**InteriAR**

**Project Proposal**

**Logo???**

**Group H**

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User Need Overview & Concept Introduction

InteriAR is an innovative way of providing home owners inspiration on the go. Our application will help users design their dream room, combining augmented reality techniques with carefully selected decorators that can make their augmentation a reality. Users will be able to choose 3D models of furniture, and place it in their living space, combined with their actual furniture, they can create an entirely new room. InteriAR takes it a step further by allowing its users to also change the colour of their walls, all within their phones camera.

Data gathering and requirements

We identified many potential stakeholders after conducting both extensive market research and approaching companies and the general public. The primary stakeholders we identified were users, the reason for this is that users want an easier way to visualize a space before investing heavily financially into designing and decorating, hence we offer them an easy option to make a make a low investment and be surer about their idea before investing heavily into Furniture/decorators. Furthermore of the potential users we asked ‘If they heard of such of an idea before? ’ 95.7% of respondents said that they did not (1) , and of the 95.7% which answered ‘no’ 65.2% were in the age group 16-25 (2). These resulted in us identifying users which fell into that age group as major stakeholders. We gathered more data among users involving functions of the app, analysing the data showed 82.6% of users found the 3D viewing of the furniture most appealing about the application (3). This meant that that we listed 3D functionality of the application as a project requirement.

Another group of significant stakeholders we identified were Retailers of furniture. Retailers want the data on the trends of the industry, for instance what pieces of furniture customers mostly use within the app, and which designs are liked the most. This would enable them to produce the type of furniture wanted by the public and keep a closer eye on industry patterns. IKEA being one of the world’s largest furniture producers have a current market share of 7.7% in the UK, latest figures show its position as market leader was further strengthened as market share grew by 0.5% to 7.7% (4). Hence we concluded that IKEA was a potential essential stakeholder, this gave rise to the idea that we would use IKEA’s furniture database within our application to allow users to design their home using the IKEA furniture catalogue.

The final group of major stakeholders which were identified were freelance decorators. We gathered data among freelance decorators in the London region, two of the main questions posed were if they would like to see an app such as this and if they would contribute financially to use this service which enables them to find customers efficiently. 90% of respondents said would like to see such an application’ and 72% said that they ‘would pay money to be matched with customers’ (5). Analysing the data gathered from this vital survey showed that freelance decorators are major stakeholders in the application. However seeing as freelance decorators are a major stakeholder meant that the dilemma arose of computationally implementing a secure and accurate complex computing system which matches decorators to potential customers.

Other minor stakeholders identified include market research companies, shareholders and the Government.

Requirement for section , done last part in red of third paragraph to satisfy it , see if its reasonable ?

‘Computer Science: you should explain the

computer science problems presented by your project, satisfying the

programme learning outcome “Apply computational thinking to the

design and implementation of moderately complex computing systems”. ‘

1. ,(2),(3) are graphs from Ifrah’s survey
2. Is from Ikea website ‘ <http://www.ikea.com/gb/en/this-is-ikea/newsroom/press-release/ikea-continues-to-grow-in-the-uk/>’ but I think I can get more repubuatle source for this info such as a business journal

I’m also planning to include my stakeholder diagram for this part of the report

Functional Specification

InteriAR would have all it’s users log in using an external company to log in, that would hold their account information such as Account information, Password, from that we will have users in a database that will hold Reviews of that user and their chosen augmentation(s) as well as smaller information such as how many times that user has used the app. ( If customer has bought 4 times, or if decorator has done 10 jobs )

Upon opening the app, it would use premade augmented reality libraries combined with computer vision techniques to correctly project the orientation and position of the 3D object. This would also aid in changing the colour of walls within the app. The user would potentially have to make changes to aid the projection and to gain additional data. Once the user has chosen and finalise a design, this would be stored in a database once again overwriting the old one (maybe or added with it); Then it’ll be sent to a decorator. Lists of decorators will also be in a database. Their profiles will be displayed by area to the user who can contact them directly with our built in messaging system.

The messaging system will likely use libraries that have been already made as a starting point. As this chat won’t differ much from a standard chat, it wouldn’t have very much different from the standard chat. Once the decorator accepts the design sent to them, an escrow payment system will be shown. This will also include an existing library to aid in the structure of the payment system.

We will also have an agreement that users will abide to that states that the money will be released once the job has been completed. Once the completed job has been confirmed, the user will have the option of reviewing the Decorator and allowing them to use the captured augmentation on their profile to help them build up their reputation.

Ethical Audit

Ifrah

Design

**Activity diagram**

The stakeholders who would be involved in the use and deployment of the activity diagram are decorating companies, freelance decorators and furniture production companies. They will simply be interacting with users (via instant messaging) whom will have interest in having their AR design implemented. Users are also another stakeholder involved in various parts of the activity diagram. They, in simple terms will use the system to create their own AR design, filter for decorators near them, send this design to the decorator, interact with them and then pay for their services if both parties agree on a deal.

the key interactions employed by users of our system are being able to drag and drop 3D objects (e.g. furniture, tiles, carpets etc.) into the camera screen, filter for decorators to meet a specific match (e.g. distance, qualification, type of work etc.), interact with a decorator through instant messaging and input card information into the payment system.

In terms of our design we decided to structure it to be as simple to use as possible. This is as the main focus of the app(the AR implementation)has potential to be quite fiddly with some users and so we would like the rest of their experience to be easily understood and laid out.

We have laid out the structure of our app using UML diagrams. One of which is the sequence diagram.

**Prototyping**

The functional prototyping for InteriAR consisted of three main technical questions:

* Is virtual wall colouring feasible to implement and what is the best method of doing so?
* Is “marked tracking” a viable method of us displaying and moving 3D objects in our augmented reality space?
* Will MongoDB be able to handle the volume of users and transactions the app may need in future? ???????

Wall colouring

This prototype was created on Processing 3 using the Ketai for Android library [REF] to access the camera on a mobile device. The software allows a user to tap a pixel on the live video, grabbing the RGB values from it. It then analyses every pixel on the camera feed and calculates whether they are similar enough to the grabbed colour. If they are, the pixel is repainted in red.



InteriAR wall colouring functional prototype v1

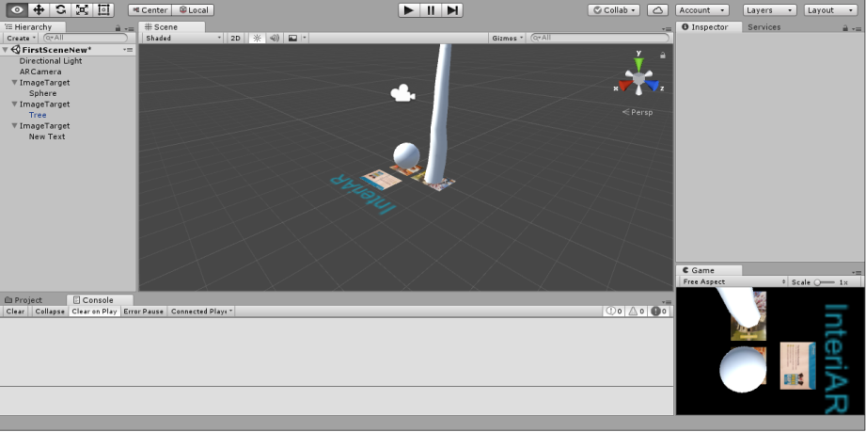
The prototype manages to successfully detect part of the surrounding wall, and avoid the more obviously differently coloured obstacles; however it also misses out large portions and does pick up some unwanted additions. Another factor is performance; when calculating colour distance on each pixel in the feed, especially on a mobile-phone processor, the program starts to stutter.

What we have learned from this prototype:

* It is feasible to implement. Even on a very basic level this functioned in some capacity.
* Further research must be done into colour matching for improved accuracy.
* We need to look into improving the performance drastically, whether via grouping pixels together or relying on another method of detection such as image segmentation.

Augmented Reality Objects

This prototype was created on Unity [REF?] using the Vuforia AR library [REF]. The software utilises a database of markers which are images of real objects or surfaces with enough unique features to be distinguishable from the surrounding area. Computer generated 3D objects are then assigned a marker so that when the camera detects it, the object will superimposed upon it wherever it moves.





InteriAR objects prototype v1 in Unity Marker with “features” highlighted

The close up functionality is impressive, even when dealing with inconsistent lighting. However as soon as the range increases past 2-3 meters it quickly becomes incapable of consistently tracking the markers.

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What we have learned from this prototype:

* Marked tracking is only viable at close range.
* While very basic, this software ran seamlessly on mobile.
* It may still be useful for some elements of our project, but we need to research further into marker-less tracking.

InteriAR Objects protoype v1 deployed to Android

Database

To assess the feasibility of using MongoDB [REF] for our project we implemented a cloud-based database using mLab services [REF]. We wanted to test if the cloud-based service was capable of handling high quantities of data being thrown at it and updated via Pymongo [REF] scripts.

To do this, I used python to insert 1,000,000 user documents into a collection and ran find commands to grab out users based on field properties. Both the insertion and any interactive find/update script I ran functioned smoothly and in a timely manner.

What we have learned from this prototype:

* We can efficiently add users to our database using python scripts.
* We can update, remove and pull information from the documents on the database in real-time.

Technical Architecture

Database

As we won’t be using our own database to be validating and logging in users, we have come to the conclusion of using Facebook and Googles login API to help create accounts. The reason is due to feedback we got from potential users, who said they usually, and prefer to login with Facebook or Google. Even though this implementation will exclude people without the above services, it makes the whole process of signing up to the app a lot faster. It also solves some issues we may have encrypting and protecting the data correctly as passwords won’t be stored with us.

In our account database, we have decided to use a MongoDB. The reason being that it is easiest to implement over MySQL. Furthermore, it has better capacity, speed and reliability than MySQL.

Augmented Reality Implementation

The main selling point of InteriAR, is the augmented reality. We aim to allow users to pretty much visualise a whole room within their phone. To develop this, we have decided to use Unity3D. Unity is designed for, but not restricted to, 3D games. As Unity an excellent 3D engine that can be worked outside of just game development, it seems to be the perfect software to use, also because it can pretty easily be deployed to Android and IOS. As an alternative, we did look at using Android Studio. We chose Unity over Android Studio simply because Android Studio doesn’t natively support 3D modelling and design, however, Unity does. Every augmented object will be a 3D model.

{Something about how we chose to model the app on a mobile over tablet, however it’s ideal on tablet because of space, however most people will have a phone. Won’t work for laptop users unless you would have an external webcam that you can point to the room, which most people do not have. (As per survey)}

One feature of our Augmentation would be the ability to change the colour of walls and even whole floors. We would achieve this by using a computer vision technique called K-Clustering, which is a form of Image Segmentation. This would give meaning to different sections of an image that are separated by some common factor. Through prototyping, we have seen that simply taking the RGB value of pixels in an image has its problems, as pixels change colour due to multiple external factors.

For the actual technology behind the augmentation, we have decided to use an external Unity Library called Wikitude. We chose this over Vuforia (another Unity Library for AR ) as Vuforia is good for recognition based AR. This is using track-able images as basis for projection such as a leaflet. Through prototyping we have discovered that this is not practical as we would like users to not need to use trackers to place things in their rooms, not to mention that if you’re too far from a tracker, the Augmentation would get ruined. Wikitude uses a projection based augmentation called SLAM. Simultaneous Localisation and Mapping is the type of AR that we need as it can recognise space and angles pretty well and correctly project the right orientation of the 3D object. We did also look at ARCore ( Androids AR library) and ARKit (Apples AR library) however they only support their respective platforms.

Messaging

We aim to including instant messaging to allow customer and decorator to securely communicate with each other. We have chosen to use an instant messaging API over standard SMS as people may not be comfortable giving their numbers out. The API we will use is called Pusher.

Payment

For the Payment within the app, we have decided to use Paypal as it supports standard card use as well as PayPal accounts. We aim to have an escrow system to hold the money until the job is done to avoid scams. In principle, this would be simple, however payments aren’t going directly to us. There is one available python library that can implement Escrow called Balanced. However, the documentation about it does not currently work and there isn’t much information available about it.

Evaluation Plan

We will be focusing most of the test cases around the augmentation the app projects as this is the main focus of InteriAR. An example of one of our test cases would be to look at whether the app would project the correct 3D object correctly, in which that would be with the correct focal points and angle. This is the main test case as without this, most of the app doesn’t work properly.

Project Management

The future development of this project will be focussed around splitting our resources up into smaller groups and giving them clear sub-tasks to meet as part of their overarching long-term milestones. This will be primarily managed via Trello for sub-tasks and documented with a Gantt chart [GANTT CHART IN APPENDIX] for the larger tasks and milestones.

For the software development there will be two group members focusing on the mobile application, working closely with another small group who will be focussed on the backend database. These parallel development projects will hold frequent meetings to ensure the other team is fully updated and both processes are on the same track. During development we will be sticking to a separation of concerns principle wherever possible to allow smoother modification where necessary.

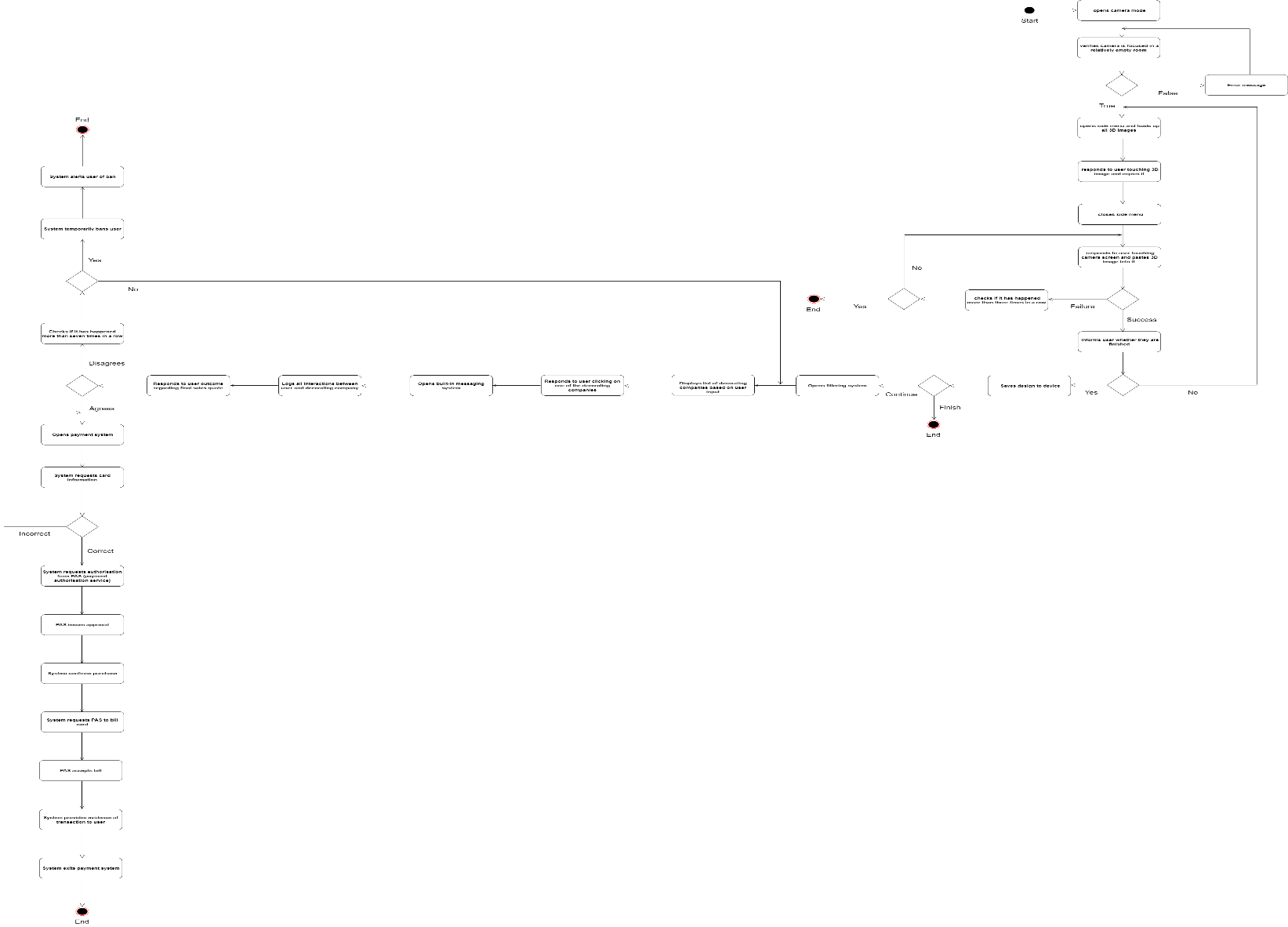
The members not directly involved with coding will primarily be focused on making sure all documentation is up to date and fulfilling any necessary requirements for the final report. They will also semi-regularly attend the software-focused meetings to ensure everyone has full knowledge of the current status and any changes that have been made during development.

While not fully embracing a pure agile methodology; we will be adhering to some of the core principles [REF]. The stand out ones for our project will be “the most efficient and effective method of conveying information to and within a development team is face-to-face conversation” and to deliver working software frequently.

Conclusion

Bibliography

Appendices

**Activity diagram**