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Augmented Reality Navigation System for Commercial Spaces

Proposal

by

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Abstract

Frustration and confusion are common emotions that are apparent at large shopping centres. After analysing recent studies, it is evident that shopping centres have a huge role to play in the overall retail experience. In order to provide greater value to both consumers and retailers, retail settings are being challenged to become smarter. One approach that is becoming increasingly recognised is mobile augmented reality (MAR) apps. Many consumers have difficulties in locating the store which satisfies their needs. In this research, we endeavour to outline the market requirement of developing an application that allows for smart retail and describing how additional value is created to customers as well as benefiting retailers. It is proposed that the application will implement a 3D model of various shopping centres, featuring navigation functionality to assist users in finding their desired store.

Word Count

xyz

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Contents

Chapter 1

Concept Introduction & User Needs

The main concept for this project revolves around the user of augmented reality on smartphones. Augmented reality (AR) is the superimposing of a computer-generated image onto a user's view of the real world [1]. This technology first came about in the 1960s [2] but has recently gained consumer and wide-spread media attention after the use of it in Snapchat filters and the 2016 game *Pokémon Go* for example. There have been many times where people get lost in unfamiliar spaces such as a museum, immersed by the culture around them, and their sense of direction. This project aims to tackle this issue by allowing users to restore their orientation by having a mobile platform to route users to their destination, using AR. The platform will use the device's camera to work out its surrounding, and will produce a highlighted line on the screen to their destination in real time.

This concept has various applications to other similar scenarios such as finding products in a supermarket, books in a library, or even valuable items that people own that can emit an electronic signal for it to be tracked down. Further, the concept could also use machine learning in identifying user's traits in places visited in a museum in order to give personalised recommendations at other similar exhibitions.

Chapter 2

Stakeholder Requirements

The main stakeholders are museum visitors and staff. After consulting with them, and potential users of the proposed application, we were able to gain a better understanding of what the apparent need was in the relative market regarding museums. Out of the 21 responses we received, 15 potential users admitted to visiting museums at least once a month. This shows that there is some level of frequency in their visits, and that there is something that can be offered to this group of people.

Since our concept principally considers the user of navigation in museums, when users were asked, "do you find yourself using the maps in the museum more than once?"- a very reassuring 100% of visitors had agreed that they did in fact refer to the maps around the museum more than once, some respondents going on to say that they referred to it over 10 times. However, these maps are not free; in most museums, including the Natural History Museum and the Science Museum in London, require a fee of £1 in order to have access to the paper maps.

This shows that there is an evident need for an accessible tool other than the maps around the museum in order to assist visitors' navigation around the museum. 18 of the respondents had agreed they would much rather prefer using their phone to navigate rather than the paper maps that are currently available to assist in their navigation around the museum. These responses that we received first-hand were very reassuring for us as developers, as it brings to light an evident need for these visitors to have access to an improved navigation solution.

Based on the stakeholder research, the project requirements are,

- navigate the user to an through the use of augmented reality
- to display navigational routes in real time
- calculate the shortest route to the user specified location
- work transferrably in other museums/commercial spaces

- contain accessibility features such as magnified text and inverted colours for example

Chapter 3

Prior Knowledge

Chapter 4

Design

4.1 The Importance of Design

Having a design process allows for more efficiency, and transparency when coming to design the application. It overcomes the risk of referring back to the drawing board when developing the application, setting in stone the main features, and functionality of the application.

4.2 The Unified Modeling Language

An effective design strategies was carried out through the implementation of the Unified Modeling Language (UML), a powerful standard for creating specifications of various parts of a software system.

Our implementation of a use case diagram outlined the different scenarios in which a user would function the application. (Figure 1. Another way UML was implemented was to further support, and refine the designing phase of the software development, through an activity diagram. (Figure 2).

The use case diagram represents the functional behaviour of the system in terms of goals (as defined in the stakeholder requirements) that can be fulfilled by the system. The activity diagram was designed to model the work flow of the system. One main reason that the activity diagram was essential was that these diagrams are normally easily comprehensible for both analysts, and stakeholders. By producing these models, we were able to have a clear understanding of what the application does, and enabled us, the developers, to visualise the application for the future.

4.3 Service Model

The following cases are born out of one important principle; convenience. The **'lost'** use case, for example, comes from the user that could be lost for whatever reason. The service we would provide would be the quickest and most convenient solution to finding their destination, whether that be the exit or a particular exhibition. The **'exploration'** case, would be more convenient with the museum, and all its exhibitions (along with brief descriptions) will be at the user's fingertips (instead of existing museum navigation options e.g. wall-maps or paper maps).

Model around two cases

The lost-case, and exploration-case has a virtually linear-stream of logic, and is as follows:

1. The user enters within the radius of an environment (museum) modelled by the service.
2. The user's location is picked up once they give use permission to.
3. The user picks their destination.
4. That location is then taken, and passed through an algorithm calculating the quickest route between the user's real-time location, and their destination.
5. The user is then displayed the route, and directed towards their destination via their camera.
6. The user is given curated suggestions on possible places they can go.

Chapter 5

Prototyping

5.1 Augmented Reality (AR) Libraries

In order to identify libraries that are good for implementing AR on mobile devices, we divided this prototyping into three platforms to explore them, and built a small AR application to find out how they help with the project.

Vulforia (Unity on Android)

Unity is a cross-platform game engine, and was used to test a simple AR camera application where the device's camera hovers an object/image, to display information about that object/image on the device. We used Vuforia, a software development kit (SDK) that enables recognition, and tracking of image targets, to build the application. This can be used for the exploration case in the use case model. Although, there is a limited amount of tools for locating user current location compared to Android.

ARKit (iOS)

We built a similar prototype to Unity on Apple's ARKit using Swift, which was easy to pick up. It was intuitive to implement AR features as there was detailed documentation but logging GPS data was harder compared to Android.

ARCore (Android)

ARCore was used to create a simple 3D model showing on a mobile device when its camera targets a flat surface. It is easier to log GPS location Android compared to Unity, and iOS. Although connecting the user interface to the scripts was more challenging than iOS.

5.2 UI/UX Designs

Chapter 6

Functional Specification

What is a functional specification?

Functional specification describes the important technical requirements for a system. It also includes the procedures in which the requirements have been met.

In this section, we are breaking down the functional specifications of our idea and how it should respond to a given task:

1. The system should allow the user to enter their current location and their destination, this is key as it allows the app to calculate the route. 2. The system should be able to calculate and work out the shortest and closest route to a given exhibition in short amount of time. 3. The system should be able to display the route on the user's smart phone in good quality and allow them to follow the route to their destination. The route would be displayed using a thick blue arrow which goes all the way to their destination, so all the users have to do is follow the arrow. For users with disability the app would have a voice guide. 4. The system should ask the user for their rating of the museum and if they would suggest the exhibition to anyone else. 5. Lastly, the system should be able to display different users reviews and past visits on the system, the reason for this is that it would use this information in the future to suggest to new users where they should visit and what museum would be suitable to them. The way the data for this would be collect is that once the user has reached their destination. The app would display a rating screening including a feedback option where users can give their honest opinion on their experience.

Chapter 7

Ethical Audit

The field of AR is currently not heavily regulated in the UK owing to the emergence of this new technology in recent times. There are certain areas such as data protection, intellectual property (IP), and security that need to be strongly factored in and considered during the development lifecycle. It should be noted that AR will involve collecting an extensive amount of data per user such as names, age and email address, but also appearance, real time location, and their interaction with other users. Within the scope of this project, we will not be working with minors and vulnerable adults. Since the concept of the project relies on the user's camera, accelerometer, and location data on the user's device, ensuring that this data cannot be obtained unlawfully and fits the scope of the Data Protection Act (1998) along with the EU General Data Protection Regulation (GDPR) is of most importance.[3]

Based on large virtual reality companies such as Oculus, these obligations are addressed by the form of a privacy policy in order to detail how data is collected, used and if it is shared with third parties. Since GDPR presents many pitfalls for developers, it is critical these regulatory issues are addressed before the completion of the product and not after. Penalties for non-compliance can be up to £17 million or 4% of annual turnover. [4]

Another regulatory standard is the intellectual property (IP) of the software. The source code and object code that serves as the underlying foundation of the platform will be be original and qualify for copyright protection. Since computer software is usually excluded from patentability in the UK, any ideas that uses AR producing a technical effect, and its associated hardware can be protected by patents. Based on our competitors, it is important that we do not infringe on their patents owned by third parties. Equally, if the concept makes new technical developments in the field relating to AR, then it should be considered whether it would be eligible for patent protection.

Given that the AR experience is built using a database of information about the real world, the database can be protected by copyright. The concept could take on a machine learning viewpoint by recognising third party logos captured on the user's camera. This could cause an infringement claim since AR could be replicating, replacing trademark or copyright works, or distorting the logo.

Chapter 8

Technical Architecture

Chapter 9

Evaluation Plan

Chapter 10

Project Management

Chapter 11

Conclusion

Appendix A

Appendix

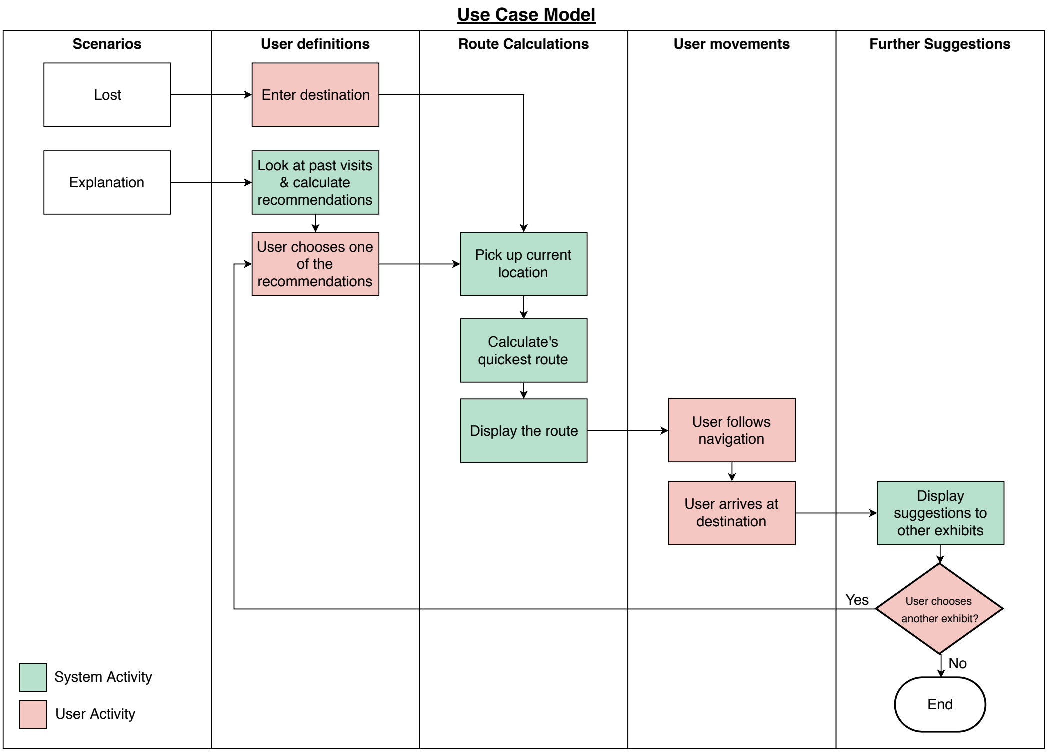

Figure 1: Use Case Diagram

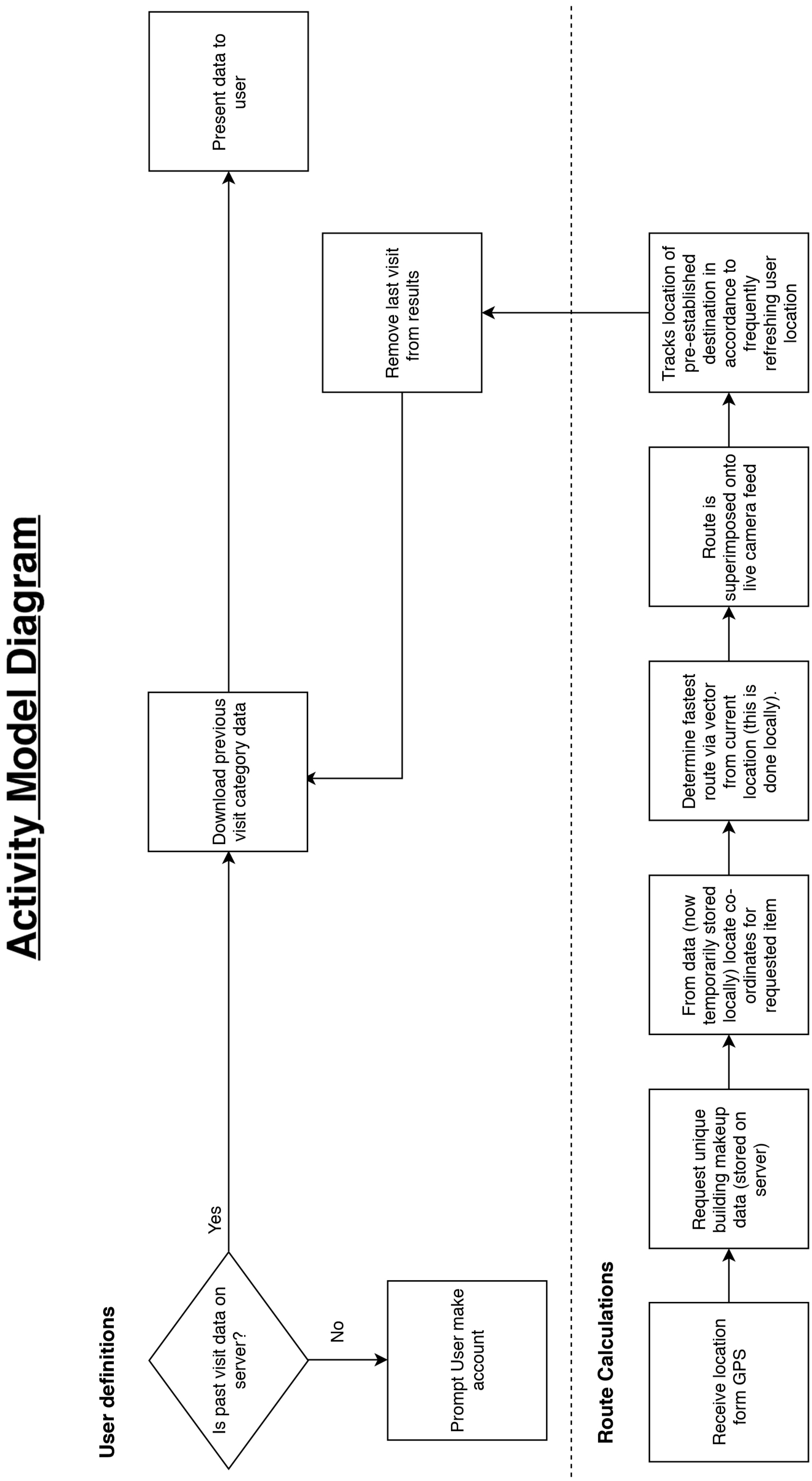

Figure 2: Activity Model Diagram

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