phase

The results of this phase are the initial gathering of the user requirements through interviewing the end users.

5.1.1 Interview

As mentioned in chapter 4 section 4.1.1.1 of the document, the Backlog List, see Table 5 below, was originated from the initial discussion with the end users. This involved questioning customers, professionals and managers of Sofa and More a sequence of unrestricted questions about their needs which allowed them to respond without restrictions so that the author could collect a wide variety of feedback relating to all components of the application including both functionality and design. Figure 6 below, shows the key points collected from this initial discussion.



Figure 6 Key Points

ID	Backlog List
1	As an unauthorized user, I need to register for a new account.
2	As an unauthorized user, I need to login and access the options related to my privileges.
3	As an authorized user, I need to browse all the decoration collection.
4	As a customer, I need to virtually ‘place’ a decoration item in ‘my’ room.
5	As a customer, I need to save a photo.
6	As a customer, I need to scan and detect a decoration item.
7	As a customer, I need to share a photo.
8	As an authorized user, I need to save my avatar.

9	As a decoration company/professional, I need to upload a 3D image.
10	As a customer, I need to search/filter for a product.
11	As an authorized user, I need to visualize the download progression of the 3D object.
12	As a customer, I need to create a shopping list.
13	As an authorized user, I need to display pop up messages.
14	As a customer, I need to generate an invoice.
15	As an application, I need to connect to the database
16	As an authorized user, I need to navigate through the interfaces.

Table 5 Backlog List

The Backlog list was the base to produce all user story cards which be found in [Appendix C](#), under the section Agile User Story Cards.

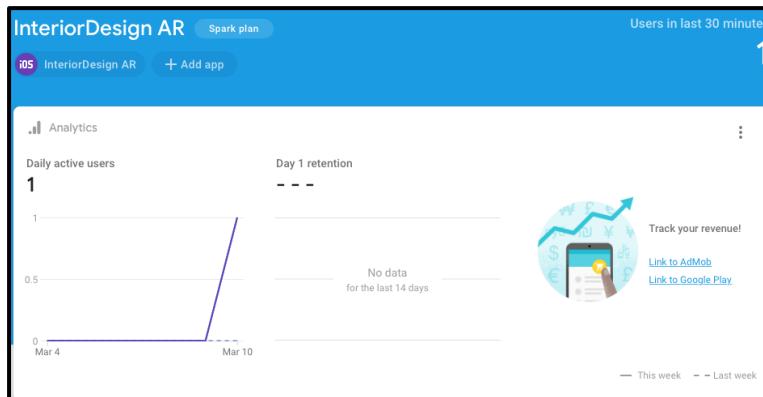
5.2 Development Phase

The results of this phase are all the features that were implemented in the AR Interior Design application to be completed.

5.2.1 Firebase Database

The AR Interior Design app uses Google Cloud Platform called Firebase to store data. Firebase acts as a real-time database where all users' details and products' details are assigned in a pre-defined design following a set of rules. These pre-set rules limit the actions which can be carried out based on the users' type. Figure 7 below shows how Firebase was initialized into the application. The test could be conducted by manually checking the Firebase Console website and seeing that was one active user, which meant the application was connected with the database. Figure 8 below shows the successful test result.

```
func connectFirebase() {
    let settings = FirestoreSettings()
    Firestore.firestore().settings = settings
    db = Firestore.firestore()
}
```

Figure 7 Firebase Initialization on AR Interior Design application*Figure 8 Test Result of Firebase Console showing one active user*

5.2.2 Scan, Detect and Add 3D Object

ARKit 2 is the library provided by Apple which permits the AR Interior Design app to perform augmented reality. Once this library is initialized to scan and detect an object, it creates a scenic view and allows the application to use the back camera so it can scan and detect an object from the real world. This object has been previously scanned by using ARKit Scanner [21] and stored in the application. Figure 9 shows the successful test result, the application successfully scanned and detected the photo frame and displayed the product information (name, description and price). The class ScanViewController.swift holds all the code to execute this feature.



Figure 9 Result of Scanning and Detecting Feature

The feature, add a 3D object, uses the same library, the ARKit 2, to place a 3D object into the real world. After the user selects an item of the product list, the application downloads the file from the Firebase database. The application gives three options to the user, to just see the 3D object, to use the augmented reality to add the 3D object in the real world or to share that 3D object file. By selecting the AR option, the users' camera is open to see the real world and it asks to move the iPhone to start the environment detection. This detection gets the depth of the surface where the item will be placed. The first test was a fail. The application downloaded the file, but it was not able to save it in the correct path location. It gave a null pointer error. After researching and implementing how to store its temporary file in the correct iPhone path, can be seen in Figure 10 below, the following test was successful. Figure 11 shows that the application could download the file, store it in the correct path and display the options to the user. The user could select the AR option and virtually place the object into the real world. The class ARViewController.swift holds all the code to execute this feature.

```
// Create local filesystem URL
let localDocumentsURL = FileManager.default.urls(for: .documentDirectory,
    in: .userDomainMask).first!
let localURL = URL(string: "\(localDocumentsURL)/picture.usdz")!
```

Figure 10 Correct Path to Store the 3D Object File

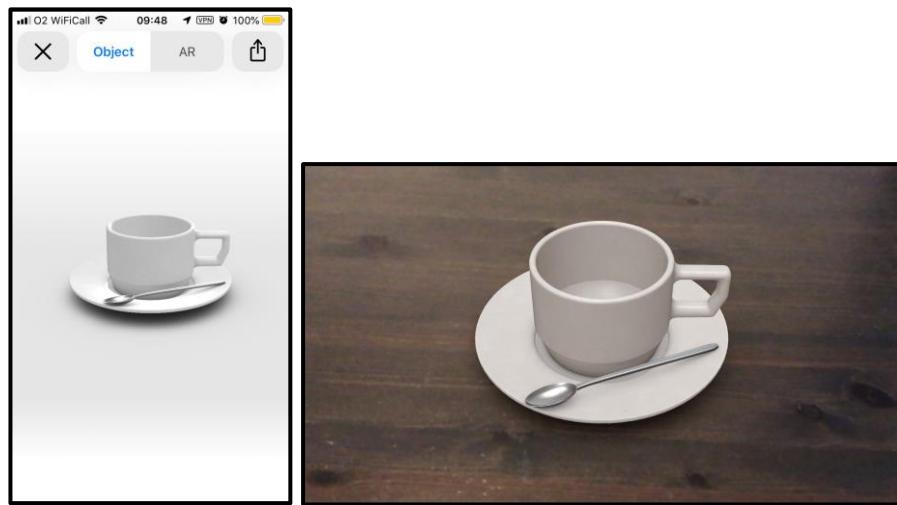


Figure 11 Result of Adding 3D Object Feature

5.2.3 User Interfaces with Navigability

All the user interfaces were designed and implemented the capability to navigate between them (go back and forth). This could be achieved by implementing a segue function to flow to the desired user interface. Figure 12 below, shows code relating to how segue work from the welcome page to sign in and create an account.

```
@IBAction func signIn(_ sender: Any) {
    performSegue(withIdentifier: "signIn", sender: self)
}
@IBAction func createAccount(_ sender: Any) {
    performSegue(withIdentifier: "createAccount", sender: self)
}
```

Figure 12 Segue Code

The test was managed by navigating back and forth from all user interfaces, starting at the welcome page up to the ending thanks for shopping. The successful test can be seen in Figure 13 below.

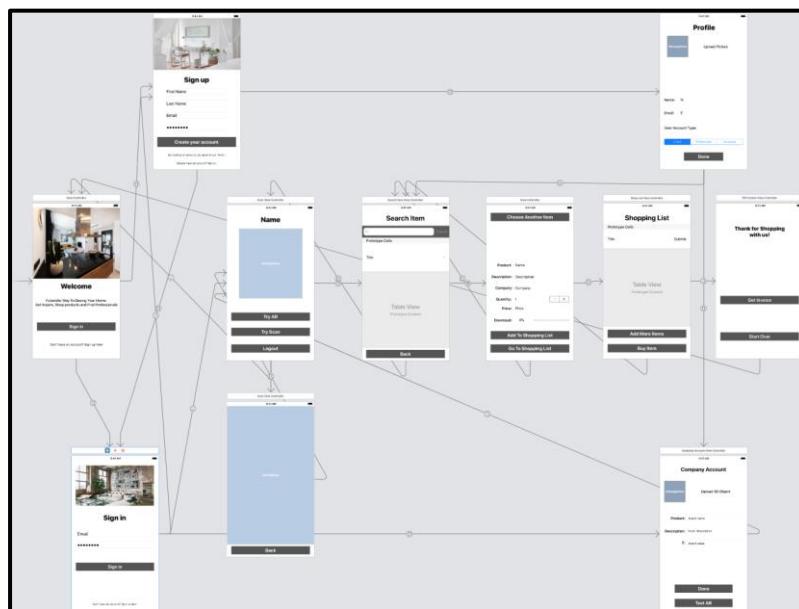


Figure 13 User Interfaces with Navigability

5.2.4 Welcome Page Create Account, Login, Upload User Avatar and 3D Object file

Once Initialized the database connection, the function to let users register for an account with their specific type and avatar was written. The create account design can be seen in Figure 14 below. This code can be found in the CreateAccountViewController.swift which gets the user name, surname email, password and checks if the email is already in the database and if it is not it creates a unique account. The next step was to submit the user avatar and specific account type which was handled by the class TypeUserViewController.swift. This class got the user name, surname and email from the database to be displayed and let the user choose the account type and upload an avatar. The avatar could be sourced by either the user's camera or photo gallery.

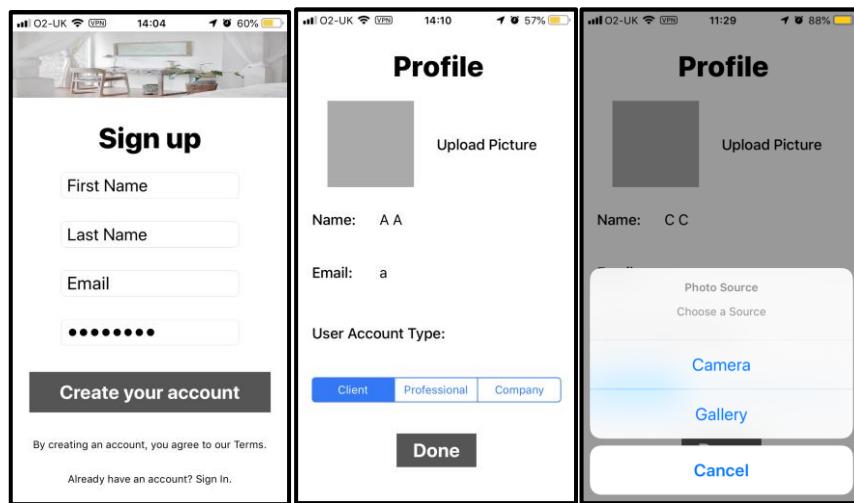


Figure 14 Design Process to Create a User Account

The test was managed by checking the database if the entries were correctly assigned to their pre-defined location in the database. Figure 15 below shows the successful test result.

Name	Value
Y2S5jY87wSAfa2a21H0a	
accType	"Client"
email	"j"
first	"Juan"
last	"Armond"
password	"j"

Figure 15 User Account created with all details and Avatar

After the successful result to create a user account, the welcome and sign in pages were design and implement, below in Figure 16. The welcome page was just a small introduction of the app, which can

be found in the class ViewController.swift. The sign in page connects to Firebase database to checks if the email and password were correct, thus allowing the user to login to the application.

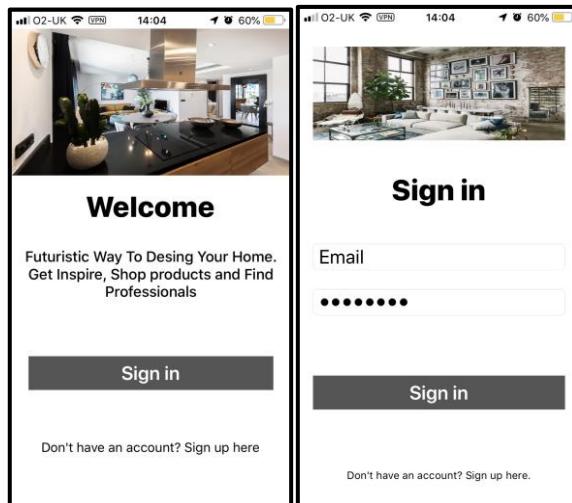


Figure 16 Design of Welcome and Sign In

The sign in process was held by the SignInViewController.swift class and part of the code to authenticate a user can be seen in Figure 17 below. The test was conducted after the user touched the AR Interior Design icon and the welcome page first showed up. The sign in only authenticated the user when he/she inserted the correct details.

```
@IBAction func signIn(_ sender: Any) {
    if let email = self.emailField.text, let password = self.passwordField.text{
        let collection = db.collection("users")
        collection
            .whereField("email", isEqualTo: email)
            .whereField("password", isEqualTo: password).getDocuments() { (querySnapshot, err) in
                if let err = err {
                    print("Error getting documents: \(err)")
                } else if querySnapshot!.isEmpty{
                    print("Document not found")
                    self.showAlert()
                } else {
                    for document in (querySnapshot?.documents)!{
                        if let em = document.data()["email"] as? String {
                            if let ps = document.data()["password"] as? String{
                                print(em, ps)
                                self.id = document.documentID
                                if let accType = document.data()["accType"] as? String{
                                    if "\u{accType}" == "Client" {
                                        self.performSegue(withIdentifier: "arScan", sender:
                                            self)
                                        print("\u{accType}")
                                    }else{
                                        self.performSegue(withIdentifier: "companyAccount",
                                            sender: self)
                                        print("\u{accType}")
                                    }
                                }
                            }
                        }
                    }
                }
            }
    }
}
```

Figure 17 Code to Authenticate User

5.2.5 Browser, Refresh and Search/Filter Products List

The browser refresh and search/filter functionalities were located in the class SearchItemViewController.swift. Figure 18 below shows the design of these features. The browser function retrieved all products names from the database and displayed them in a table format. The successful test was done by matching the items displayed by the application to the items stored in the database. The refresh function permitted the user to swipe down and refresh the product list. Figure 19 below, shows the successful test result of the refresh implementations. The search/filter function started

searching as soon the user started typing inside the search bar. The successful test result can be seen in Figure 20 below.

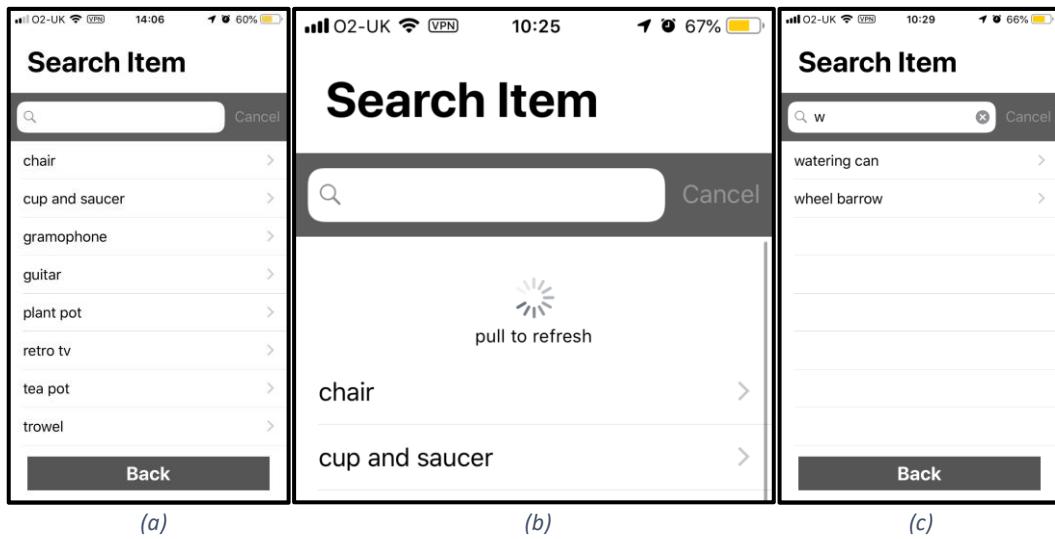


Figure 18 (a) Design of Browser, Refresh and Search/Filter, (b) Result Test of Refresh and (c) Search/Filter

5.2.6 Save and Share Photo

After the user inserted the 3D object into the real world, the button to capture the photo was displayed and could be pressed to save a photo. After the photo was taken, the share interface would show up with all the user's social media. If the user did not wish to share at the time, the photo will be automatically saved into their photo library. This feature could be found in the ARViewController.swift class. The test consisted of the user pressing the capture photograph button and taking it, which automatically revealed the share menu option after placed the 3D object into the real world. The successful test result can be seen in Figure 19 below.



Figure 19 Result Test of Saving and Sharing a Photo

5.2.7 Download Progression Bar

The featured download progression bar code can be seen in Figure 20 below and was in the ARViewController.swift class. After the user had selected the 3D object, all the information about that

product was revealed and the download of the files started. As the download increased the progress of the progression bar filled up by becoming darker and the percentage number increased. The test involved selecting a 3D object file and watching the progressing bar fill by becoming darker until 100% of the file was downloaded. The successful result test can be seen in Figure 21 below.

```
downloadTask.observe(.progress) { snapshot in
    // A progress event occurred
    self.percentComplete = 100.0 * Double(snapshot.progress!.completedUnitCount)
        / Double(snapshot.progress!.totalUnitCount)
    print(Float(self.percentComplete/100))
    self.progressLabel.text = NSString(format: "%.\(1)f", self.percentComplete) as String + "%"
    self.progressView.progress = Float(self.percentComplete/100)
}
```

Figure 20 Download Progression Bar Code



Figure 21 Result Test of Download Bar

5.2.8 Shopping List

Following the selection of the item, the user could add it to the shopping list. This feature held all the selected items the user wanted to buy which could be found in the ShopListViewController.swift class. This feature leads to the implementation of the remove item from the list. The remove was done by swiping to the left which revealed the delete button which the user could press. The test covered that after the user added one item to the list, that item could be removed by swiping left, thus making the delete button show up so that button could be pressed. The successful test result can be seen in Figure 22 below.

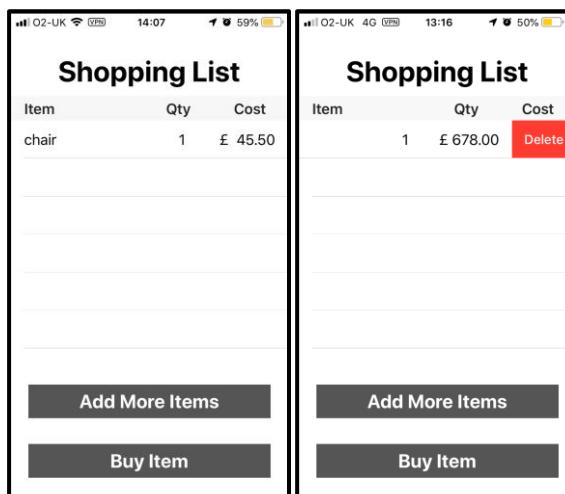


Figure 22 Result Test of Adding an Item to the Shopping List and Remove it

5.2.9 PDF Invoice Generator

When picking the option to buy an item, the application automatically generated a PDF invoice. The implementation made use of the Simple PDF API which produced the PDF file. The invoice had the date, the company information with logo and address, the customer's name and email and the item's name, quantity and price. After seeing the invoice, the user could save and share it. The testing of this feature consisted in to check if the layout contained all the correct information mention above. The successful test result can be seen in Figure 23 below.



Figure 23 Result Test of PDF Invoice

5.2.10 Popup Messages

The featured popup messages were feedback alerts design to help the usability of the application. These alerts contained a small text that informed the user about what was happening. To test included a series of checks such as inputting the wrong password, trying to create an account without filling in all the fields or with an email which already existed in the database, confirming that an item was added to shopping list, updating an item's quantity in the shopping list, trying to add an item that was already in the shopping list, displaying the total price of the shopping list, uploading a product that had the same name in the database, trying to upload a product without filling in all the fields and the terms and conditions description. Figure 24 below shows all the successful tests results.

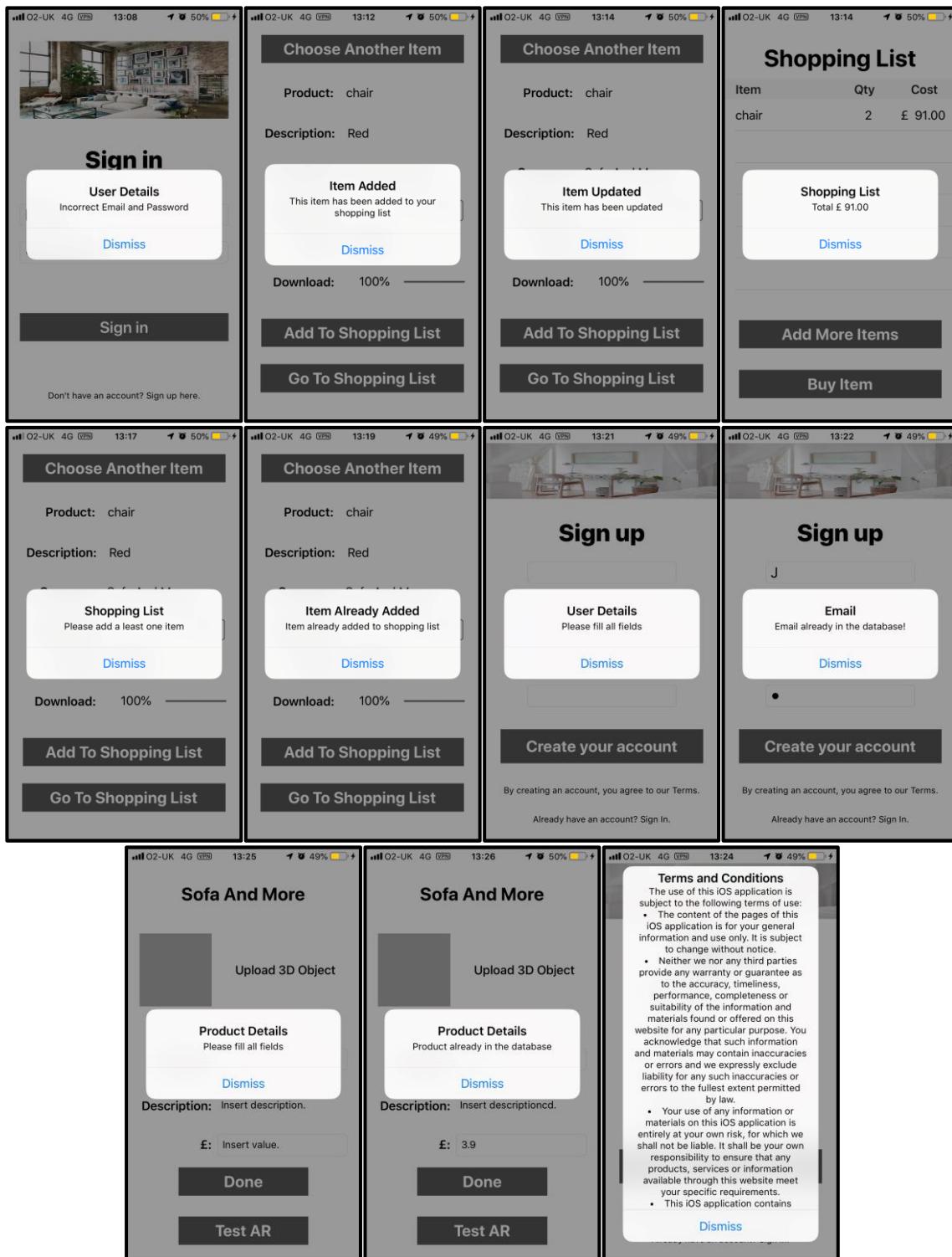


Figure 24 Test Results of All Popup Messages

5.3 Post-Game Phase

The result of this phase was the final testing of the system. The testing was conducted at Sofa and More and before testing the application, the project's details were explained to each participant through the consent form and signed. After was explained about augmented reality, how was used in

the AR Interior Design app to virtually add furniture into their homes to improve the customer experience. With all the information given, the testing was carried out and consisted of using the application to follow through scenarios and later answer the usability questionnaire with a Likert scale. A Likert scale is an approach to scaling responses with a level of agreement or disagreement in questionnaire research which can be seen in Figure 25 below.

Strongly Agree	Agree	Uncertain / Not Applicable	Disagree	Strongly Disagree
-----------------------	--------------	-----------------------------------	-----------------	--------------------------

Figure 25 Likert Scale Used in the Feedback Report

5.3.1 Task Scenarios

Task scenarios were used to observe how each participant would use the application. This was essential to gain qualitative insights to help determine if the design had been successful and/or how it could be improved. The aim of tasks one to four was to explore the usability effect and tasks five and six were aimed in discovering the impact of the augmented reality in the application. These scenarios were carried out to simulate the real world as much as possible and with minimal input from the person that was conducting the test. These were the six task scenarios:

The pre-requisite to perform all task scenarios was ensuring that there was internet connection.

1. All the users were asked to create an account. They easily inserted all the details: name, surname, email, password, upload an avatar and select their user account type.

The pre-requisite for tasks 2 to 5 was to have an account and to be logged to the application.

2. All the users were asked to buy the item/s. They effortlessly bought the item/s and without hesitation clicked the button to generate the PDF invoice.
3. All the users were asked to log out and to log back in using the details they had created before. They undoubtedly completed the task and reacted very positively when seeing their respective avatar.
4. All the users were asked to add at least three items to the shopping list in different quantities and to remove one of them. They simply navigated back and forth to add items with different quantities from the product list to the shopping list and easily removed one item.

The results from task one to four were very positive. This means that these tasks were performed quickly in a very intuitive/spontaneous approach.

5. All the users were asked to browse the product list. They straightforwardly selected an item from the list and were able to see the object, but some found it difficult to use the augmented

reality. They asked how they could place the 3D object into the real world. The person conducting the test intervened and explained how to use this technology.

6. All the users were asked to use the scan and detect an object. As mention before with the use of augmented reality, some did not quite understand how to achieve this, but after a short demonstration, they easily used this feature.

The result from task five and six was not too positive. This was pretty understandable because some user did not comprehend augmented reality and all of them had never used before. This mean that the process to use augmented reality to add or to scan and detect were not too intuitive and could be improved in future versions.

5.3.2 Usability Questionnaire

After performing all the test scenarios above, the third part of the final testing was initiated. This involved a usability questionnaire composed of several queries related to the project's objective. Almost all the queries in the questionnaire used a Likert scale because this qualitative method of information gathering was known as very efficient in evaluating feelings towards a subject. This was because the answer from participants was in the form of the amount to which they approved to a query rather than just agreeing and disagreeing. Only the last question was a discursive answer. A total of eleven participants carried out the final testing out of five which were a user client type and three were user professional type and three user company type.

5.3.3 Evaluation Results

The following part contains the figure of the results obtained from the usability questionnaire conducted at Sofa and More. Each query in the questionnaire will be outlined and results will be explained.

5.3.3.1 Privacy

To gain information about the permission request to use the camera was reasonable. The access to the user camera was essential for the application to work properly, it is through the camera that the application “sees” the world.

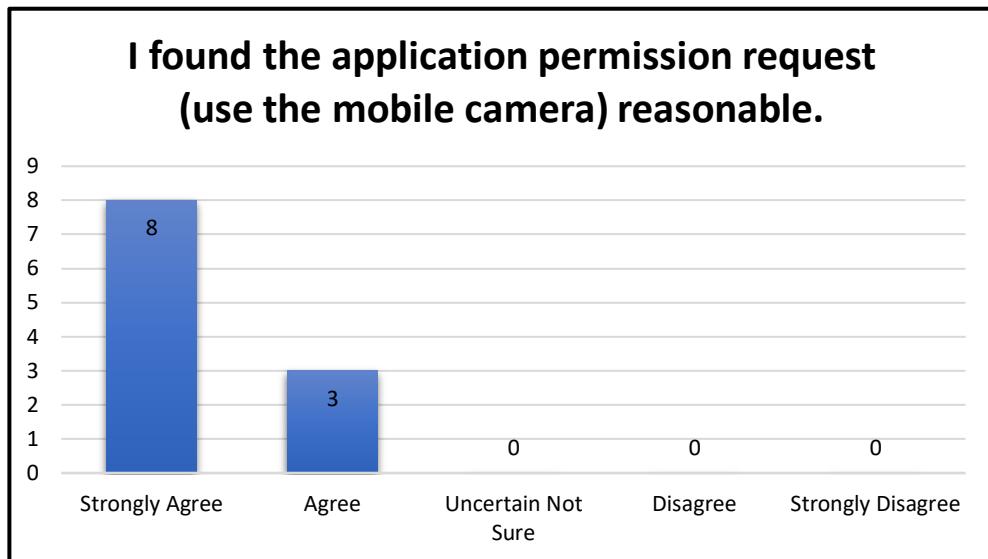


Figure 26 Result of the Permission Request to Access User Mobile Camera

Figure 26 above, shows the result of the question about the permission to request access to the user's mobile camera. This question was designed to measure how intrusive it was to ask for permission to use the user's mobile camera. All participants either agreed or strongly agreed to allow the application to use the mobile camera being reasonable. See [Appendix E](#) query one of the Feedback Reports section.

5.3.3.2 Simplicity

These queries below were conceived to understand how intuitive to use the application's interfaces were. Intuitive user interfaces allowed the user to easily understand how the application could be useful and create a great mobile experience.

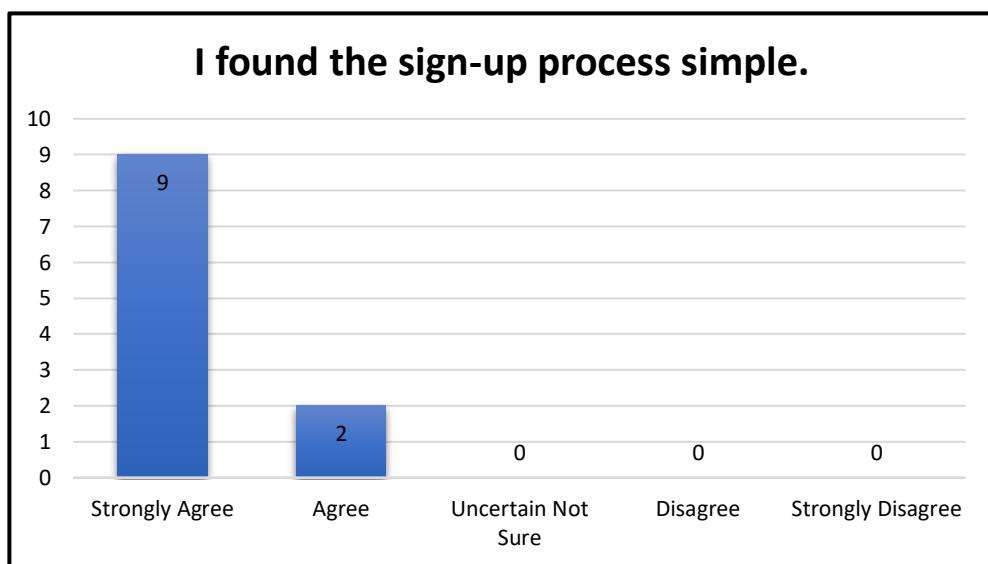


Figure 27 Result of Sign-up Process

Figure 27 above, shows the result of the question regarding how simple the sign-up process was. This question was thought to measure how straightforward the sign-up process was. Out of all participants, 82% strongly agreed and 18% agreed that the sign-up process was simple. See [Appendix E](#) query one of the Feedback Reports section.

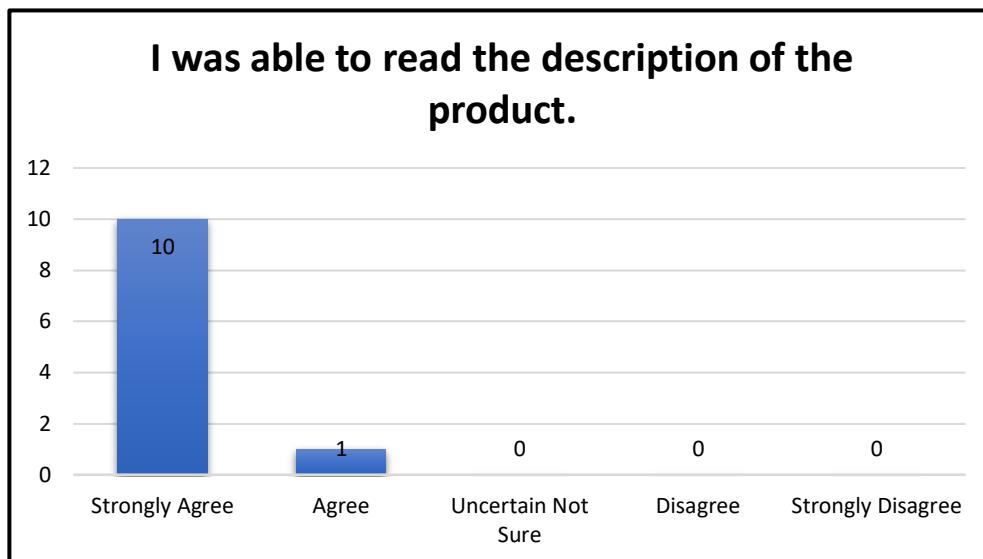


Figure 28 Result of Able to Read the Product Description

Figure 28 above, shows the result of the question relating to how readable the product description was. This question was made to measure how users efficiently read and take the product description. Out of all participants, 91% strongly agreed and 9% agreed that the product description was readable. See [Appendix E](#) query one of the Feedback Reports section.

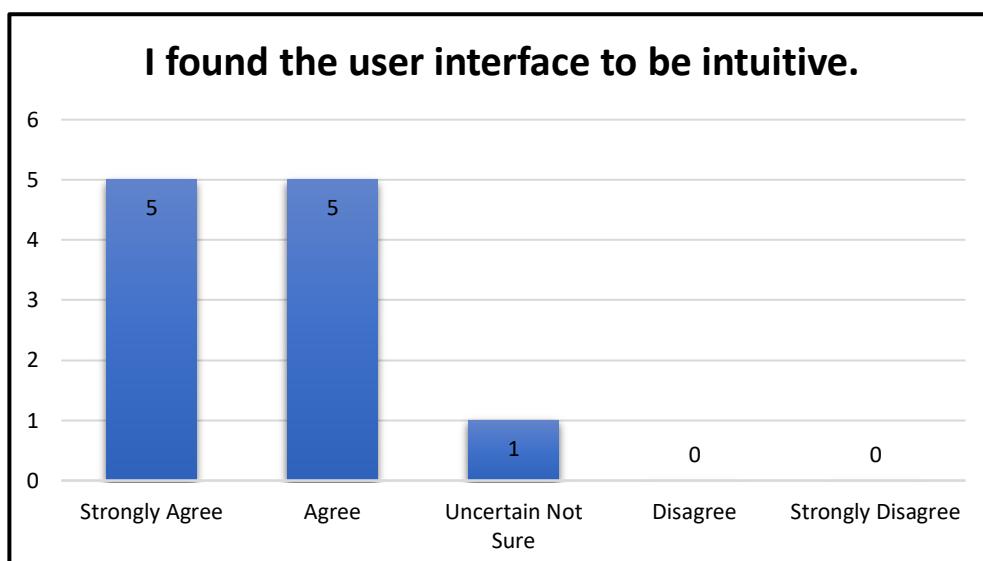


Figure 29 Result of User Interface is Intuitive

Figure 29 above, shows the result of the question about how intuitive the user interface was. This question was designed to measure how intuitive to use and navigate the user interface was. Out of

participants, 45.5% strongly agreed 45.5% agreed and 9% uncertain/not applicable that the user interface was intuitive. See [Appendix E](#) query one of the Feedback Reports section.

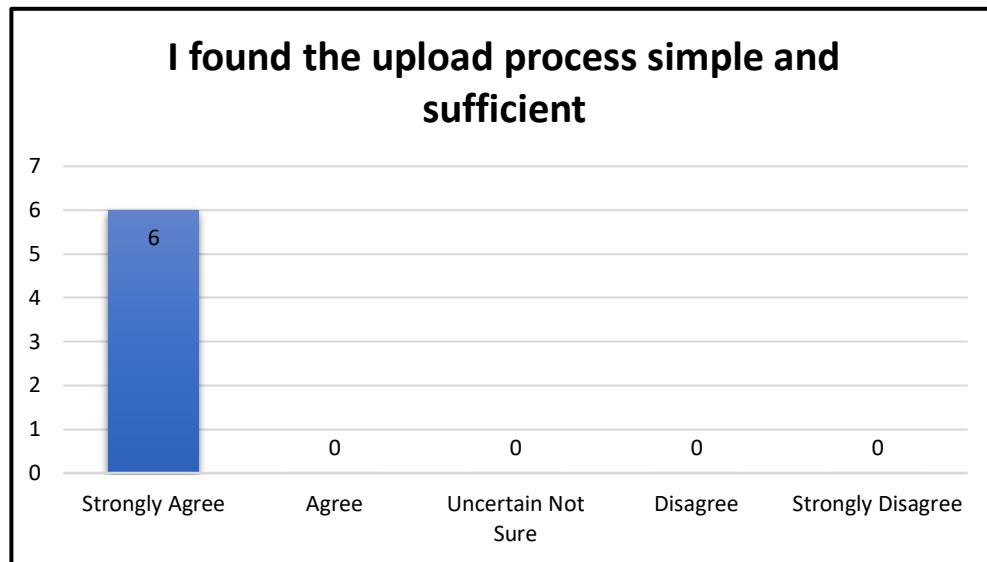


Figure 30 Result of Upload Process Simple and Sufficient

Figure 30 above, shows the result of the question regarding how simple and sufficient the upload process was. This question was thought to measure how simple and sufficient the upload process for 3D object files was. The only user account with the type of professional and company can upload 3D object files. Out of participants, 100% strongly agree that the upload process is simple and sufficient. See [Appendix E](#) query one of the Feedback Reports section.

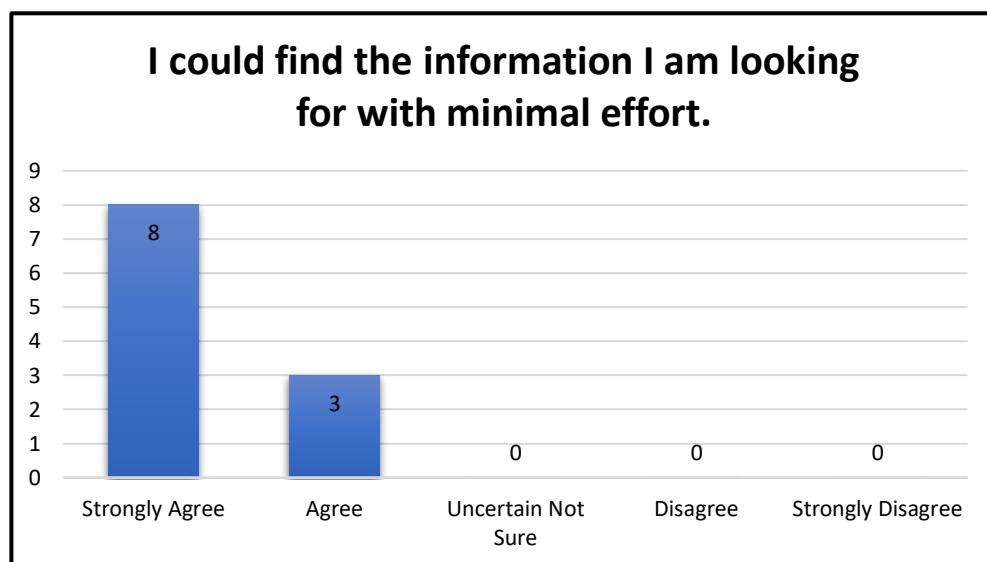


Figure 31 Result of Find Information with Minimal Effort

Figure 31 above, shows the result of the question about finding the needed information with minimal effort. This question was written to measure how intuitive the application was at finding the desired

information. Out of participants, 73% strongly agreed and 27% agreed that they found the information needed with minimal effort. See [Appendix E](#) query one of the Feedback Reports section.

5.3.3.3 Technical Impact

These queries below were to understand how the application's features impacted the user's experience. To be a successful application AR Interior Design should have delivered a robust user experience like fast loading times and features that work as expected.

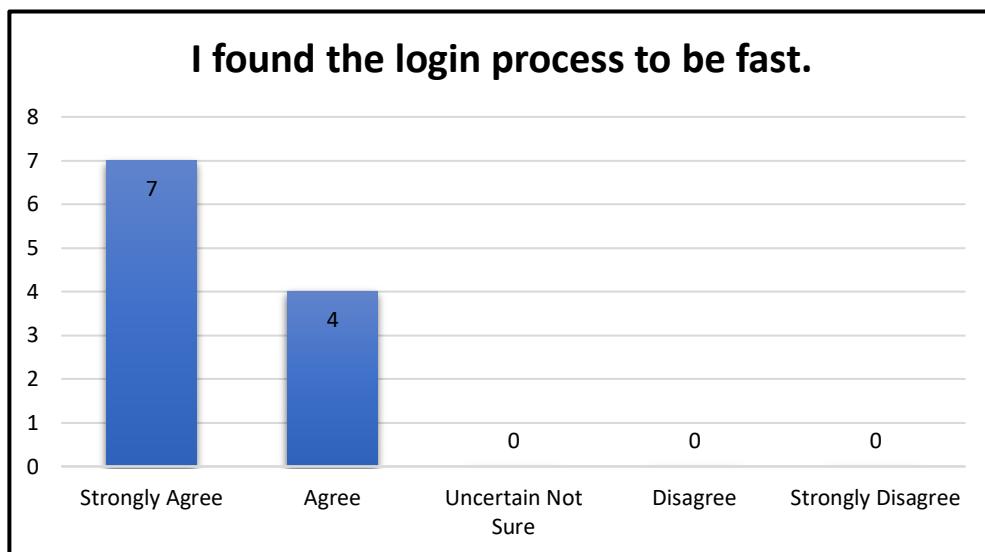


Figure 32 Result of How Fast Login Process

Figure 32 above, shows the result of the question relating how fast the login process was. This question was designed to measure how long the application would take to log in. Out of participants, 64% strongly agreed and 36% agreed that the login process was fast. See [Appendix E](#) query one of the Feedback Reports section.

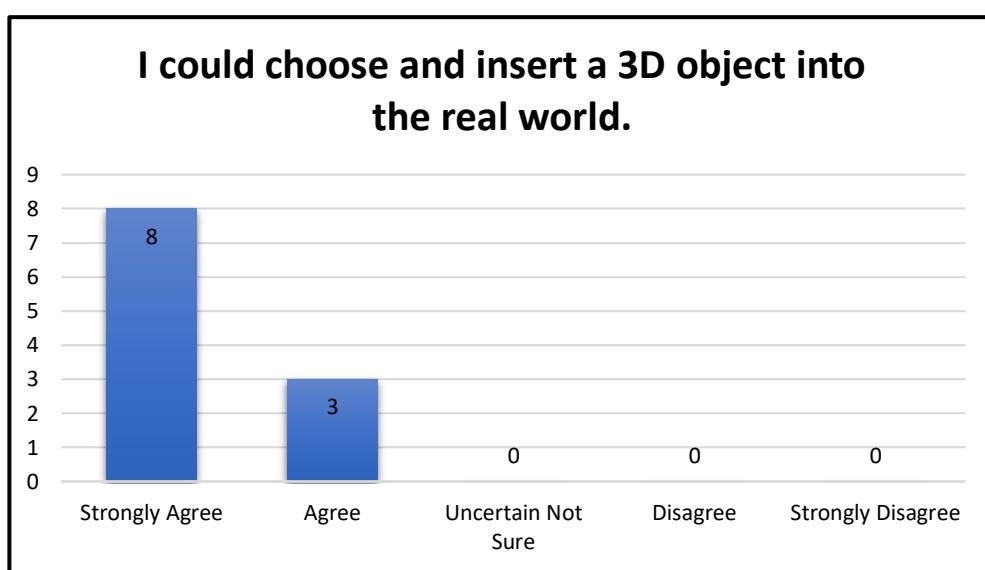


Figure 33 Result of Adding 3D Object into the Real World

Figure 33 above, shows the result of the question concerning adding a 3D object into the real world. This question was thought to measure how successfully the feature functioned. Out of participants, 73% strongly agreed and 27% agreed that they could choose and insert a 3D object in the real world. See [Appendix E](#) query one of the Feedback Reports section.

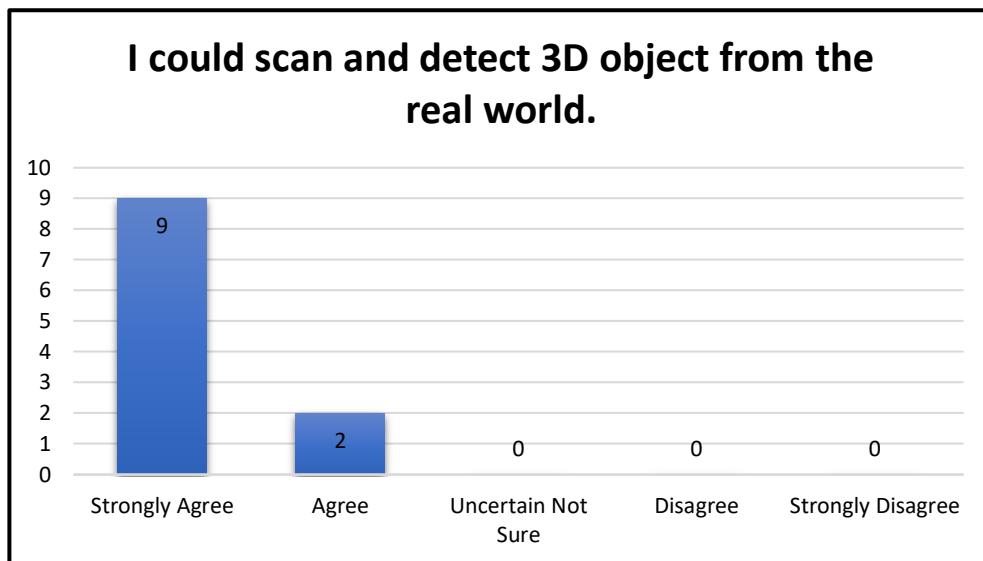


Figure 34 Result of Scan and Detect 3D Object from the Real World

Figure 34 above, shows the result of the question regarding scanning and detecting a 3D object from the real world. This question was designed to measure how successfully the feature functioned. Out of participants, 82% strongly agreed and 18% agreed that they could scan and detect a 3D object in the real world. See [Appendix E](#) query one of the Feedback Reports section.

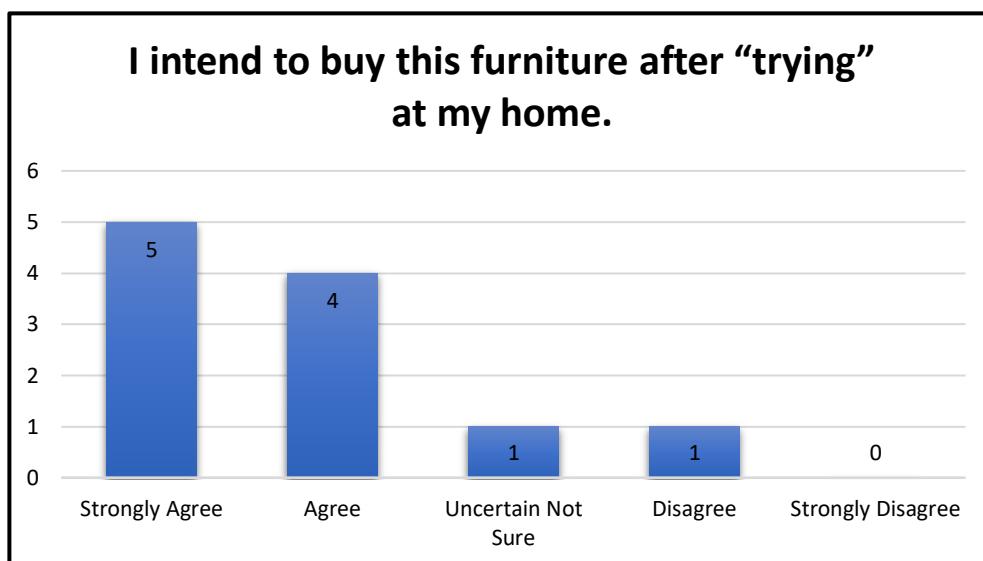


Figure 35 Result of Intention to Buy a Furniture after Trying at Home

Figure 35 above, shows the result of the question concerning the intention to buy a piece of furniture after trying it at their homes. This question was thought to measure how successful the whole

experience of using the application was. Out of participants, 45.5% strongly agreed, 36.5% agreed, 9% uncertain/not applicable and 9% disagreed that they had the intention to buy a piece of furniture after trying it at their homes. See [Appendix E](#) query one of the Feedback Reports section.

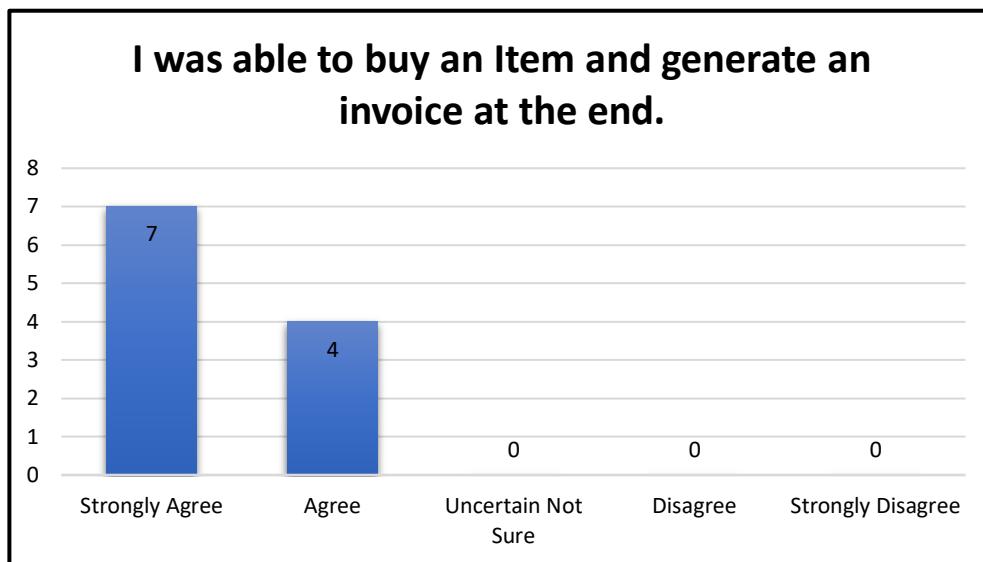


Figure 36 Result of Buy an Item and Generate an Invoice

Figure 36 above, shows the result of the question about being able to buy an item and generate an invoice at the end of using the application. This question was designed to measure how successfully the feature functioned. Out of participants, 64% strongly agreed and 36% agreed, that they were able to buy an item and generate an invoice at the end of using the application. See [Appendix E](#) query one of the Feedback Reports section.

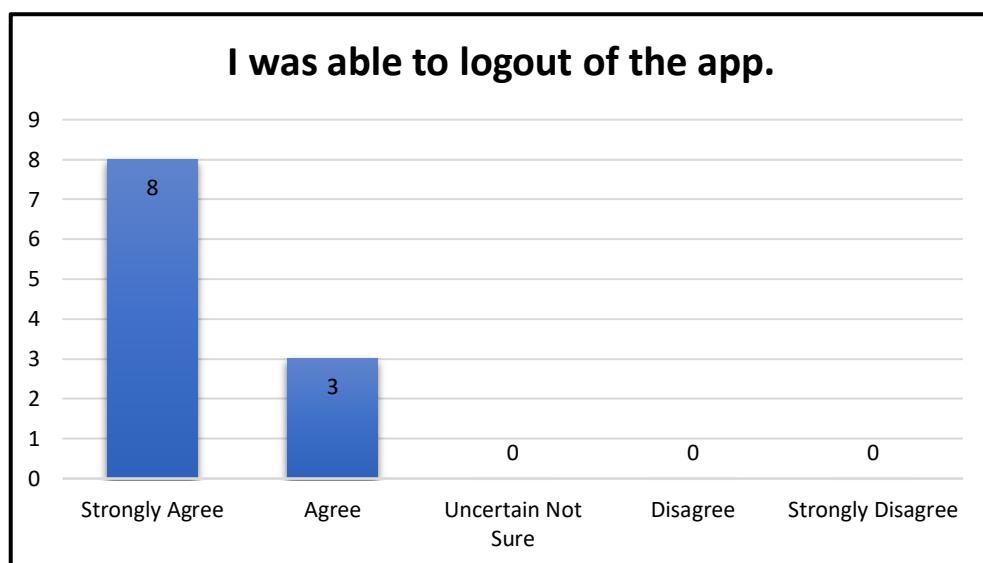


Figure 37 Result of Able to Logout of the App

Figure 37 above, shows the result of the question about being able to logout of the application. This question was thought to measure how successfully the feature functioned. Out of participants, 73%

strongly agreed and 27% agreed, that they were able to logout of the application. See [Appendix E](#) query one of the Feedback Reports section.

5.3.2.4 Free Form Question

This part involved the last query in the questionnaire which consisted of leaving a comment. These were the seven comments and can be found in [Appendix E](#) the Feedback Reports section.

“Perfect app. Very easy and fun.”

“Very good app.”

“Great app.”

“Thank you, I believe this will be extremely useful for our company.”

“I found the app very good and easy to use. I would definitely use it.”

“Very interesting and easy to use. I would like to have it available in the future.”

“Great experience to show, another type of channel (e-commerce) that you can see your 3D products to share a real idea with customers.”

From these comments, we could conclude that the application was successful in fulfilling the project's objective which was to create an easy and useful mobile platform that connected customers to companies and professionals by using augmented reality in order to promote their products and services.

5.4 Summary of Chapter 5

Chapter 5 displays all the results produced during every activity reported in chapter 4 Method. It very clearly identified the results from each of the Scrum phases. The Pre-game phase was presented together with the key points collected in the initial discussion with end users and the backlog list. The Development phase was presented with all the features' results that were implemented. The Post-game phase was presented which consisted of the final testing results including the assessment results.

Chapter 6 – Conclusion and Discussion

This chapter revisits the project’s objectives and requirements and evaluates its success by observing all research carried through, the extent to which the project has accomplished all the objectives and requirements. Also, it will discuss prospects for any future work and the knowledge gained from undertaking this project.

6.1 Project Objectives

As mentioned in chapter 1 section 1.3.1, the fundamental primary objectives of this project were to “Design and build a mobile application for the iOS platform that would permit customers to scan and identify 3D objects and place them into the real world by using AR technology. Also, decoration companies and professionals will be able to promote their collection and services.”

The AR Interior Design application achieved all the project’s objectives by delivering a mobile application that uses AR to promote products and services of decoration companies and professionals to customers. Also allowed customers to buy and share photographs of products. It is secure to say that the application is robust and accomplished all the user stories criteria from the various testing and assessment carried out whilst also attending the user’s usability requirements. All the expected features of table 3 Tabular Comparison of Existing Software in chapter 3 section 3.1 were delivered.

The full source code is located on Moodle.

6.1.1 Database

An essential feature of the project was a robust and fast database connection, using Google’s Firebase provided a unique real-time database allowing users to seamless upload and download files through an Internet connection. The implementation is detailed in chapter 4 Method and chapter 5 Results of the report. To measure the success of the implementation of this feature, a series of queries were inserted into the questionnaire as followed: ‘*I found the login process to be fast*’, ‘*I was able to logout of the app*’ and ‘*I found the sign-up process simple*’. By asking participants these queries a deduction can be made as to whether the database connection was fast and robust. The given queries resulted in participants giving an average of eight votes that strongly agreed and three votes that agreed out of eleven participants. This implies that the feature was successfully implemented.

6.1.2 Scan and Detect Objects

One of the main features of the project was the implementation of scanning and detecting objects from the real world. As mentioned in chapter 1 section 1.3.1.2 this feature intended to create a new shopping experience for customers. The implementation is detailed in chapter 4 Method and chapter 5 Results of the report. To measure the success from the implementation of this feature, a query was

inserted into the questionnaire as follows: '*I could scan and detect 3D objects from the real world*'. The query resulted in nine votes that strongly agreed and two votes which agreed out of eleven participants. This implies that the feature was successfully implemented.

6.1.3 Add 3D Objects

The second main feature was the implementation of adding 3D objects into the real world. As mentioned in chapter 1 section 1.3.1.3 this feature intended to be the most fascinating aspect of the AR Interior Design app. The implementation is detailed in chapter 4 Method and chapter 5 Results of the report. To measure the success of the implementation of this feature, a query was inserted into the questionnaire as follows: '*I could choose and insert 3D objects into the real world*'. The query resulted in eight votes which strongly agreed and three votes that agreed out of eleven participants. This implies that the feature was successfully implemented.

6.2 Future Work

The successful implementation of AR Interior Design helped to envision how the application could evolve. Listed below are three majors' deployments of future work that could be undertaken.

6.2.1 Apple's App Store

Apple's App Store is a digital distribution service that provides a great user experience with a fluid interface and high security that shielding customers from viruses and malware [22]. Submitting the application to Apple's App Store would allow it to be download and installed by people around the world. Apple's App Store also permits free apps to make money from adverts, which discussed in the following section 6.2.2 Capitalize.

6.2.2 Capitalize

The AR Interior Design could capitalize (on money) from advertising and sponsorship. In that case, decoration companies and professionals could pay to promote their products and services. In the application's product list, their products and services would show up first. Also, the application could add Search Ads [23] which is a banner usually at the bottom of the screen with advertisements. Search Ads pay every time that a user clicks the banner and downloads that advertised app. Another way could be that every time users finish using the AR feature, the application could show an advertisement video, usually around 15 to 30 seconds.

6.2.3 Support for Android Platform

Another way to increase demand and capitalize would be porting¹ the AR Interior Design to Google's Android operating system (OS) [24]. Apps from this OS are published and deployed on Google's Play Store [25]. The Play Store is a digital distribution service operated and developed by Google which is the official app store for the Android OS. Also, has a similar way to capitalize (on money) from advertising called AdMob [26]. AdMob works almost in the same way as Apple's Search Ads.

6.3 Knowledge Gained

After all the hard work of this project, the amount of knowledge and skills acquired are very extensive. Initially, with no experience of XCode application or Swift as a programming language, the learning curve was very steep, and information had to be learned quickly to successfully implement all the application features. It involved hours of extensive research in learning Swift with its libraries and the third-party APIs. Also, the knowledge gained from Scrum the agile development methodology used. How to plan, to create product backlog list and turn it into sprint backlog list, the iterative cycles where the functionality was developed and the system testing. Not only was technical knowledge gained but also the soft skills such as time management, ability to work under pressure, problem-solving and a very important skill that was appreciated is self-motivation.

6.4 Project Management and Control

By creating, following and updating the work plans whether needed such as the Gantt chart and sprints made the project ran really smoothly. Some features took less time to implement than initially thought which made the whole project be ahead of schedule. The project management and control were very robust leaving no margins to fall behind the defined schedule.

6.5 Conclusion

The report started with a brief introduction of the project describing the problem to be solved, challenges and the motivation underlying this project. Also, provides an explanation of all the project's objectives of and outlines the work accomplished to meet these objectives. It contains a list of the outputs produced and a review of the literature undertaken to support the accomplishment of the development of the project. This is followed by explaining the chosen method with all the requirements analysis, design, implementation, testing and delivery process which the project undertook. All the results that were produced while undertaking the project were presented in detail. In the end, an evaluation of the project's achievement, future work opportunities and considerations

¹ Port (verb) is to change an application program from an operating system environment in which it was developed to another operating system environment so it can be executed there.

are discussed. In conclusion, the project's objectives were achieved, and the end users were very pleased with the AR Interior Design's functionalities. It has been a remarkable experience to learn a new programming language and to apply all which had been learnt so far at university to develop a project of this size.

Glossary

Term	Definition
API / Library	Set of functions that allows persons to access features of a third-party application.
iOS	Apple's operations systems that run in iPhone and iPad.
OS	Operation Systems
AR	Augmented Reality.
SDK	Set of software development tools that support in the creation of applications.
JSON	JavaScript Object Notation.
IDE	Integrated Development Environment

References

- [1] Apple, 2018. iOS 12. [Online]
Available at: <https://www.apple.com/uk/ios/ios-12/>
[Accessed 15 February 2018].
- [2] BFC, 2018. British Furniture Confederation. [Online]
Available at: <http://britishfurnitureconfederation.org.uk/about-the-industry/>
[Accessed 9 October 2018].
- [3] Apple, 2018. ARKit Framework. [Online]
Available at: <https://developer.apple.com/documentation/arkit>
[Accessed 15 February 2018].
- [4] Google, 2018. Firebase. [Online]
Available at: <https://firebase.google.com>
[Accessed 15 February 2018].
- [5] Apple's App Store, 2018. App Store Preview. [Online]
Available at: <https://itunes.apple.com/gb/app/ikea-place/id1279244498?mt=8>
[Accessed 15 February 2018].
- [6] Apple's App Store, 2018. App Store Preview. [Online]
Available at: <https://itunes.apple.com/gb/app/houzz/id399563465?mt=8>
[Accessed 15 February 2018].
- [7] Palmer, S. R. and J. M. Felsing (2002). A Practical Guide to Feature-Driven Development.
- [8] Apple, 2018. XCode 10. [Online]
Available at: <https://developer.apple.com/xcode/>
[Accessed 15 February 2018].
- [9] Apple, 2018. Swift 4. [Online]
Available at: <https://developer.apple.com/swift/>
[Accessed 15 February 2018].
- [10] Apple, 2018. iOS Developer Library. [Online]
Available at: <https://developer.apple.com>
[Accessed 15 February 2018].
- [11] Rewik, Nutchaphon, 2018. SimplePDF. [Online]
Available at: <https://cocoapods.org/pods/SimplePDF>
[Accessed 15 February 2018].
- [12] CocoaPods Dev Team, 2018. CocoaPods. [Online]
Available at: <https://cocoapods.org>
[Accessed 15 February 2018].

- [13] Google, 2018. YouTube. [Online]
Available at: <https://www.youtube.com>
[Accessed 15 February 2018].
- [14] Stack Overflow, 2018. Stack Overflow. [Online]
Available at: <https://stackoverflow.com>
[Accessed 15 February 2018].
- [15] Apple, 2018. Cocoa Application Competencies for iOS. [Online]
Available at:
<https://developer.apple.com/library/archive/documentation/General/Conceptual/Devpedia-CocoaApp/Storyboard.html>
[Accessed 15 February 2018].
- [16] Google, 2018. Firebase. [Online]
Available at: <https://firebase.google.com/docs/ios>
[Accessed 15 February 2018].
- [17] Stack Overflow, 2018. Stack Overflow. [Online]
Available at: <https://stackoverflow.com/questions/10600613/ios-image-orientation-has-strange-behavior>
[Accessed 15 February 2018].
- [18] Google, 2018. Firebase Cloud Firestore. [Online]
Available at: <https://firebase.google.com/docs/firestore/quickstart>
[Accessed 15 February 2018].
- [19] Google, 2018. Firebase Storage. [Online]
Available at: <https://firebase.google.com/docs/storage/ios/upload-files>
[Accessed 15 February 2018].
- [20] Apple, 2018. QuickLook. [Online]
Available at: <https://developer.apple.com/documentation/quicklook>
[Accessed 15 February 2018].
- [21] Apple, 2018. Scanning and Detecting 3D Objects. [Online]
Available at:
https://developer.apple.com/documentation/arkit/scanning_and_detecting_3d_objects
[Accessed 15 February 2018].
- [22] Apple's App Store, 2018. App Store. [Online]
Available at: <https://www.apple.com/uk/ios/app-store/>
[Accessed 15 February 2018].
- [23] Apple's Search Ads, 2018. Search Ads. [Online]
Available at: <https://searchads.apple.com>
[Accessed 15 February 2018].
- [24] Google, 2018. Android OS. [Online]
Available at: <https://www.android.com>
[Accessed 15 February 2018].

- [25] Google, 2018. Play Store. [Online]
Available at: <https://play.google.com/store>
[Accessed 15 February 2018].
- [26] Google, 2018. AdMob. [Online]
Available at: <https://admob.google.com/home/>
[Accessed 15 February 2018].
- [27] Beck, K. (2000). Extreme Programming Explained: Embrace Change.
- [28] Schwaber, K. and M. Beedle (2002). Agile Software Development With Scrum. Upper Saddle River, NJ, Prentice-Hall.
- [29] Palmer, S. R. and J. M. Felsing (2002). A Practical Guide to Feature-Driven Development.

Appendix A – PDD

Juan Armond

ACKA399

2018-19

City University London

Software Engineering
Final Year Project Report

Academic Year: 2018-19

(AR) Interior Design Concept

By

Juan Armond

Tel. 075 1578-9552

Email: juan.armond@city.ac.uk

Project supervisor: Dr. Ross Paterson

Juan Armond

ACKA399

2018-19

Juan Armond

ACKA399

2018-19

Table of Contents

SECTION 1 – PROPOSAL.....	3
THE PROBLEM TO BE SOLVED.....	3
PROJECT BENEFICIARIES	4
PROJECT OBJECTIVES.....	4
<i>Scan and Detect Objects.....</i>	4
<i>Add 3D Objects</i>	5
<i>Extra Features.....</i>	5
SOFTWARE DEVELOPMENT PROCESS.....	6
WORK PLAN	7
<i>Work Breakdown.....</i>	7
Work Pre-Package.....	7
WPP D1 – Research and Requirements.....	7
WPP D2 – Requirement Prioritising	7
WPP D3 – Learn XCode, Swift and AR Kit API	7
GANTT CHART.....	9
PROJECT RISKS	10
REFERENCES	12
SECTION 2 – RESEARCH ETHIC CHECKLIST	13
APPENDIX – CONSENT FORM	18
APPENDIX – QUESTIONNAIRE.....	19

Monday, 25 June 2018

2

Juan Armond

ACKA399

2018-19

Section 1 – Proposal

The Problem to be Solved

The problem I have chosen to address is to decorate homes by seeing how the furniture fits in before buying the product. Users will get an idea how their rooms would look like furnished by inserting furniture that looks lifelike.

The motivation behind this Augment Reality(AR) app concept is to create an easy tool to customers experience a different style to furnished their homes, instead of customers going to showrooms and try to imagine how each furniture would fit into their houses, the customers experience will be completely new, because using this app they don't need to imagine anymore, they can furnish their houses before buying the actual furniture.

This will permit customers to create new interior designs with few clicks just by adding items from a collection. For example, a customer wants to buy a new sofa for their living room. They just need to open the app in the living room, facing the rear camera to the position they want to place the new sofa. Now, they can browser into the sofas collection, chose the one they like and just added. Customer will get the experience of the sofa been in the place they want it.

There is one app in the Apple store that simulates this experience and is from IKEA. This app is called IKEA Place and lets users to virtually 'place' IKEA products in 'their' space.

This app uses the AR Kit 1 from Apple Swift code, which allows developers to enhance their app with augmented reality. IKEA successfully use AR into their app to sell their products. However, unlike my project, IKEA Place only sells IKEA products.

My project will be an open platform concept that allows more than one company to add and sell their collection. I believe by being open will increase the number of users to experience the different products of different companies.

Another relevant app that is in the market that helps users to decorate their house is called Houzz. Houzz also connects users with architects, builders, interior designers and repair professionals. The main difference between Houzz and my platform is the AR technology, Houzz only uses high-quality images. Unfortunately, these images don't give the same experience as 3D images.

More apps that use AR technology are being used for games and educational. Example AR apps include the following:

Monday, 25 June 2018

3

Juan Armond

ACKA399

2018-19

- BBC Civilisations AR – users can explore beneath the surface of Renaissance masterpieces and discover the secrets of ancient Egypt.
- Lego AR Studio – users can play with digital versions of selected LEGO sets in their real-world scenes.

Project Beneficiaries

According to 2016 Government statistics 8,390 companies contribute £11.3 billion to the country's GDP (7.6% up on previous year), £8.4 billion of this is from UK furniture manufacturing, which equates to 1.6% of manufacturing output. There are 150,000 in specialist furniture and furnishings retail and wholesale, 3,000 in repair, plus a proportion of the 52,000 registered specialist designers. Consumer expenditure on furniture and furnishings in 2016 reached £16.7 billion. (BFC, 2017)

Considering this vast market, I think my project could be very appreciated by those companies and professionals, by building a bridge between them and the consumers.

I already signup with Sofa and More to embark on this entrepreneur project. They will be the first company to include part of their catalogue. This concept app will be used by their clients and interior designers.

Also, I will be a beneficiary, as this will be great opportunity to apply all that I learned and added to my portfolio to show as a great achievement to future employers.

Project Objectives

This project shall create an open platform concept for customers, professionals and decoration companies. Users will be able to scan, detect 3D objects and place them in the real world by using AR technology. Customers can be classified as interior design, builders, homeowner and architects. They will use the app to decorate a room or entire houses by browsing the different collection and adding 3D furniture with the option to save and buy that furniture. Decoration companies will use the app to promote their collection.

The main objective will be divided into two different parts as follows:

Scan and Detect Objects

The first main part of my project, scanning and detecting 3D objects from the real world will enable decorations companies to display and sell their products. This can be delivered

Monday, 25 June 2018

4

Juan Armond

ACKA399

2018-19

through the implementation of accurate scan and detect 3D objects, by making use of the ARKit 2 library. This library gives the tools to scan and detect 3D objects and save the image file to be used later.

This will be assessed in the same user study of 5 to 10 people, they will be observed and asked to try a prototype app and later answer a survey as a form of feedback.

This is quantifiable by testing whether the concept app possesses the correct features such as the following:

- Scan Object – ensuring the app has the feature to scan an object and save as a 3D image.
- Detect Object– ensuring the app has the feature to detect previous save 3D objects.

Add 3D Objects

The second main part of my project, adding lookalike 3D objects into the real world is very important and will give a great experience to users. This can be delivered through the implementation of AR environment by using the ARKit 2 library in Swift language. This library can accurately insert lookalike 3D objects into the real world, which is a whole will contribute to the user immersion of the sense of reality.

This will also be assessed in the same user study of 5 to 10 people, they will be observed and asked to try a prototype app and later answer a survey as a form of feedback.

This is quantifiable by testing whether the concept app has the capacity to renders new virtual objects to create a seamless viewing experience into the real world.

This is important within my project as it is based on allowing users to view the furniture and decoration items in 3D by rotating them and viewing all the augmented content before deciding to purchase.

The follow sub-objectives will be related to the implementation of my application:

Extra Features

- User Account – a users must be able to create an account and select which type of user is going to be.

Juan Armond

ACKA399

2018-19

- Testable – user details will be gathered upon registration and saved in a database. This will let them to login at later date and have quick access to their account.
- Search / Filter – users must be able search and filter for products.
 - Testable – upon insert some word into search field, the user will have option to narrow and the product if found it will be displayed.
- Photo / Share – users must be able to decorate and insert 3D objects and save as a picture to share later.
 - Testable – a photo must be stored on the device and must be retrieved to allow sharing.
- Security – users must be able to login using Touch ID.
 - Testable – user should be able to enter the application by simply using the Touch ID feature if present on their device.

Software Development Process

The project implementation will follow an agile development methodology. This means that it will be developed iteratively and involve customer interactions and feedback throughout each package of the build. As stated earlier, the application will be built in packages and so this methodology is appropriate as it permits the application to be built faster and for users to have continued input in respects to designs and features.

The application will also undergo a lot of User Acceptance Testing (UAT) with real end users subsequent other test methods being accepted successfully. UAT tests will be carried out with a voluntary group of customers, professional and decoration companies after full consent has been agreed.

Monday, 25 June 2018

6

Juan Armond

ACKA399

2018-19

Work Plan

The work plan will be breakdown into packages. Each package will contain deployments with tasks. Performing this will permit me to “divide and conquer” this project.

Work Breakdown

Work Pre-Package

Research and Requirements

WPP D1 – Research and Requirements

- Initial discussion with end users (customers, professionals and decorations companies) to collect a set of requirements.
- Research related applications currently on the market that uses augmented reality and document advantages and disadvantages.
- Relate this document with my proposal in regard to what my application offers that they don't.
- Research all the information necessary (server connection, store information, requirements, etc) for the application to work.

WPP D2 – Requirement Prioritising

- Allocate priority levels (high, medium or low) to each requirement, by comparison the level of interest from end users with complexity to implement.

WPP D3 – Learn XCode, Swift and AR Kit API

- Learn the fundamentals of XCode, Swift and AR Kit by using Apple developer tutorial and YouTube videos.

Juan Armond

ACKA399

2018-19

Juan Armond

ACKA399

2018-19

*Work Package 0*Server Setup

WP0 D1 – Implement Server

- Implement backend database structure to save and access data.

*Work Package 1*Augment Reality

WP1 D1 – Implement User Interface

- Implement the functions scan, detect and add a 3D object.

*Work Package 2*User Account / Types of User

WP2 D1 – Implement User Login Interface

- Implement Welcome, register, sign in and all pages necessary.

*Work Package 3*Extra Features

WP3 D1 – Implement User Interface

- Implement all the extra features.

Deliverables

- Assemble all meetings notes, questionnaires, consent forms I have received from users as a result of user study group.
- Create a well written final report including all research references carried and recognizing any external work.

Juan Armond

ACKA399

2018-19

Juan Armond	ACKA399	2018-19																														
<p>Gantt Chart</p> <p>AR Interior Design Concept</p> <p>Company Name: Armond Software Systems Project Lead: Juan Armond</p> <p>The Gantt chart details the timeline for various project phases:</p> <ul style="list-style-type: none"> Phase 1 Documentation (Oct 1 - Oct 15): Task 1 (Professional Definition Document) at 0%. Phase 2 Coursework and Exams (Oct 16 - Dec 15): Task 1 (Coursework (Term 1)) at 0%, Task 2 (Exams(Term1)) at 0%. Phase 3 Work Pre-Package (Dec 16 - Jan 15): Task 1 (Deliverable1) at 0%, Task 2 (Deliverable2) at 0%, Task 3 (Deliverable3) at 0%. Phase 4 Work Package 0 (Jan 16 - Feb 15): Task 1 (Deliverable1) at 0%. Phase 3 Work Package 1 (Feb 16 - Mar 15): Task 1 (Deliverable1) at 0%. Phase 4 Work Package 2 (Mar 16 - Apr 15): Task 1 (Deliverable1) at 0%. Phase 5 Work Package 3 (Apr 16 - May 15): Task 1 (Deliverable1) at 0%. 																																
Juan Armond	ACKA399	2018-19																														
<p>Project Risks</p> <p>A circular risk meter divided into three segments: Green (Low), Yellow (Med), and Red (High). An arrow points towards the Red segment, indicating a high risk level.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Risk</th> <th>Description</th> <th>Impact Level</th> <th>Probability Level</th> <th>How can Impact be Reduced?</th> <th>How can Probability be Reduced?</th> </tr> </thead> <tbody> <tr> <td>Unsolvable Programming Problem</td> <td>Encounter a programming problem that can't be solved.</td> <td>High</td> <td>High</td> <td>Ensure early that my project objectives can be implemented and are feasible. Apple XCode has an extensive community forum in which difficult questions can be answered.</td> <td>Research significantly ahead of time to guarantee every component of the project is achievable.</td> </tr> <tr> <td>Hardware Failures</td> <td>Hardware (computer and internet connection) used to create the project fails.</td> <td>High</td> <td>Medium</td> <td>Create regular backups on cloud databases and with external devices, so if this happens all work is not gone.</td> <td>Run hardware checks frequently to test whether a device is faulty in anyway.</td> </tr> <tr> <td>AR Implementation not Feasible</td> <td>AR implementation too complex to implement.</td> <td>High</td> <td>Medium</td> <td>Using Apple developer tutorials along with other tutorials, like YouTube videos.</td> <td>Review AR features beforehand evaluating the feasibility and complexity.</td> </tr> <tr> <td>Backend Implementation not Feasible</td> <td>Backend implementation too complex to implement.</td> <td>High</td> <td>Medium</td> <td>Using Apple developer tutorials along with other tutorials, like YouTube videos.</td> <td>Review backend requirement beforehand evaluating the feasibility and complexity.</td> </tr> </tbody> </table>			Risk	Description	Impact Level	Probability Level	How can Impact be Reduced?	How can Probability be Reduced?	Unsolvable Programming Problem	Encounter a programming problem that can't be solved.	High	High	Ensure early that my project objectives can be implemented and are feasible. Apple XCode has an extensive community forum in which difficult questions can be answered.	Research significantly ahead of time to guarantee every component of the project is achievable.	Hardware Failures	Hardware (computer and internet connection) used to create the project fails.	High	Medium	Create regular backups on cloud databases and with external devices, so if this happens all work is not gone.	Run hardware checks frequently to test whether a device is faulty in anyway.	AR Implementation not Feasible	AR implementation too complex to implement.	High	Medium	Using Apple developer tutorials along with other tutorials, like YouTube videos.	Review AR features beforehand evaluating the feasibility and complexity.	Backend Implementation not Feasible	Backend implementation too complex to implement.	High	Medium	Using Apple developer tutorials along with other tutorials, like YouTube videos.	Review backend requirement beforehand evaluating the feasibility and complexity.
Risk	Description	Impact Level	Probability Level	How can Impact be Reduced?	How can Probability be Reduced?																											
Unsolvable Programming Problem	Encounter a programming problem that can't be solved.	High	High	Ensure early that my project objectives can be implemented and are feasible. Apple XCode has an extensive community forum in which difficult questions can be answered.	Research significantly ahead of time to guarantee every component of the project is achievable.																											
Hardware Failures	Hardware (computer and internet connection) used to create the project fails.	High	Medium	Create regular backups on cloud databases and with external devices, so if this happens all work is not gone.	Run hardware checks frequently to test whether a device is faulty in anyway.																											
AR Implementation not Feasible	AR implementation too complex to implement.	High	Medium	Using Apple developer tutorials along with other tutorials, like YouTube videos.	Review AR features beforehand evaluating the feasibility and complexity.																											
Backend Implementation not Feasible	Backend implementation too complex to implement.	High	Medium	Using Apple developer tutorials along with other tutorials, like YouTube videos.	Review backend requirement beforehand evaluating the feasibility and complexity.																											
Juan Armond	ACKA399	2018-19																														

Juan Armond		ACKA399			2018-19
Time Allocation	There is not sufficient time to complete all three work packages.	Medium	Medium	Prioritise the main objectives declared in the project and adjust work plan based on these reasons.	Frequently compare current productivities to the work plan to monitor work package development.
Exam / Coursework Interference	Exams and coursework from other modules interfere with the project, causing overloaded workload.	Medium	High	Account for this possibility in the work plan and plan around it.	Significantly respect the work plan and impose efficient time management to ensure conflicting does not occur.
Lack of Resources	Relevant resources can't be found to give real information on project topic.	Medium	Medium	Have different topics prepare to encase this risk happens.	Attempt to search for resources early to negate problems further down the line.
Absence of Supervisor	Supervisor cannot be reached for external reasons, which means no assistance for that period of time.	Low	Medium	Access to support from other lectures in the field while supervisor is away.	Talk to my supervisor, about this, and meet another lecture in the field.
Learning Swift Language	Difficult to learn new programming language may delay the project.	Medium	High	Likewise, to learning to use XCode, I have begun looking at tutorial and videos and building samples projects.	To improve my knowledge of the application, I will work with sample projects.

Monday, 25 June 2018

11

Juan Armond

ACKA399

2018-19

References

- Apple, 2018. Available at: *Swift* Org. [Online] <https://swift.org/getting-started/#installing-swift> [Accessed 9 October 2018].
- Apple, 2018. Available at: *Swift Interactive Playground.* [Online] <https://developer.apple.com/swift/blog/?id=35> [Accessed 9 October 2018].
- Apple, 2018. Available at: *ARKit 2.* [Online] <https://developer.apple.com/documentation/arkit> [Accessed 9 October 2018].
- Apple, 2018. Available at: *Scanning and Detecting 3D Objects.* [Online] https://developer.apple.com/documentation/arkit/scanning_and_detecting_3d_objects [Accessed 9 October 2018].
- Code with Chris, 2017. Available at: *How to Make an App for Beginners.* [Online] <https://codewithchris.com/lesson1/> [Accessed 9 October 2018].
- Mykola, V. Gleb, B. Evgeniy, A., 2017. Available at: *Create Augment Reality App.* [Online] <https://rubygarage.org/blog/create-augmented-reality-app-for-ios-11> [Accessed 9 October 2018].
- Kirtland, T., 2017. Available at: *Decorating Your Home with ARKit.* [Online] <https://blog.rocketinsights.com/how-to-arkit/> [Accessed 9 October 2018].

Juan Armond

ACKA399

2018-19

Juan Armond

ACKA399

2018-19

Section 2 – Research Ethic Checklist

Ethics Review Form: BSc, MSci, MSc and MA Projects

Computer Science Research Ethics Committee (CSREC)

Undergraduate and postgraduate students undertaking their final project in the Department of Computer Science are required to consider the ethics of their project work and to ensure that it complies with research ethics guidelines. In some cases, a project will need approval from an ethics committee before it can proceed. Usually, but not always, this will be because the student is involving other people ("participants") in the project.

In order to ensure that appropriate consideration is given to ethical issues, all students must complete this form and attach it to their project proposal document. There are two parts:

Part A: Ethics Checklist. All students must complete this part. The checklist identifies whether the project requires ethical approval and, if so, where to apply for approval.

Part B: Ethics Proportionate Review Form. Students who have answered "no" to questions 1 – 18 and "yes" to question 19 in the ethics checklist must complete this part. The project supervisor has delegated authority to provide approval in this case. The approval may be provisional: the student may need to seek additional approval from the supervisor as the project progresses.

A.1 If your answer to any of the following questions (1 – 3) is YES, you must apply to an appropriate external ethics committee for approval. <i>Delete as appropriate</i>		
1.	Does your project require approval from the National Research Ethics Service (NRES)? For example, because you are recruiting current NHS patients or staff? If you are unsure, please check at http://www.hra.nhs.uk/research-community/before-you-apply/determine-which-review-body-approvals-are-required/ .	No
2.	Does your project involve participants who are covered by the Mental Capacity Act? If so, you will need approval from an external ethics committee such as NRES or the Social Care Research Ethics Committee http://www.scie.org.uk/research/ethics-committee/ .	No
3.	Does your project involve participants who are currently under the auspices of the Criminal Justice System? For example, but not limited to, people on remand, prisoners and those on probation? If so, you will need approval from the ethics approval system of the National Offender Management Service.	No

Monday, 25 June 2018

13

Juan Armond

ACKA399

2018-19

A.2 If your answer to any of the following questions (4 – 11) is YES, you must apply to the City University Senate Research Ethics Committee (SREC) for approval (unless you are applying to an external ethics committee).			<i>Delete as appropriate</i>
4.	Does your project involve participants who are unable to give informed consent? For example, but not limited to, people who may have a degree of learning disability or mental health problem, that means they are unable to make an informed decision on their own behalf?	No	
5.	Is there a risk that your project might lead to disclosures from participants concerning their involvement in illegal activities?	No	
6.	Is there a risk that obscene and or illegal material may need to be accessed for your project (including online content and other material)?	No	
7.	Does your project involve participants disclosing information about sensitive subjects? For example, but not limited to, health status, sexual behaviour, political behaviour, domestic violence.	No	
8.	Does your project involve you travelling to another country outside of the UK, where the Foreign & Commonwealth Office has issued a travel warning? (See http://www.fco.gov.uk/en/)	No	
9.	Does your project involve physically invasive or intrusive procedures? For example, these may include, but are not limited to, electrical stimulation, heat, cold or bruising.	No	
10.	Does your project involve animals?	No	
11.	Does your project involve the administration of drugs, placebos or other substances to study participants?	No	

A.3 If your answer to any of the following questions (12 – 18) is YES, you must submit a full application to the Computer Science Research Ethics Committee (CSREC) for approval (unless you are applying to an external ethics committee or the Senate Research Ethics Committee). Your application may be referred to the Senate Research Ethics Committee.

12.	Does your project involve participants who are under the age of 18?	No
13.	Does your project involve adults who are vulnerable because of their social, psychological or medical circumstances (vulnerable adults)? This includes adults with cognitive and / or learning disabilities, adults with physical disabilities and older people.	No
14.	Does your project involve participants who are recruited because they are staff or students of City University London? For example, students	No

Monday, 25 June 2018

14

Juan Armond

ACKA399

2018-19

	studying on a specific course or module. (If yes, approval is also required from the Head of Department or Programme Director.)	
15.	Does your project involve intentional deception of participants?	No
16.	Does your project involve participants taking part without their informed consent?	No
17.	Does your project pose a risk to participants or other individuals greater than that in normal working life?	No
18.	Does your project pose a risk to you, the researcher, greater than that in normal working life?	No

A.4 If your answer to the following question (19) is YES and your answer to all questions 1 – 18 is NO, you must complete part B of this form.

19.	Does your project involve human participants or their identifiable personal data? For example, as interviewees, respondents to a survey or participants in testing.	Yes
-----	---	-----

Part B: Ethics Proportionate Review Form

If you answered YES to question 19 and NO to all questions 1 – 18, you may use this part of the form to submit an application for a proportionate ethics review of your project. Your project supervisor has delegated authority to review and approve this application.

However, if you cannot provide all the required attachments (see B.3) with your project proposal (e.g. because you have not yet written the consent forms, interview schedules etc), the approval from your supervisor will be provisional. You **must** submit the missing items to your supervisor for approval prior to commencing these parts of your project. Failure to do so may result in you failing the project module.

There may also be circumstances in which your supervisor will ask you to submit a full ethics application to the CSREC, e.g. if your supervisor feels unable to approve your application or if you need an approval letter from the CSREC for an external organisation.

B.1 The following questions (20 – 24) must be answered fully.		<i>Delete as appropriate</i>
20.	Will you ensure that participants taking part in your project are fully informed about the purpose of the research?	Yes
21.	Will you ensure that participants taking part in your project are fully informed about the procedures affecting them or affecting any information collected about them, including information about how the data will be used, to whom it will be disclosed, and how long it will be kept?	Yes

Monday, 25 June 2018

15

Juan Armond

ACKA399

2018-19

22.	When people agree to participate in your project, will it be made clear to them that they may withdraw (i.e. not participate) at any time without any penalty?	Yes
23.	Will consent be obtained from the participants in your project? Consent from participants will be necessary if you plan to involve them in your project or if you plan to use identifiable personal data from existing records. "Identifiable personal data" means data relating to a living person who might be identifiable if the record includes their name, username, student id, DNA, fingerprint, address, etc. <i>If YES, you must attach drafts of the participant information sheet(s) and consent form(s) that you will use in section B.3 or, in the case of an existing dataset, provide details of how consent has been obtained.</i> <i>You must also retain the completed forms for subsequent inspection.</i> <i>Failure to provide the completed consent request forms will result in withdrawal of any earlier ethical approval of your project.</i>	Yes
24.	Have you made arrangements to ensure that material and/or private information obtained from or about the participating individuals will remain confidential? Provide details:	Yes

B.2 If the answer to the following question (25) is YES, you must provide details		<i>Delete as appropriate</i>
25.	Will the research be conducted in the participant's home or other non-University location? <i>If YES, provide details of how your safety will be ensured:</i>	No

B.3 Attachments (these should be provided if applicable):		<i>Delete as appropriate</i>
Participant information sheet(s)**		Yes
Consent form(s)**		Yes
Questionnaire(s)**		Yes
Topic guide(s) for interviews and focus groups**		No
Permission from external organisations (e.g. for recruitment of participants)**		Not applicable

Monday, 25 June 2018

16

Juan Armond

ACKA399

2018-19

****If these items are not available at the time of submitting your project proposal, provisional approval through proportionate review can still be given, under the condition that you must submit the final versions of all items to your supervisor for approval at a later date. All such items **must** be seen and approved by your supervisor before the activity for which they are needed starts.**

Templates

You must use the templates provided by the University as the basis for your participant information sheets and consent forms. These are available from the links below but you **must** adapt them according to the needs of your project before you submit them for consideration.

Adult information sheet:

http://www.city.ac.uk/_data/assets/word_doc/0018/153441/TEMPLATE-FOR-PARTICIPANT-INFORMATION-SHEET.doc

Adult consent form:

http://www.city.ac.uk/_data/assets/word_doc/0004/153418/TEMPLATE-FOR-CONSENT-FORM.doc

Further Information

Information about the Computer Science Research Ethics Committee (CSREC) is available at:

<http://www.city.ac.uk/department-computer-science/research-ethics>

Information about the City University Senate Research Ethics Committee is available at:

<http://www.city.ac.uk/research/research-and-enterprise/research-ethics>

Juan Armond

ACKA399

2018-19

Appendix – Consent Form

Consent Form Template

Consent form for testing AR Interior Design Concept – Mobile Application

I _____ agree to take part in the above-named City University final year project. |

The project has been fully explained to me and understand both the information given to me by the individual carrying out the research and the information sheet which I am able to keep for future records.

I understand that I may be required to:

- Complete questionnaires asking about my experiences with the application along with potential changes I could suggest.
- Make use of a provided iPhone to run the application on.
- Make myself available for future interviews should it be a requirement.

Furthermore, I understand that any information I provide will be used for the purposes of improving the final build for the project and submitted as part of the final write-up of the project.

I also understand that any material that is not required for submission will be confidentially disposed of at the end of the project.

I understand that my participation is voluntary and that I have the option to withdraw at any given time and that the whole process will be run under the obligations set out by the Data Protection Act 1998

Participant Name: _____

Juan Armond

ACKA399

2018-19

Appendix – Questionnaire

Questionnaire

User: _____ Date: _____

Please complete the following questionnaire by placing a cross in the appropriate box.

	Strongly Agree	Agree	Uncertain / Not	Disagree	Strongly Disagree
1. I was able to successfully install the app.	<input type="checkbox"/>				
2. I found the application permission requests (use mobile camera) reasonable.	<input type="checkbox"/>				
3. I found the sign-up process simple and sufficient.	<input type="checkbox"/>				
4. I found the login process to be fast.	<input type="checkbox"/>				
5. I found the user interface to be intuitive.	<input type="checkbox"/>				
6. I could find the information I am looking for with minimal effort.	<input type="checkbox"/>				
7. I could choose and insert 3D objects into the real world.	<input type="checkbox"/>				
8. I could scan and detect 3D objects from the real world.	<input type="checkbox"/>				
9. I intend to buy this furniture after “trying” at my home.	<input type="checkbox"/>				
10. I was able to clearly read the description of the object.	<input type="checkbox"/>				
11. I found the push notifications to be useful.	<input type="checkbox"/>				
12. I was able to log out of the app.	<input type="checkbox"/>				
13. I found the upload process simple and sufficient.	<input type="checkbox"/>				
14. Leave a comment.					
<ul style="list-style-type: none"> • 13 – Only be answer by Decoration Companies and Professionals 					

Juan Armond

ACKA399

2018-19

Appendix B – Code Lines

```
\ Project/InteriorDesign\ AR/InteriorDesign\ AR/Controller
Juans-MacBook-Air:Controller juanarmond$ ls
ARScanViewController.swift           SearchItemViewController.swift
ARViewController.swift               SignInViewController.swift
AppDelegate.swift                  TypeUserViewController.swift
CompanyAccountViewController.swift  ViewController.swift
CreateAccountViewController.swift   pdfCreatorViewController.swift
ScanViewController.swift           shopListViewController.swift
Juans-MacBook-Air:Controller juanarmond$ find . -name "*.swift" -print0 | xargs
-0 wc -l
    26 ./ViewController.swift
  218 ./SearchItemViewController.swift
  139 ./ARScanViewController.swift
  109 ./ScanViewController.swift
  190 ./pdfCreatorViewController.swift
  166 ./shopListViewController.swift
    55 ./AppDelegate.swift
  310 ./ARViewController.swift
  115 ./CreateAccountViewController.swift
  288 ./CompanyAccountViewController.swift
  270 ./TypeUserViewController.swift
  102 ./SignInViewController.swift
 1988 total
Juans-MacBook-Air:Controller juanarmond$
```

Figure 38 Total of Lines of Code

Appendix C – Software Requirements Analysis Document

Commercial-in-Confidence

City University London

Software Engineering Final Year Project Report

Academic Year: 2018-19

Software Requirements Analysis Document

For

(AR) Interior Design Concept

By

Juan Armond

Tel. 075 1578-9552

Email: juan.armond@city.ac.uk

Commercial-in-Confidence

Table of Contents

<i>Preface</i>	3
Purpose and Scope of Document	3
Intended Audience.....	3
History of Document.....	3
<i>Comparison of Existing Systems</i>	4
Introduction.....	4
Tabular Comparison of Existing Systems	4
<i>Interview with End Users</i>	- 5 -
Story Cards Meaning.....	- 5 -
Key points Collected from Interviews.....	- 5 -
<i>Agile Story Cards Backlog</i>	6
<i>Prioritized Requirements</i>	12
<i>Storyboard</i>	13
<i>System Evolution</i>	14
<i>Index</i>	14
<i>References</i>	15

Commercial-in-Confidence**Preface**

The following document was created during the analysis and requirements phase of AR Interior Design Concept project.

Purpose and Scope of Document

This is a software requirements document for the AR Interior Design Concept project and uses story card to cover the requirements with the various implementation constraints defined in the initial interview with from the end users.

The document explains what the system shall do but not how the functionality can be implemented. Various models are used to convey in more detail to system developers the expected behaviour of the system.

Intended Audience

The intended audience for this document includes the developer, supervisor and any third-part individual involved in the marking of this project's success.

History of Document

Version	Date	Author	Description
1.0	29/10/2018	Juan Armond	Initial Version
1.1	05/11/2018	Juan Armond	Added changes to tabular comparison of existing systems
1.2	10/11/2018	Juan Armond	Added more details to story cards.
1.3	01/12/2018	Juan Armond	Add Storyboard

Commercial-in-Confidence

Comparison of Existing Systems

Introduction

The table below displays a comparison of two applications presently on Apple's AppStore that offer similar functionality to that of AR Interior Design application. The AR Interior Design column of the table indicates whether the author desires to include in the application.

Tabular Comparison of Existing Systems

Features	IKEA Place	Houzz	AR Interior Design
User Account	-	X	Expect
Different Types of Users	-	X	Expect
Browse Collection	X	X	Expect
Search Item	X	X	Expect
3D Object Augment Reality	X	-	Expect
Scan and Detect Object	-	-	Expect
User Avatar	-	X	Expect
Upload 3D Object file	-	-	Expect
Shopping List	X	X	Expect
Save and Share	X	X	Expect
Generate PDF Invoice	-	-	Expect
Download Bar Progression	-	-	Expect

Table 1 Tabular Comparison of Existing Software

As the table 1 shows, Ikea Place has a lack of the feature's create user account, type of users, scan and detect object, user avatar, upload 3D object file, generate PDF invoice and download bar progression. Houzz has the feature to create user account, different types of users, user avatar but unfortunately, don't have the option to visualize and upload 3D objects, generate PDF invoice and download bar progression. However, AR Interior Design is expected to include all the Ikea and Houzz features plus the features that they don't have.

Commercial-in-Confidence**Interview with End Users**

Interview with end users are handled to understand what requirements the software needed to accomplish. Was used story cards to capture user requirements and to manage the delivery of user functionality.

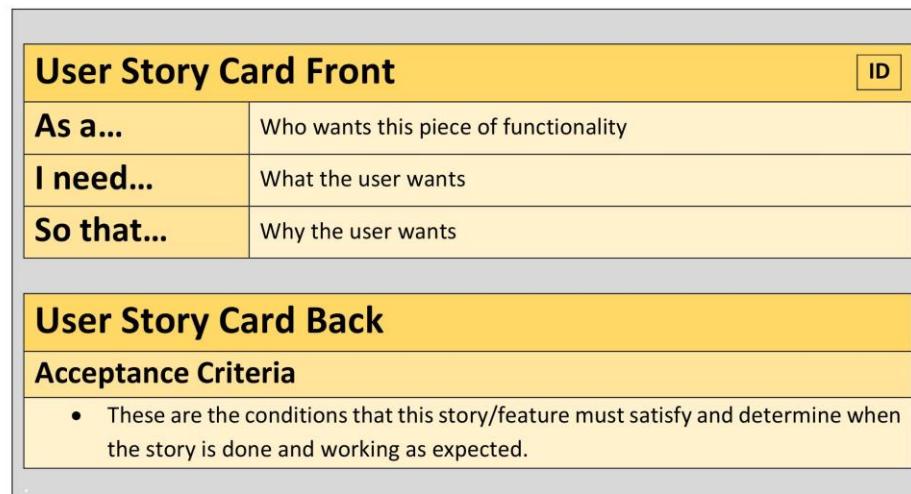
User Story Cards Meaning

Figure 1 Story Card Model

Key points Collected from Interviews

- Customers find difficult to imagine how a furniture will fit in their room by just looking at them.
- Independent professionals and small decoration companies don't have a platform to promote their services and products.
- Expense and complexity tools to create new interior designs.
- Hard to find good professionals.
- New type of shopping experience.

Commercial-in-Confidence**Agile User Story Cards**

Story cards is a very high-level definition of a requirement, which includes ID number, As a (role) I need (desire/goal), So that (receive benefit) and Acceptance Criteria (the expect result of this story card) so that the developers can put together a reasonable estimate of the effort to implement it. All the story cards are group together and can be tested later to see if offers all functionality agreed with potential end users.

User Story Card Front		1
As a...	Unauthorized user	
I need...	To register for an account	
So that...	I can have an account.	
User Story Card Back		
Acceptance Criteria		
<ul style="list-style-type: none"> Given I am a Customer, Professional or Decoration Company account is created and stored in the database. Welcome page. Images should load and the correct validation to each text field. 		

Figure 2 Story Card 1

User Story Card Front		2
As a...	Unauthorized user	
I need...	To login and access the options related to my privileges.	
So that...	I can use the application.	
User Story Card Back		
Acceptance Criteria		
<ul style="list-style-type: none"> Given I am a customer, I can start browsing all the decoration collection and professionals' services. Given I am a decoration company / professional, I can upload 3D object file. Images should load and the correct validation to each text field. 		

Figure 3 Story Card 2

Commercial-in-Confidence

User Story Card Front		3
As a...	As an authorized user	
I need...	To browser all the decoration collection.	
So that...	I can choose what I want.	
User Story Card Back		
Acceptance Criteria		
<ul style="list-style-type: none"> • Authorized User must be able see all different products. • Authorized User must be able to swap down and refresh the decoration collection. 		

Figure 4 Story Card 3

User Story Card Front		4
As a...	Customer	
I need...	To virtually 'place' decoration item in 'my' room.	
So that...	I can experience how that furniture will harmonise into my room.	
User Story Card Back		
Acceptance Criteria		
<ul style="list-style-type: none"> • Customer must be able to download and load a 3D objects file. • Customer must be able to add 3D objects into their room. • Customer must be able to add that item into a shopping list. 		

Figure 5 Story Card 4

User Story Card Front		5
As a...	Customer	
I need...	Save photo.	
So that...	I can see how the product fitted in my room later.	
User Story Card Back		
Acceptance Criteria		

Commercial-in-Confidence

- Customer must be able to save a photo into their mobile photo library after adding the product into their room.

Figure 6 Story Card 5

User Story Card Front

6

As a...	Customer
I need...	To scan and detect furniture.
So that...	I can read a description and check price.

User Story Card Back**Acceptance Criteria**

- Customer must be able to scan and detect any furniture that is previous scanned and display the correct description and price of that furniture.

Figure 7 Story Card 6

User Story Card Front

7

As a...	Customer
I need...	To share photo.
So that...	I can share the photo of the product into my room.

User Story Card Back**Acceptance Criteria**

- Customer must be able to share a photo of the product into their room by social media and/or email without leaving the app.

Figure 8 Story Card 7

User Story Card Front

8

As a...	As an authorized user
I need...	To save my avatar.
So that...	I can be easily recognised.

Commercial-in-Confidence

User Story Card Back

Acceptance Criteria

- User must be able to take self or upload a previous picture and store it in their account.

Figure 9 Story Card 8

User Story Card Front

9

As a...	Decoration Company/Professional
I need...	To upload 3D images.
So that...	I can display my collection.

User Story Card Back

Acceptance Criteria

- I Decoration Company / Professional must be able to insert the details and upload 3D images of furniture to create a collection range.

Figure 10 Story Card 9

User Story Card Front

10

As a...	Customer
I need...	To search/filter for a product.
So that...	I can narrow down my search.

User Story Card Back

Acceptance Criteria

- A customer can be able to search by keywords at the product list.

Figure 11 Story Card 10

User Story Card Front

11

As a...	As an authorized user
I need...	To visualise the download progression of 3D object.
So that...	I can see the percentage of the download progression.

Commercial-in-Confidence

User Story Card Back

Acceptance Criteria

- After selecting the product, the application must show a download bar progression and how many percentages was download.

Figure 12 Story Card 11

User Story Card Front

12

As a...	Customer
I need...	To create a shopping list.
So that...	I can see all my items.

User Story Card Back

Acceptance Criteria

- Customer can add products into a shopping list to buy later.
- Customer can remove products from a shopping list.

Figure 13 Story Card 12

User Story Card Front

13

As a...	Authorized user
I need...	A popup messages.
So that...	I can receive some feedback.

User Story Card Back

Acceptance Criteria

- Unauthorized User that insert wrong username and/or password.
- Unauthorized User creating an account without fill all the fields.
- Unauthorized User creating an account with email that is already in the database.
- Authorized User add an item to shopping list.
- Authorized User update a shopping list item quantity.
- Authorized User trying to check an empty shopping list.
- Authorized User trying to add an already item into their shopping list.
- Authorized User go to the shopping list and automatically displays the price total.
- Decoration Company/Professional trying to upload a product that is already in the database.
- Decoration Company/Professional trying to upload a product without fill all the fields.

Commercial-in-Confidence

- Terms and Conditions description.

Figure 14 Story Card 13

User Story Card Front

14

As a...	Customer
I need...	An invoice.
So that...	I can buy a product.

User Story Card Back**Acceptance Criteria**

- Customer select generate PDF invoice option after chose to buy, the application will generate a PDF Invoice with the company details, all items previous selected and total.

Figure 15 Story Card 14

User Story Card Front

15

As a...	Application
I need...	To connect to database.
So that...	Information could be store.

User Story Card Back**Acceptance Criteria**

- Firebase console shows that have an active user connected.

Figure 16 Story Card 15

User Story Card Front

16

As a...	Authorized user
I need...	To navigate through the interfaces.
So that...	I can go to the desire interface.

User Story Card Back**Acceptance Criteria**

Commercial-in-Confidence

- Authorized user could navigate through the different interfaces of the application. Go forward and back.

Figure 17 Story Card 16

Prioritized Requirements

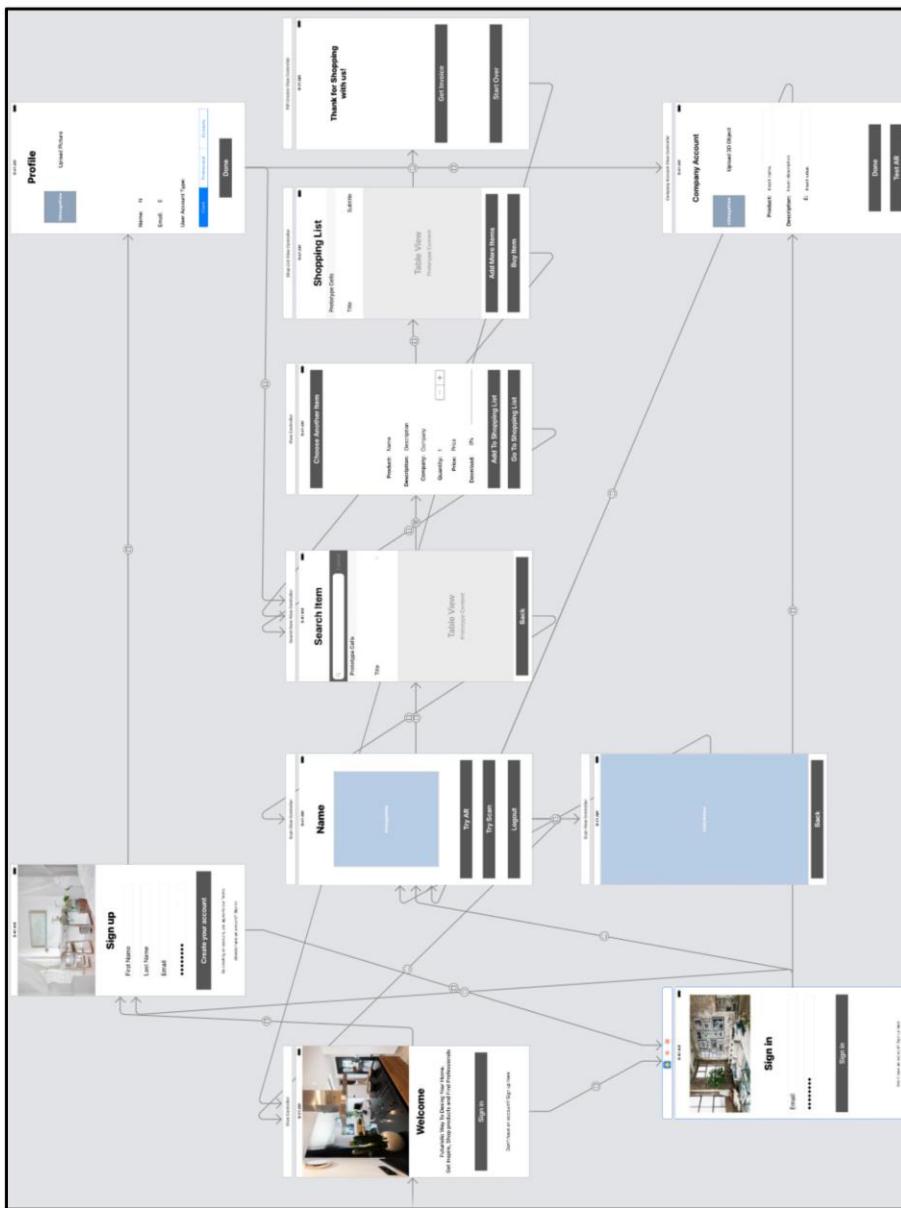
The table below demonstrates the list of story cards with priority level attribute added to each one. This priority level was the outcome of discussions with both supervisor, end users and the author analysis of the complexity of task versus availability of time.

To Do...	Priority
SC01	High
SC02	High
SC03	High
SC04	High
SC05	Low
SC06	High
SC07	Low
SC08	Medium
SC09	High
SC10	Medium
SC11	Low
SC12	High
SC13	Low
SC14	High
SC15	High
SC16	Medium

Commercial-in-Confidence

Storyboard

Storyboard is a visual representation of the user interface of an iOS application, showing screens of content and the connections between those screens. A storyboard is composed of a sequence of scenes, each of which represents a view controller and its views; scenes are connected by segue objects, which represent a transition between two view controllers [1].



Commercial-in-Confidence**System Evolution**

No discussions about system evolution have taken place yet. However, we envision developing ways to capitalize from advertising and sponsorship. In that case, decoration companies and professionals will pay to promote and send notifications about new products and services.

Index

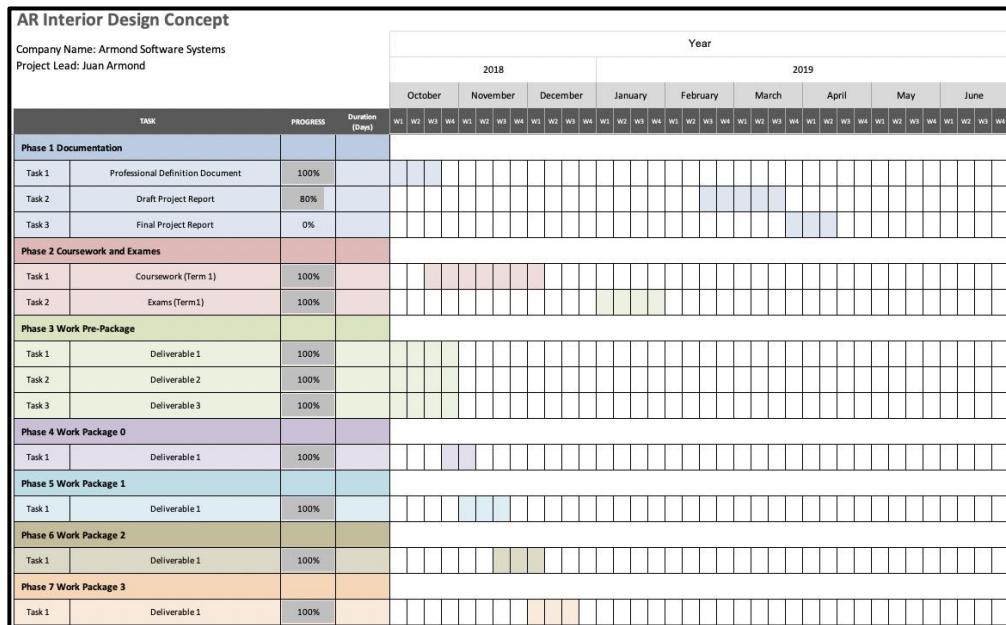
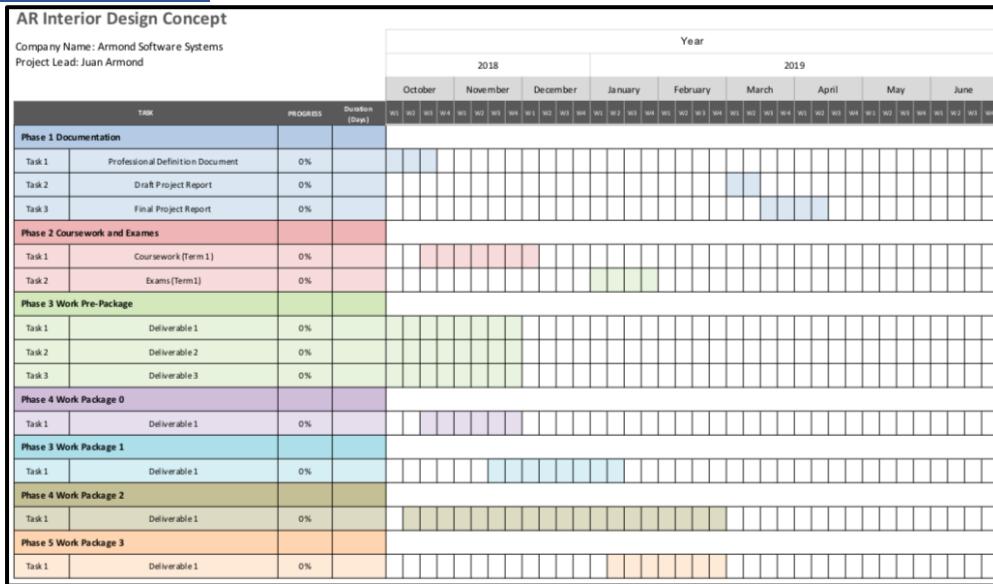
Not provided in this version of the document.

Commercial-in-Confidence

References

- [1] Apple, 2018. Cocoa Application Competencies for iOS. [Online]
Available at:
<https://developer.apple.com/library/archive/documentation/General/Conceptual/Devpedia-CocoaApp/Storyboard.html>
[Accessed 15 February 2018].

Appendix D – Gantt Chart



Comparing Figure 7 Original Gantt Chart and Figure 8 Updated Gantt Chart, Phase 1 Documentation PDD was completed on the estimated time, draft project report was initiated two weeks before scheduling and final project report is expected to be ready on the scheduled time. Phase 2 Coursework and Exams was completed on the estimated time. Phase 3 Work Pre-Package was delivered with four weeks before the estimated time. Phase 4 Work Package 0 was started one week late but was delivered three weeks early. Phase 5 Work Package 1 was implemented two weeks early and finished seven weeks before planned. Phase 6 Work Package 2 was expected to endure nineteen weeks but was delivered on three weeks. Also, Phase 7 Work Package 3 was delivered in three weeks.

The Author was expecting a comprehensive amount of work since he didn't have the knowledge required to programming an iPhone application, and to not take any risks in delivery the project behind schedule, the initial estimate to complete each deliverable was planned to be lasting longer. As soon the author started researching, watching tutorial videos and reading the library documentation each interaction of the project was updated to a more realistic time.

Appendix E – Feedback Reports

Juan Armond

Individual Project - 2018

ACKA399

Consent Form Template

Consent form for testing AR Interior Design Concept – Mobile Application

I Juan Armond agree to take part in the above-named City University final year project.

The project has been fully explained to me and understands both the information given to me by the individual carrying out the research and the information sheet which I am able to keep for future records.

I understand that I may be required to:

- Complete questionnaires asking about my experiences with the application along with potential changes I could suggest.
- Make use of a provided iPhone to run the application on.
- Make myself available for future interviews should it be a requirement.

Furthermore, I understand that any information I provide will be used for the purposes of improving the final build for the project and submitted as part of the final write-up of the project.

I also understand that any material that is not required for submission will be confidentially disposed of at the end of the project.

I understand that my participation is voluntary and that I have the option to withdraw at any given time and that the whole process will be run under the obligations set out by the Data Protection Act 1998.

Participant Name: Juan Armond

Participant Signature: Juan Armond Date 11/12/2018

Juan Armond

Individual Project - 2018

ACKA399

Questionnaire

User: Luciana BucciDate: 11/11/18.

Please complete the following questionnaire by placing a cross in the appropriate box.

	Strongly Agree	Agree	Uncertain / Not	Disagree	Strongly Disagree
1. I found the application permission requests (use the mobile camera) reasonable.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I found the sign-up process simple.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I found the login process to be fast.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I found the user interface to be intuitive.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I could find the information I am looking for with minimal effort.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I could choose and insert 3D objects into the real world.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I could scan and detect 3D objects from the real world.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. I intend to buy this furniture after "trying" at my home.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I was able to read the description of the object clearly.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. I was able to buy and generate an invoice at the end.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. I was able to logout of the app.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. I found the upload process simple and sufficient. *	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Leave a comment.	<p>Perfect App. Very easy and fun.</p>				

* Only to be answered by professionals or companies.

Juan Armond

Individual Project - 2018

ACKA399

Consent Form Template

Consent form for testing AR Interior Design Concept – Mobile Application

I FADYNE L DAI0 agree to take part in the above-named City University final year project.

The project has been fully explained to me and understands both the information given to me by the individual carrying out the research and the information sheet which I am able to keep for future records.

I understand that I may be required to:

- Complete questionnaires asking about my experiences with the application along with potential changes I could suggest.
- Make use of a provided iPhone to run the application on.
- Make myself available for future interviews should it be a requirement.

Furthermore, I understand that any information I provide will be used for the purposes of improving the final build for the project and submitted as part of the final write-up of the project.

I also understand that any material that is not required for submission will be confidentially disposed of at the end of the project.

I understand that my participation is voluntary and that I have the option to withdraw at any given time and that the whole process will be run under the obligations set out by the Data Protection Act 1998.

Participant Name: FADYNE L DAI0

Participant Signature: Fadyne L DAI0 Date 11/12/2018

Juan Armond

Individual Project - 2018

ACKA399

Questionnaire

User: Fady Date: 11/12/2018

Please complete the following questionnaire by placing a cross in the appropriate box.

	Strongly Agree	Agree	Uncertain / Not	Disagree	Strongly Disagree
1. I found the application permission requests (use the mobile camera) reasonable.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I found the sign-up process simple.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I found the login process to be fast.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I found the user interface to be intuitive.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I could find the information I am looking for with minimal effort.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I could choose and insert 3D objects into the real world.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I could scan and detect 3D objects from the real world.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. I intend to buy this furniture after "trying" at my home.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I was able to read the description of the object clearly.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. I was able to buy and generate an invoice at the end.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. I was able to logout of the app.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. I found the upload process simple and sufficient. *	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

13. Leave a comment.

Very good app

* Only to be answered by professionals or companies.

Invoice
Date: 11/12/2018



Sofa and More
Unit 5, Phoenix Trading Estate
Bilton Road, Perivale
Greenford, UB6-7DZ

Name: Fady Daio
Email: finance1@sm-london.com

Item Name	Quantity	Cost
chair	1	£ 45.50
Total		£ 45.50

Juan Armond

Individual Project - 2018

ACKA399

Consent Form Template

Consent form for testing AR Interior Design Concept – Mobile Application

I JOSIANI AP. PELISSON agree to take part in the above-named City University final year project.

The project has been fully explained to me and understands both the information given to me by the individual carrying out the research and the information sheet which I am able to keep for future records.

I understand that I may be required to:

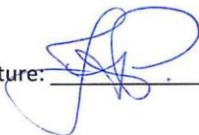
- Complete questionnaires asking about my experiences with the application along with potential changes I could suggest.
- Make use of a provided iPhone to run the application on.
- Make myself available for future interviews should it be a requirement.

Furthermore, I understand that any information I provide will be used for the purposes of improving the final build for the project and submitted as part of the final write-up of the project.

I also understand that any material that is not required for submission will be confidentially disposed of at the end of the project.

I understand that my participation is voluntary and that I have the option to withdraw at any given time and that the whole process will be run under the obligations set out by the Data Protection Act 1998.

Participant Name: JOSIANI AP. PELISSON

Participant Signature: 

Date 11/12/2018

Juan Armond

Individual Project - 2018

ACKA399

Questionnaire

User: JOSIANI AP RELISSONDate: 11/12/2018

Please complete the following questionnaire by placing a cross in the appropriate box.

	Strongly Agree	Agree	Uncertain / Not	Disagree	Strongly Disagree
1. I found the application permission requests (use the mobile camera) reasonable.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I found the sign-up process simple.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I found the login process to be fast.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I found the user interface to be intuitive.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I could find the information I am looking for with minimal effort.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I could choose and insert 3D objects into the real world.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I could scan and detect 3D objects from the real world.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. I intend to buy this furniture after "trying" at my home.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I was able to read the description of the object clearly.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. I was able to buy and generate an invoice at the end.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. I was able to logout of the app.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. I found the upload process simple and sufficient. *	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Leave a comment.					

* Only to be answered by professionals or companies.

Invoice
Date: 11/12/2018



Sofa and More
Unit 5, Phoenix Trading Estate
Bilton Road, Perivale
Greenford, UB6-7DZ

Name: Josiani Pelisson
Email: finance2@sm-london.com

Item Name	Quantity	Cost
guitar	1	£ 678.00
Total		£ 678.00

Juan Armond

Individual Project - 2018

ACKA399

Consent Form Template

Consent form for testing AR Interior Design Concept – Mobile Application

I Elisiole Brito agree to take part in the above-named City University final year project.

The project has been fully explained to me and understands both the information given to me by the individual carrying out the research and the information sheet which I am able to keep for future records.

I understand that I may be required to:

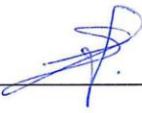
- Complete questionnaires asking about my experiences with the application along with potential changes I could suggest.
- Make use of a provided iPhone to run the application on.
- Make myself available for future interviews should it be a requirement.

Furthermore, I understand that any information I provide will be used for the purposes of improving the final build for the project and submitted as part of the final write-up of the project.

I also understand that any material that is not required for submission will be confidentially disposed of at the end of the project.

I understand that my participation is voluntary and that I have the option to withdraw at any given time and that the whole process will be run under the obligations set out by the Data Protection Act 1998.

Participant Name: Elisiole Brito

Participant Signature:  Date 11 Dec. 2018

Juan Armond

Individual Project - 2018

ACKA399

Questionnaire

User: Elisete BiroDate: 11 Dec. 2018

Please complete the following questionnaire by placing a cross in the appropriate box.

	Strongly Agree	Agree	Uncertain / Not	Disagree	Strongly Disagree
1. I found the application permission requests (use the mobile camera) reasonable.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I found the sign-up process simple.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I found the login process to be fast.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I found the user interface to be intuitive.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I could find the information I am looking for with minimal effort.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I could choose and insert 3D objects into the real world.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I could scan and detect 3D objects from the real world.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. I intend to buy this furniture after "trying" at my home.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I was able to read the description of the object clearly.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. I was able to buy and generate an invoice at the end.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. I was able to logout of the app.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. I found the upload process simple and sufficient. *	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Leave a comment.	<p>GREAT APP...</p> <p>I wish you very successful</p>				

* Only to be answered by professionals or companies.

Invoice
Date: 11/12/2018



Sofa and More
Unit 5, Phoenix Trading Estate
Bilton Road, Perivale
Greenford, UB6-7DZ

Name: Elisabete Brito
Email: info@sm-london.com

Item Name	Quantity	Cost
plant pot	1	£ 5.00
Total		£ 5.00

Juan Armond

Individual Project - 2018

ACKA399

Consent Form Template

Consent form for testing AR Interior Design Concept – Mobile Application

I Pedro Ribeiro agree to take part in the above-named City University final year project.

The project has been fully explained to me and understands both the information given to me by the individual carrying out the research and the information sheet which I am able to keep for future records.

I understand that I may be required to:

- Complete questionnaires asking about my experiences with the application along with potential changes I could suggest.
- Make use of a provided iPhone to run the application on.
- Make myself available for future interviews should it be a requirement.

Furthermore, I understand that any information I provide will be used for the purposes of improving the final build for the project and submitted as part of the final write-up of the project.

I also understand that any material that is not required for submission will be confidentially disposed of at the end of the project.

I understand that my participation is voluntary and that I have the option to withdraw at any given time and that the whole process will be run under the obligations set out by the Data Protection Act 1998.

Participant Name: Pedro Ribeiro

Participant Signature: JR Date 11/12/2018

Juan Armond

Individual Project - 2018

ACKA399

Questionnaire

User: RodsoDate: 11/12/18

Please complete the following questionnaire by placing a cross in the appropriate box.

	Strongly Agree	Agree	Uncertain / Not	Disagree	Strongly Disagree
1. I found the application permission requests (use the mobile camera) reasonable.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I found the sign-up process simple.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I found the login process to be fast.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I found the user interface to be intuitive.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I could find the information I am looking for with minimal effort.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I could choose and insert 3D objects into the real world.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I could scan and detect 3D objects from the real world.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
8. I intend to buy this furniture after "trying" at my home.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
9. I was able to read the description of the object clearly.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. I was able to buy and generate an invoice at the end.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. I was able to logout of the app.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. I found the upload process simple and sufficient. *	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

13. Leave a comment.

Thank you, I believe this will be extremely useful for our company.

* Only to be answered by professionals or companies.

Invoice
Date: 11/12/2018



Sofa and More
Unit 5, Phoenix Trading Estate
Bilton Road, Perivale
Greenford, UB6-7DZ

Name: Pedro Ribeiro
Email: pedro@sm-london.com

Item Name	Quantity	Cost
guitar	1	£ 678.00
Total		£ 678.00

Juan Armond

Individual Project - 2018

ACKA399

Consent Form Template

Consent form for testing AR Interior Design Concept – Mobile Application

I Jonathan agree to take part in the above-named City University final year project.

The project has been fully explained to me and understands both the information given to me by the individual carrying out the research and the information sheet which I am able to keep for future records.

I understand that I may be required to:

- Complete questionnaires asking about my experiences with the application along with potential changes I could suggest.
- Make use of a provided iPhone to run the application on.
- Make myself available for future interviews should it be a requirement.

Furthermore, I understand that any information I provide will be used for the purposes of improving the final build for the project and submitted as part of the final write-up of the project.

I also understand that any material that is not required for submission will be confidentially disposed of at the end of the project.

I understand that my participation is voluntary and that I have the option to withdraw at any given time and that the whole process will be run under the obligations set out by the Data Protection Act 1998.

Participant Name: Jonathan Boas

Participant Signature: Jonathan Boas Date 11/12/18

Juan Armond

Individual Project - 2018

ACKA399

Questionnaire

User: _____ Date: _____

Please complete the following questionnaire by placing a cross in the appropriate box.

	Strongly Agree	Agree	Uncertain / Not	Disagree	Strongly Disagree
1. I found the application permission requests (use the mobile camera) reasonable.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I found the sign-up process simple.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I found the login process to be fast.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I found the user interface to be intuitive.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I could find the information I am looking for with minimal effort.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I could choose and insert 3D objects into the real world.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I could scan and detect 3D objects from the real world.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. I intend to buy this furniture after "trying" at my home.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I was able to read the description of the object clearly.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. I was able to buy and generate an invoice at the end.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. I was able to logout of the app.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. I found the upload process simple and sufficient. *	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Leave a comment.					

* Only to be answered by professionals or companies.

Invoice
Date: 11/12/2018



Sofa and More
Unit 5, Phoenix Trading Estate
Bilton Road, Perivale
Greenford, UB6-7DZ

Name: Jonathan Vilas boas
Email: jonathan@sm-london.com

Item Name	Quantity	Cost
chair	1	£ 45.50
Total		£ 45.50

Juan Armond

Individual Project - 2018

ACKA399

Consent Form Template

Consent form for testing AR Interior Design Concept – Mobile Application

I Juan3 Benjamin agree to take part in the above-named City University final year project.

The project has been fully explained to me and understands both the information given to me by the individual carrying out the research and the information sheet which I am able to keep for future records.

I understand that I may be required to:

- Complete questionnaires asking about my experiences with the application along with potential changes I could suggest.
- Make use of a provided iPhone to run the application on.
- Make myself available for future interviews should it be a requirement.

Furthermore, I understand that any information I provide will be used for the purposes of improving the final build for the project and submitted as part of the final write-up of the project.

I also understand that any material that is not required for submission will be confidentially disposed of at the end of the project.

I understand that my participation is voluntary and that I have the option to withdraw at any given time and that the whole process will be run under the obligations set out by the Data Protection Act 1998.

Participant Name: Juan3 Benjamin

Participant Signature: Juan3 Benjamin Date 11/12/18

Juan Armond

Individual Project - 2018

ACKA399

Questionnaire

User: Juan ArmondDate: 11/12/18

Please complete the following questionnaire by placing a cross in the appropriate box.

	Strongly Agree	Agree	Uncertain / Not	Disagree	Strongly Disagree
1. I found the application permission requests (use the mobile camera) reasonable.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I found the sign-up process simple.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I found the login process to be fast.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I found the user interface to be intuitive.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I could find the information I am looking for with minimal effort.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I could choose and insert 3D objects into the real world.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I could scan and detect 3D objects from the real world.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. I intend to buy this furniture after "trying" at my home.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I was able to read the description of the object clearly.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. I was able to buy and generate an invoice at the end.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. I was able to logout of the app.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. I found the upload process simple and sufficient. *	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Leave a comment.	<p>I found the app very good and easy to use. I would definitely use it.</p>				

* Only to be answered by professionals or companies.

Invoice
Date: 11/12/2018



Sofa and More
Unit 5, Phoenix Trading Estate
Bilton Road, Perivale
Greenford, UB6-7DZ

Name: Luana Benjamin
Email: luana@sm-london.com

Item Name	Quantity	Cost
chair	1	£ 45.50
cup and saucer	1	£ 3.99
Total		£ 49.49

Juan Armond

Individual Project - 2018

ACKA399

Consent Form Template

Consent form for testing AR Interior Design Concept – Mobile Application

I Ekaterina Mekhtieva agree to take part in the above-named City University final year project.

The project has been fully explained to me and understands both the information given to me by the individual carrying out the research and the information sheet which I am able to keep for future records.

I understand that I may be required to:

- Complete questionnaires asking about my experiences with the application along with potential changes I could suggest.
- Make use of a provided iPhone to run the application on.
- Make myself available for future interviews should it be a requirement.

Furthermore, I understand that any information I provide will be used for the purposes of improving the final build for the project and submitted as part of the final write-up of the project.

I also understand that any material that is not required for submission will be confidentially disposed of at the end of the project.

I understand that my participation is voluntary and that I have the option to withdraw at any given time and that the whole process will be run under the obligations set out by the Data Protection Act 1998.

Participant Name: Ekaterina Mekhtieva

Participant Signature:

Juyzaylyfa Date 11/12/2018

Juan Armond

Individual Project - 2018

ACKA399

Questionnaire

User: EkatserinaDate: 11/12/2018

Please complete the following questionnaire by placing a cross in the appropriate box.

	Strongly Agree	Agree	Uncertain / Not	Disagree	Strongly Disagree
1. I found the application permission requests (use the mobile camera) reasonable.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I found the sign-up process simple.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I found the login process to be fast.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I found the user interface to be intuitive.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I could find the information I am looking for with minimal effort.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I could choose and insert 3D objects into the real world.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I could scan and detect 3D objects from the real world.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. I intend to buy this furniture after "trying" at my home.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I was able to read the description of the object clearly.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. I was able to buy and generate an invoice at the end.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. I was able to logout of the app.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. I found the upload process simple and sufficient. *	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Leave a comment.					

* Only to be answered by professionals or companies.

Invoice
Date: 11/12/2018



Sofa and More
Unit 5, Phoenix Trading Estate
Bilton Road, Perivale
Greenford, UB6-7DZ

Name: Ekaterina Mukhafizova
Email: katarina@sm-london.com

Item Name	Quantity	Cost
cup and saucer	2	£ 7.98
Total		£ 7.98

Juan Armond

Individual Project - 2018

ACKA399

Consent Form Template

Consent form for testing AR Interior Design Concept – Mobile Application

I Sonia Pires agree to take part in the above-named City University final year project.

The project has been fully explained to me and understands both the information given to me by the individual carrying out the research and the information sheet which I am able to keep for future records.

I understand that I may be required to:

- Complete questionnaires asking about my experiences with the application along with potential changes I could suggest.
- Make use of a provided iPhone to run the application on.
- Make myself available for future interviews should it be a requirement.

Furthermore, I understand that any information I provide will be used for the purposes of improving the final build for the project and submitted as part of the final write-up of the project.

I also understand that any material that is not required for submission will be confidentially disposed of at the end of the project.

I understand that my participation is voluntary and that I have the option to withdraw at any given time and that the whole process will be run under the obligations set out by the Data Protection Act 1998.

Participant Name: Sonia Cristina Lomão da Veiga Pires

Participant Signature: Sonia Pires Date 11 December 2018

Juan Armond

Individual Project - 2018

ACKA399

Questionnaire

User: Señor PiacesDate: 11/12/2018

Please complete the following questionnaire by placing a cross in the appropriate box.

	Strongly Agree	Agree	Uncertain / Not	Disagree	Strongly Disagree
1. I found the application permission requests (use the mobile camera) reasonable.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I found the sign-up process simple.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I found the login process to be fast.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I found the user interface to be intuitive.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I could find the information I am looking for with minimal effort.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I could choose and insert 3D objects into the real world.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I could scan and detect 3D objects from the real world.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. I intend to buy this furniture after "trying" at my home.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I was able to read the description of the object clearly.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. I was able to buy and generate an invoice at the end.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. I was able to logout of the app.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. I found the upload process simple and sufficient. *	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Leave a comment. <i>Very interesting and easy to use. I would like to have it available in the future.</i>					

* Only to be answered by professionals or companies.

Invoice
Date: 11/12/2018



Sofa and More
Unit 5, Phoenix Trading Estate
Bilton Road, Perivale
Greenford, UB6-7DZ

Name: Sonia Pires
Email: admin@sm-london.com

Item Name	Quantity	Cost
plant pot	1	£ 5.00
cup and saucer	4	£ 15.96
Total		£ 20.96

Juan Armond

Individual Project - 2018

ACKA399

Consent Form Template

Consent form for testing AR Interior Design Concept – Mobile Application

I Rui Dias agree to take part in the above-named City University final year project.

The project has been fully explained to me and understands both the information given to me by the individual carrying out the research and the information sheet which I am able to keep for future records.

I understand that I may be required to:

- Complete questionnaires asking about my experiences with the application along with potential changes I could suggest.
- Make use of a provided iPhone to run the application on.
- Make myself available for future interviews should it be a requirement.

Furthermore, I understand that any information I provide will be used for the purposes of improving the final build for the project and submitted as part of the final write-up of the project.

I also understand that any material that is not required for submission will be confidentially disposed of at the end of the project.

I understand that my participation is voluntary and that I have the option to withdraw at any given time and that the whole process will be run under the obligations set out by the Data Protection Act 1998.

Participant Name: Rui Dias

Participant Signature: Rui Dias Date 11/12/2018

Juan Armond

Individual Project - 2018

ACKA399

Questionnaire

User: _____ Date: _____

Please complete the following questionnaire by placing a cross in the appropriate box.

	Strongly Agree	Agree	Uncertain / Not	Disagree	Strongly Disagree
1. I found the application permission requests (use the mobile camera) reasonable.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I found the sign-up process simple.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I found the login process to be fast.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I found the user interface to be intuitive.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I could find the information I am looking for with minimal effort.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I could choose and insert 3D objects into the real world.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I could scan and detect 3D objects from the real world.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. I intend to buy this furniture after "trying" at my home.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I was able to read the description of the object clearly.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. I was able to buy and generate an invoice at the end.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. I was able to logout of the app.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. I found the upload process simple and sufficient.*	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Leave a comment. <i>Great Experience to show another type of channel (ecommerce) that you can see your products 3D (share a real idea to customers).</i>					

* Only to be answered by professionals or companies.

Invoice
Date: 11/12/2018



Sofa and More
Unit 5, Phoenix Trading Estate
Bilton Road, Perivale
Greenford, UB6-7DZ

Name: Rui Dias
Email: rui.desousa.dias@gmail.com

Item Name	Quantity	Cost
cup and saucer	1	£ 3.99
gramophone	1	£ 299.00
Total		£ 302.99

Juan Armond

Individual Project - 2018

ACKA399

Consent Form Template

Consent form for testing AR Interior Design Concept – Mobile Application

I Diego Armond agree to take part in the above-named City University final year project.

The project has been fully explained to me and understands both the information given to me by the individual carrying out the research and the information sheet which I am able to keep for future records.

I understand that I may be required to:

- Complete questionnaires asking about my experiences with the application along with potential changes I could suggest.
- Make use of a provided iPhone to run the application on.
- Make myself available for future interviews should it be a requirement.

Furthermore, I understand that any information I provide will be used for the purposes of improving the final build for the project and submitted as part of the final write-up of the project.

I also understand that any material that is not required for submission will be confidentially disposed of at the end of the project.

I understand that my participation is voluntary and that I have the option to withdraw at any given time and that the whole process will be run under the obligations set out by the Data Protection Act 1998.

Participant Name: Diego Armond

Participant Signature: Diego Armond Date 11/12/2018

Juan Armond

Individual Project - 2018

ACKA399

Questionnaire

User: Diego ArondoDate: 11/12/2018

Please complete the following questionnaire by placing a cross in the appropriate box.

	Strongly Agree	Agree	Uncertain / Not	Disagree	Strongly Disagree
1. I found the application permission requests (use the mobile camera) reasonable.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I found the sign-up process simple.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I found the login process to be fast.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I found the user interface to be intuitive.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I could find the information I am looking for with minimal effort.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I could choose and insert 3D objects into the real world.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I could scan and detect 3D objects from the real world.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. I intend to buy this furniture after "trying" at my home.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I was able to read the description of the object clearly.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. I was able to buy and generate an invoice at the end.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. I was able to logout of the app.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. I found the upload process simple and sufficient. *	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Leave a comment.					

* Only to be answered by professionals or companies.

Invoice
Date: 11/12/2018



Sofa and More
Unit 5, Phoenix Trading Estate
Bilton Road, Perivale
Greenford, UB6-7DZ

Name: Diego Armond
Email: diegoarmond@gmail.com

Item Name	Quantity	Cost
guitar	1	£ 678.00
Total		£ 678.00

Appendix F – Agile Methods

Extreme Programming (XP) – has developed from the problems caused by the extensive development cycles of traditional development models. The term ‘extreme’ comes from taking these common-sense principles and practices of the traditional development models to extreme levels [27]. Its life cycle consists of five phases: exploration, planning, iterations to release, productionizing and death. See page 20 of [4] for more details.

Scrum – development approach involves three phases (pre-game, development and post-game) that provide methods, techniques and guidelines followed to release the system. It is an empirical approach applying the ideas of industrial process control theory to systems development resulting in an approach that reintroduces the ideas of flexibility, adaptability and productivity [28]. See page 29 of [7] for more details.

This was the chosen software development for this project. More details can be found in Chapter 4 Method.

Crystal Family of Methodologies – Crystal Clear and Crystal Orange are the two Crystal family members that have been constructed and used. Depend on the project size each one is chosen. Each member is marked with a colour indicating the heaviness of the methodology. Also, uses a scale to indicate the criticality level: Comfort (C), Discretionary money (D), Essential money (E) and Life (L). Criticality level C indicates that the system crash on defects causes a loss of comfort for the user where defects in a life-critical system may literally cause loss of life. See page 38 of [7] for more details.

Feature Driven Development – is an adaptive approach for development systems as it covers all the total software development process, but rather focuses on the design and build phases. It has been designed to work with the other activities of software development and does not require a specific process model to be used [29]. It consists of five sequential processes: Develop an Overall Model, Build a Feature List, Plan by Feature, Design by Feature and Build by Feature. See page 49 of [7] for more details.