Senior Project
Final Report

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Executive Summary

This document details the team's activities for the Estimote Beacon-ShopAir Project for Hamad International Airport. It includes 4 major sections: Overview, iBeacon Technology, Prototype App, and Cost-Benefit Analysis.

The Overview contains introductions to the Team, the Client and the Project. This section includes details about the Client's Vision and Client Liaison. It also provides the scope of the Project and information about the Commercial Department at HIA.

The section about iBeacon Technology describes the technology and its potential. In addition, it lists out the current vendors that are working with this technology and highlights Estimote, as it is the startup, the Project Team worked with.

The section about the Prototype App details the development, the functionality of the App and the illustrations of the Use Cases of the App. Alongside these, it describes the challenges and issues faced throughout the development and Project Sprints.

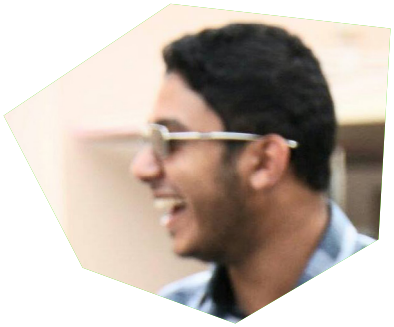
Lastly, the Cost-Benefit Analysis section includes the potential benefits of implementing the technology and the risks associated with the technology. After the analysis, it includes the team's recommendation to not deploy the Estimote Beacon-ShopAir combination in the Commercial Department of HIA, and follows it up by exploring further opportunities for the technology.

Overview

The Team

Ahmed R. Hashmi is a Senior level student at Carnegie Mellon University at Qatar, with a major in Information Systems, and is the Project Manager and Client Liaison for this project.

He is interested in the impact of modern Technology on people and culture. He has co-curated a TEDx conference, served as SCRUM Master of a mobile-app (Liberum) development team and is pursuing a Ethics Minor.



Khaled Fares is a Senior level student at Carnegie Mellon University at Qatar, with a major in Information Systems, and is the Product Designer for this project.

He is interested in design, and how to make applications and websites more user-friendly. He is currently pursuing a Minor in Business Administration and served as a Design Lead in mobile-app (Q-Promotions) development team.

Nihal Fathima is a Senior level student at Carnegie Mellon University at Qatar, with a major in Information Systems, and is the Technical Lead for this project.

She is interested in studying the relationship between Technology and Businesses and how these fields impact each other. She is currently pursuing a Minor in Business Administration and plans to pursue a career in IT consultancy.

Professor Maher Hakim (Advisor)
Maher Hakim holds a Ph.D. in computer-aided engineering and management from Carnegie Mellon University and a M.S. in Civil Engineering from the University of Illinois, Urbana Champaign. He is a visiting associate professor of Information Systems at Carnegie Mellon University Qatar.

Overview

The Client

Our Client, Hamad International Airport (HIA), opened its doors to customers earlier this year, in May 2014. It's located just outside the capital city Doha, Qatar. Currently, it has the capacity to serve over 360,000 flights and 30 million passengers a year.

Once the third and final phase of construction is complete, HIA's capacity to serve will jump to 50 million passengers a year. Already, at 600,000 sq. metres, the passenger terminal complex is the biggest building in Qatar. The check-in hall spans over 25,000 sq. metres of column-less space and 138 check-in counters.

The design and aesthetics of HIA focus on the smooth and seamless 'flow' of passengers. To promote this 'flow', HIA has used an Aquatic Theme to design its space.

Our Client Representative, Zaid Haque is an alumnus of Carnegie Mellon University Qatar. He is currently working as the Lead Desktop Publishing Officer in the Operations Department at Hamad International Airport.

While Zaid has been personally responsible for designing the information layout and interface of the Display Screens at HIA, the Operations Department takes care of all the matters concerned with running the airport smoothly. These include a variety of tasks that range from small everyday routines such as coordinating the number of personnel at Information Desks to larger strategic issues such as reducing delays, displaying relevant information to customers and managing queue flows.

This Pictures where taken from: http://dohahamadairport.com/media/library

Overview

The Project

The HIA Operations Department consists of sub-departments that include but are not limited to: Safety, Security, Passenger Process, Customer Experience, Baggage and Commercial.

The Project Team along with the Client Representative, chose the Commercial Department to explore the use of iBeacon Technology in to help HIA gain competitive advantage, increase revenue, and provide customers with a unique, world-class experience.

Commercial Department: The main source of revenue of HIA is the Commercial Department. There is a constant need to attract customers to the Qatar Duty Free Section in order to increase sales and generate more revenue. Qatar Duty Free (QDF) uses traditional marketing strategies, such as advertising through billboards in the airport, brochures, and magazines distributed on airplanes. Alongside this, QDF has an online website that's used for advertising.
The iBeacon Technology provides a new way of marketing to QDF and a personalised shopping experience to its customers. The iBeacon Technology allows for the uncertainties inherent in the traditional marketing strategies to be eliminated to a great extent, as it integrates in-store advertising based on real-time customer data processing.
The proposed technology is an all purpose tool for retail owners for indoor marketing and data-collection. It will allow retailers to track the customers' demographic information along with shopping activities and habits. This will enable the the retailer to fine-tune their merchandising strategy as well as create a more personalised and targeted marketing strategy for the customers.

iBeacon Technology

The Technology

iBeacons are hardware that use battery-friendly, low-energy Bluetooth connections to transmit messages or prompts directly to a Smartphone or tablet. They are poised to transform how retailers, event organizers, transit systems, enterprises, and educational institutions communicate with people indoors.

To explain how iBeacons work, imagine a user walked into a crowded store. At this moment, notifications are sent to the user's phone informing him of available brands or items on his preferences list, that are available at the store. Alongside this, more notifications can be pushed to him, showing him personalised discounts, and recommended items based on the data collected by iBeacons from the user.

iBeacons work with Geo-location GPS receivers. Unlike GPS where it shows where users are in the world; Geo-location GPS receivers can pick up a satellite broadcast. After picking up the broadcast, iBeacons can mark and flag what is around the user based on triggers from nearby transmitters. The iBeacon emits a unique signature that transmitters can recognize on smartphones, which can be used by an API.

The Vendors

GeLo: GeLo wants to make things easy for developers by creating their own 'Beacon HW' and associated services for various solutions. Tags are deployed in spaces at points of interest. The app reads the beacon and triggers specific information for that point. From a museum walk through to an elaborate scavenger hunt, GeLo's beacon solutions can help developers get to market quickly.

Swirl: Swirl is looking to transform shopper's Smartphones into the ultimate shopping resource. By using beacons, Swirl is providing consumers with their own personal shopping assistant—someone who knows your style and keeps up on the trends. They provide an entire platform for retailers that can be deployed without costly infrastructure or hardware investments by using Bluetooth connections.

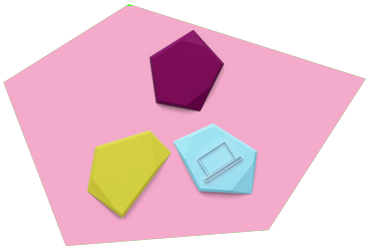
iBeacon Technology

Estimote

Estimote uses micro-location information, to enhance the shopping experience, and make retailers interact with consumers via iBeacons and 'Stickers'. (Mini-beacons that turn the products into 'nearables' or smart objects). For this project, we are using Estimote.

Beacons

Estimote Beacons are low energy, bluetooth enabled, come in different colors and can be stuck various surfaces. The battery lasts for approximately 3 years and each beacon can possess unique Major and Minor IDs



Stickers

Estimote Stickers are tiny beacons. They have a powerful ARM processor, memory, Bluetooth Smart module, and temperature and motion sensors. Stickers can turn things into "nearables" - smart objects fully detectable by mobile devices.

ShopAir

The Purpose

To simulate the use of iBeacon Technology in Hamad International Airport, we developed a prototype app, ShopAir.

It's a simple app with three main pages:

- The Home Page that instructs the user how to use the app.
- The Settings Page where the User logs in and out of Facebook, and toggles notifications.
- The Preferences Page where the User chooses to curate his shopping experience.

notifications
In the User Research Phase, our team interviewed passengers who had used the Qatar Duty Free Area in Hamad International Airport. Most of them suggested that they shop at Qatar Duty Free only when they have a significant amount of time to spare.

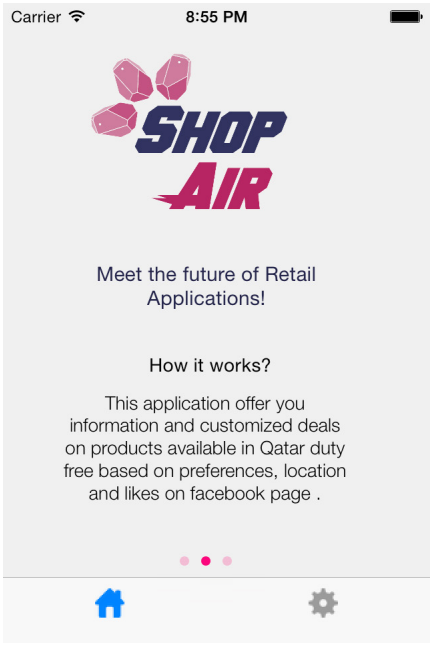
With the help of our client, we established that there are about 38,000 transit passengers every day with waiting times longer than 8 hours. We set out to provide these passengers a unique shopping experience with our prototype.

ShopAir

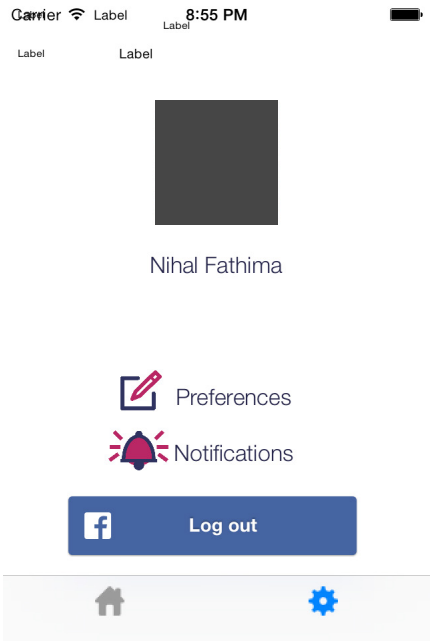
Screenshots

Launch Page

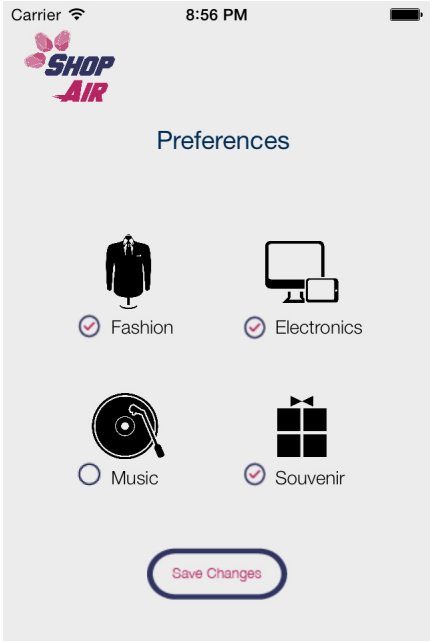
Home Page



Settings Page

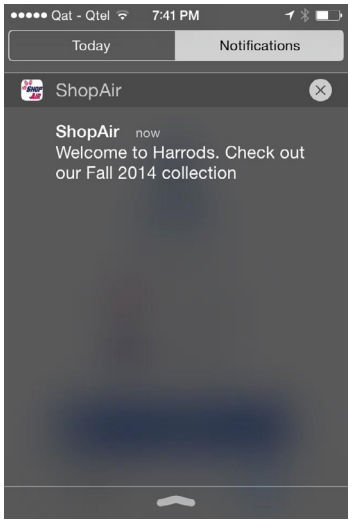


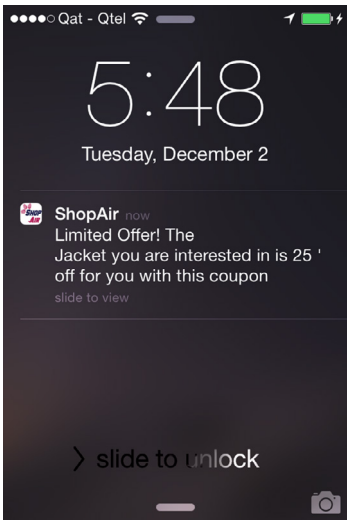
Preferences Page

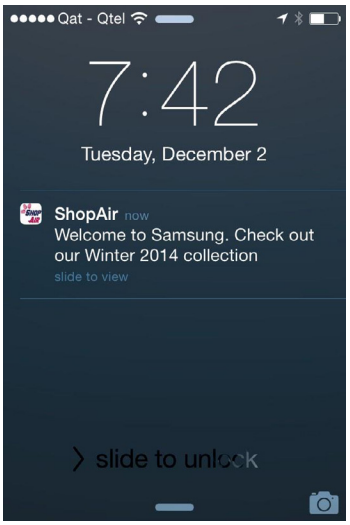


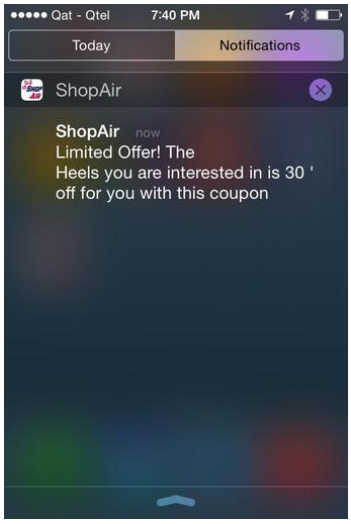
ShopAir

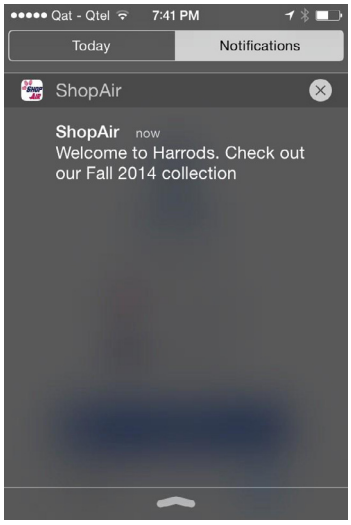
Notifications

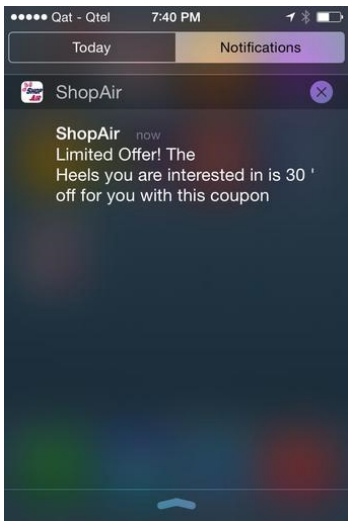


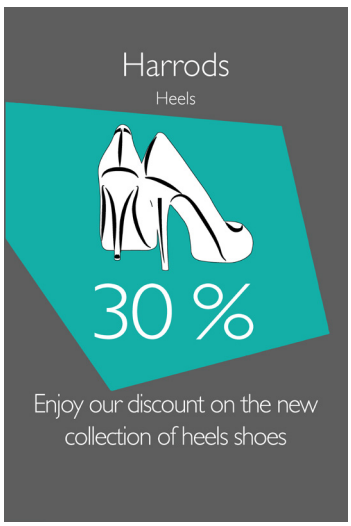












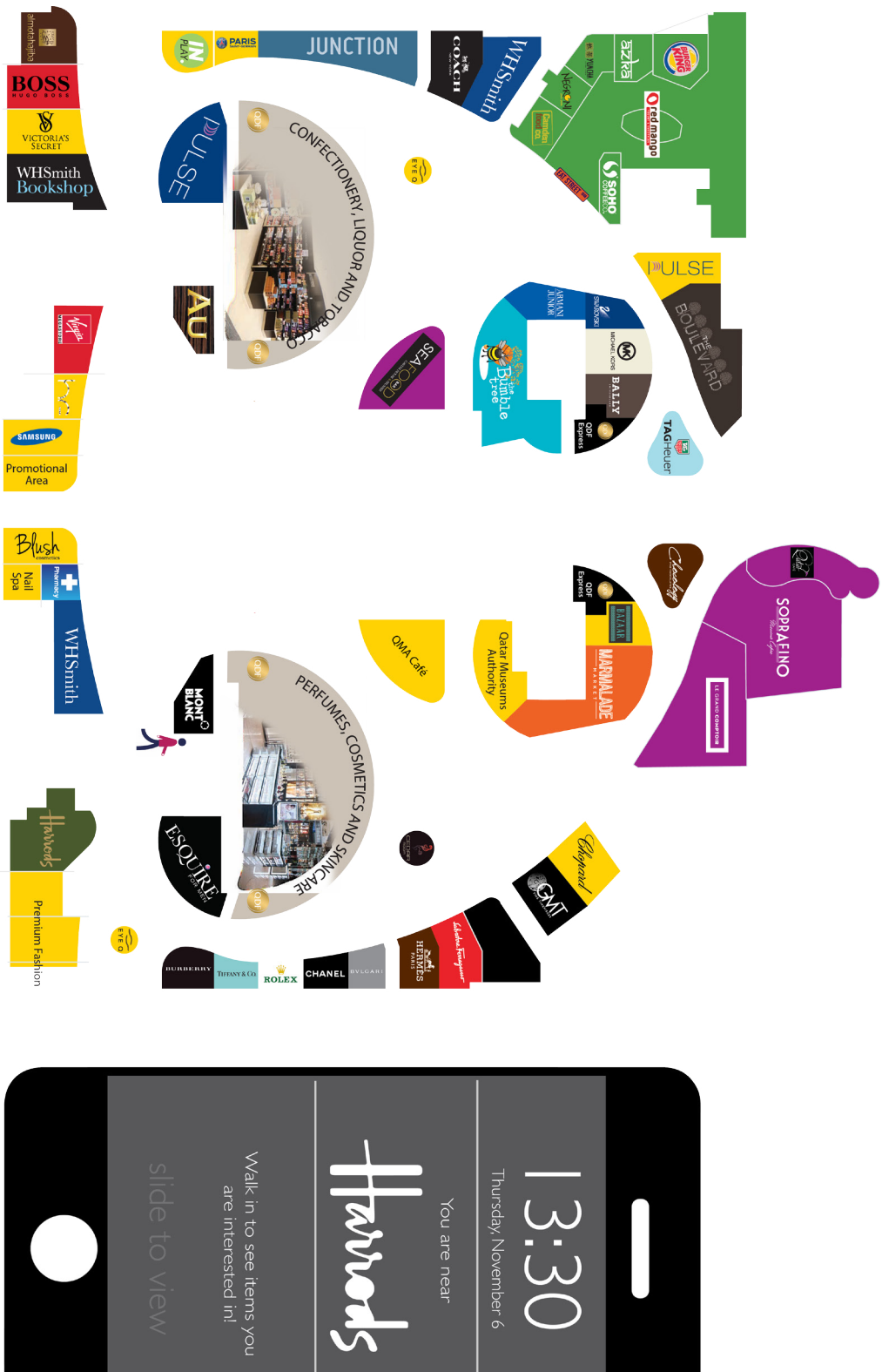
Illustrated Prototypes

Please see attached Appendix A for Hi-Res Illustrated Use Cases.

Passenger Entering QDF

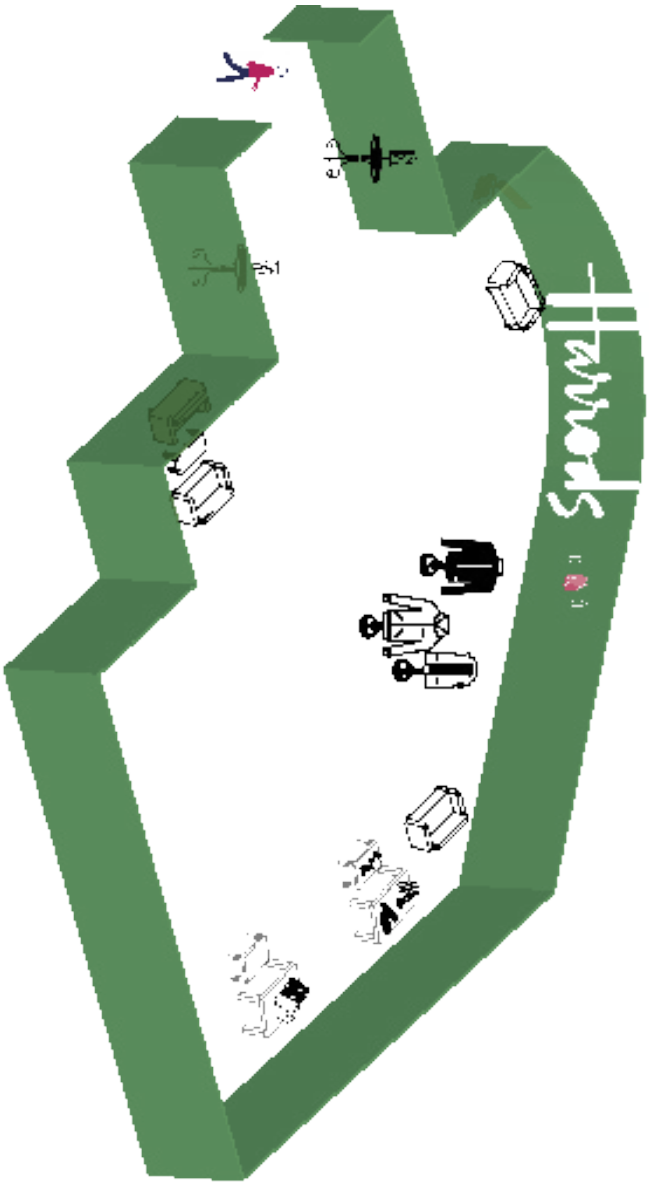
Illustrated Prototypes

Passenger Near Harrods



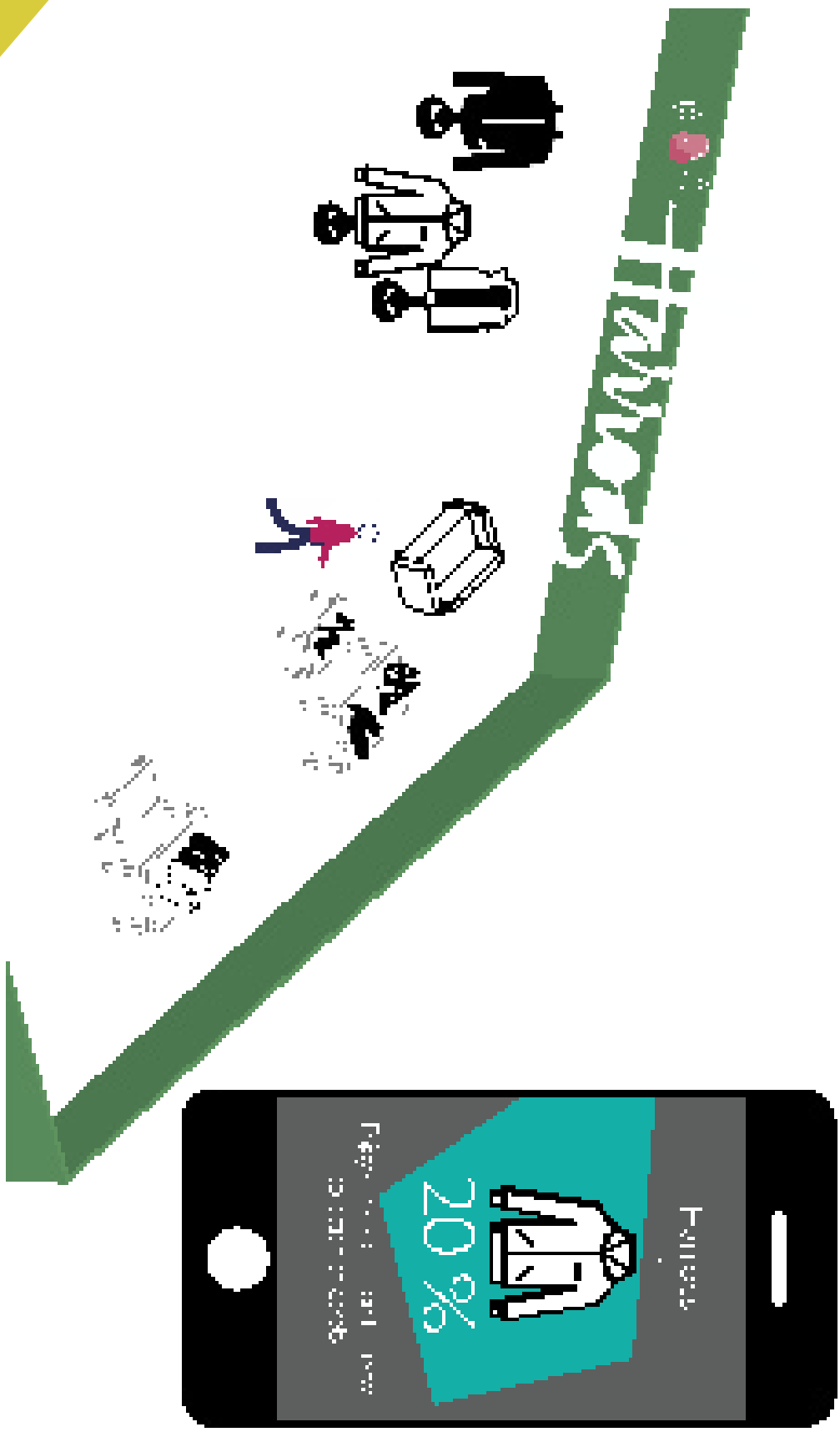
Illustrated Prototypes

Passenger Entering Harrods



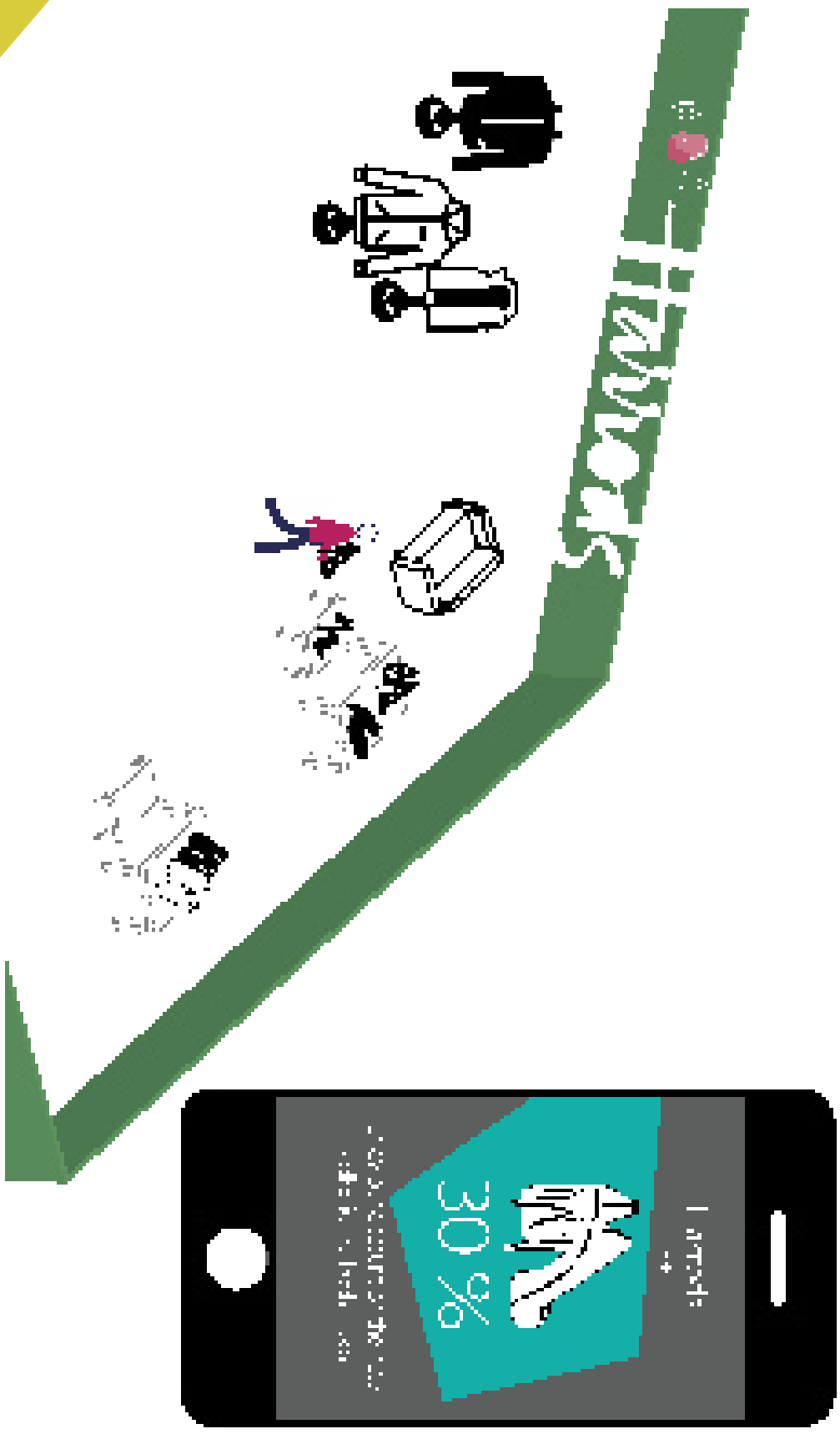
Illustrated Prototypes

Discount Based on his preferences



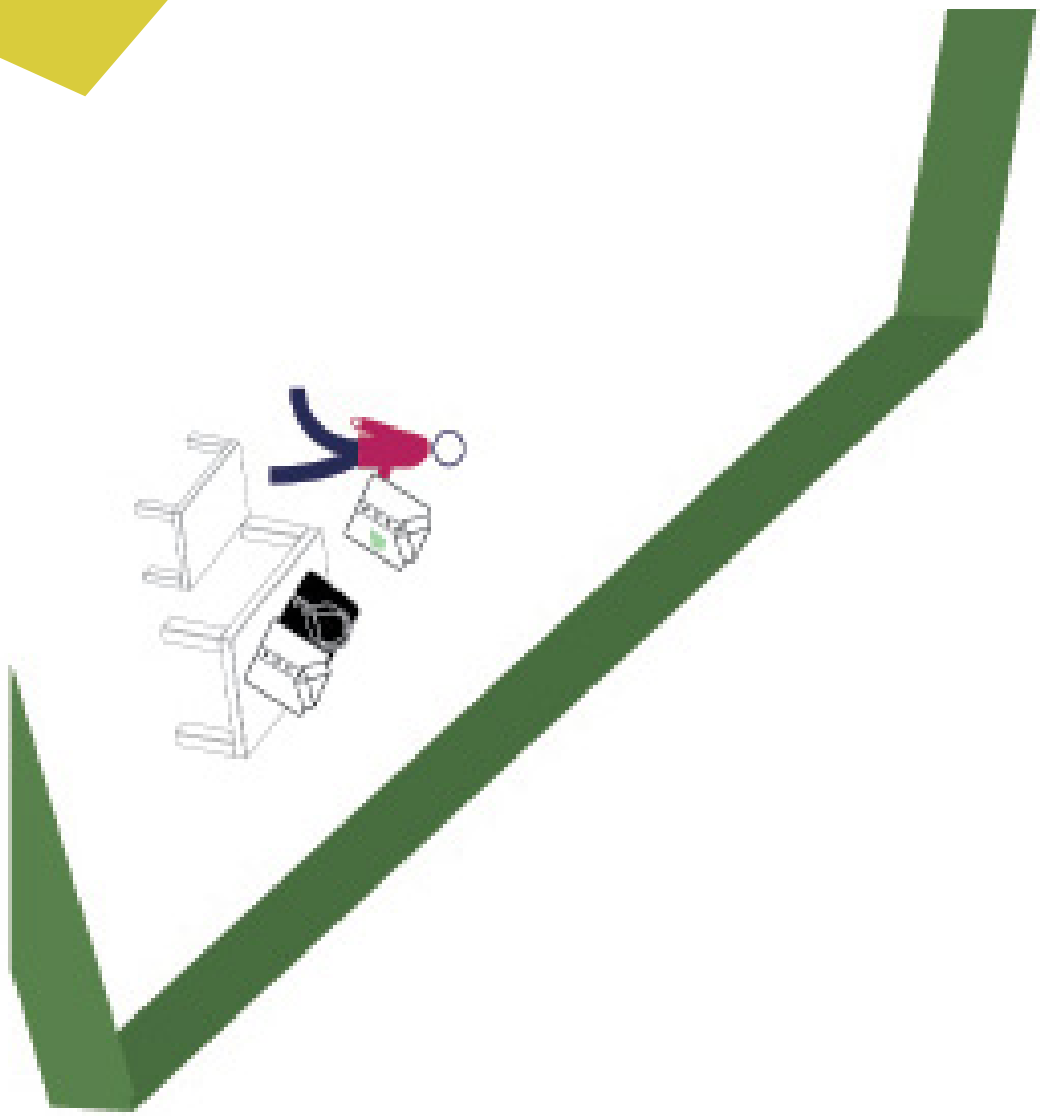
Illustrated Prototypes

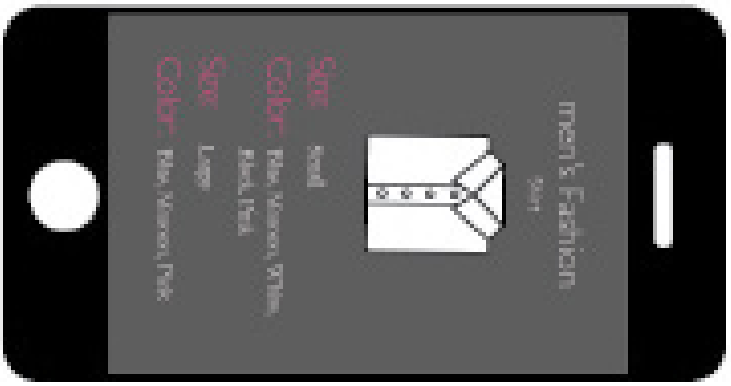
Discount Based on her preferences



Illustrated Prototypes

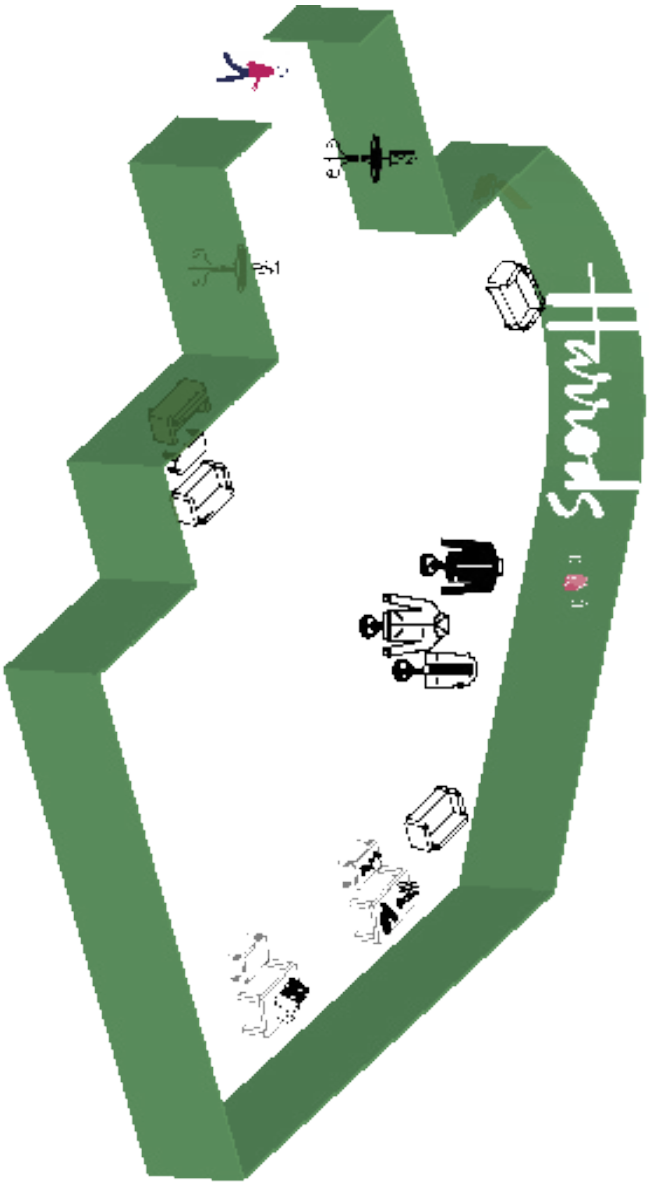
Stickers sends Information about an Item





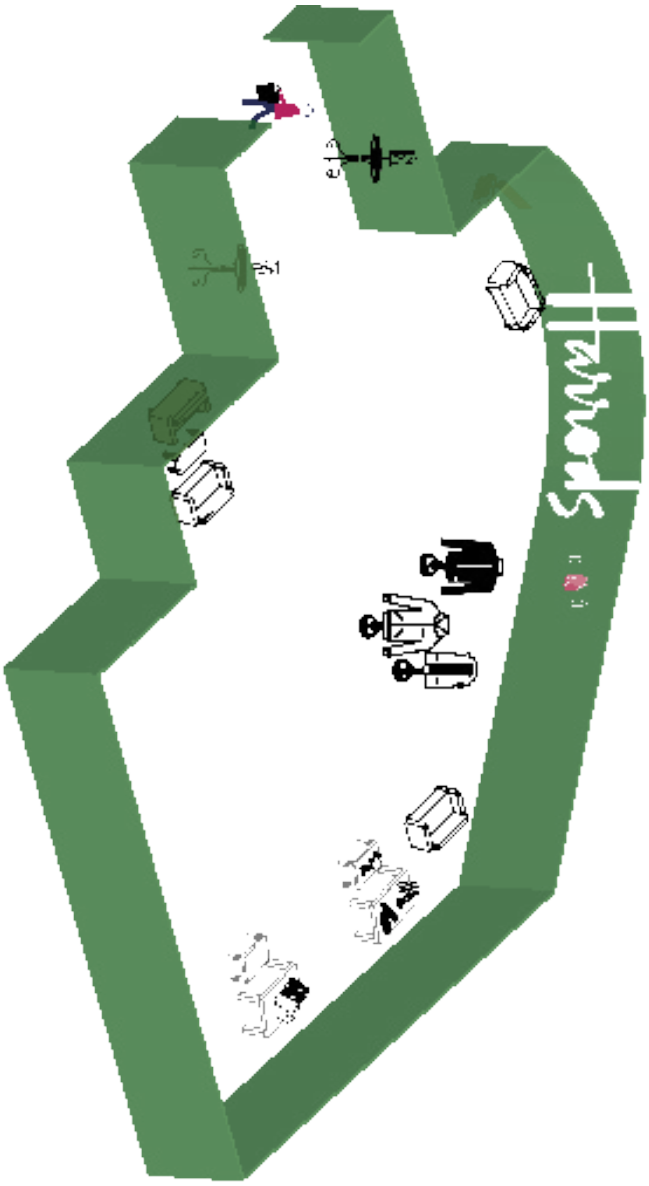
Illustrated Prototypes

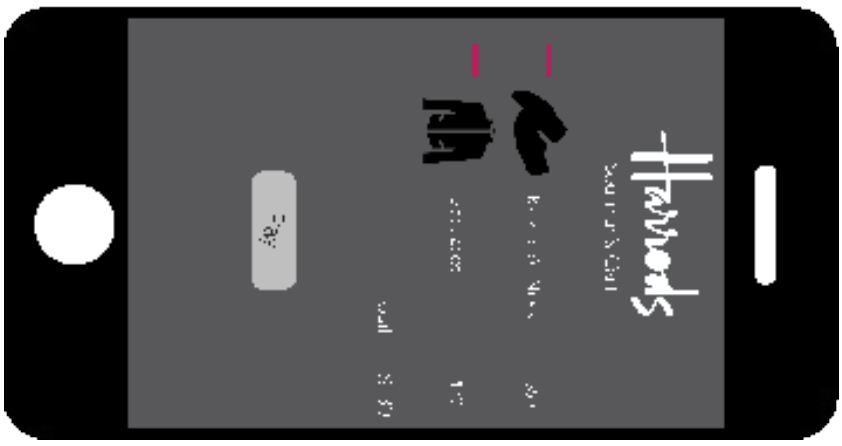
Passenger Recieves New Collection notificaton



Illustrated Prototypes

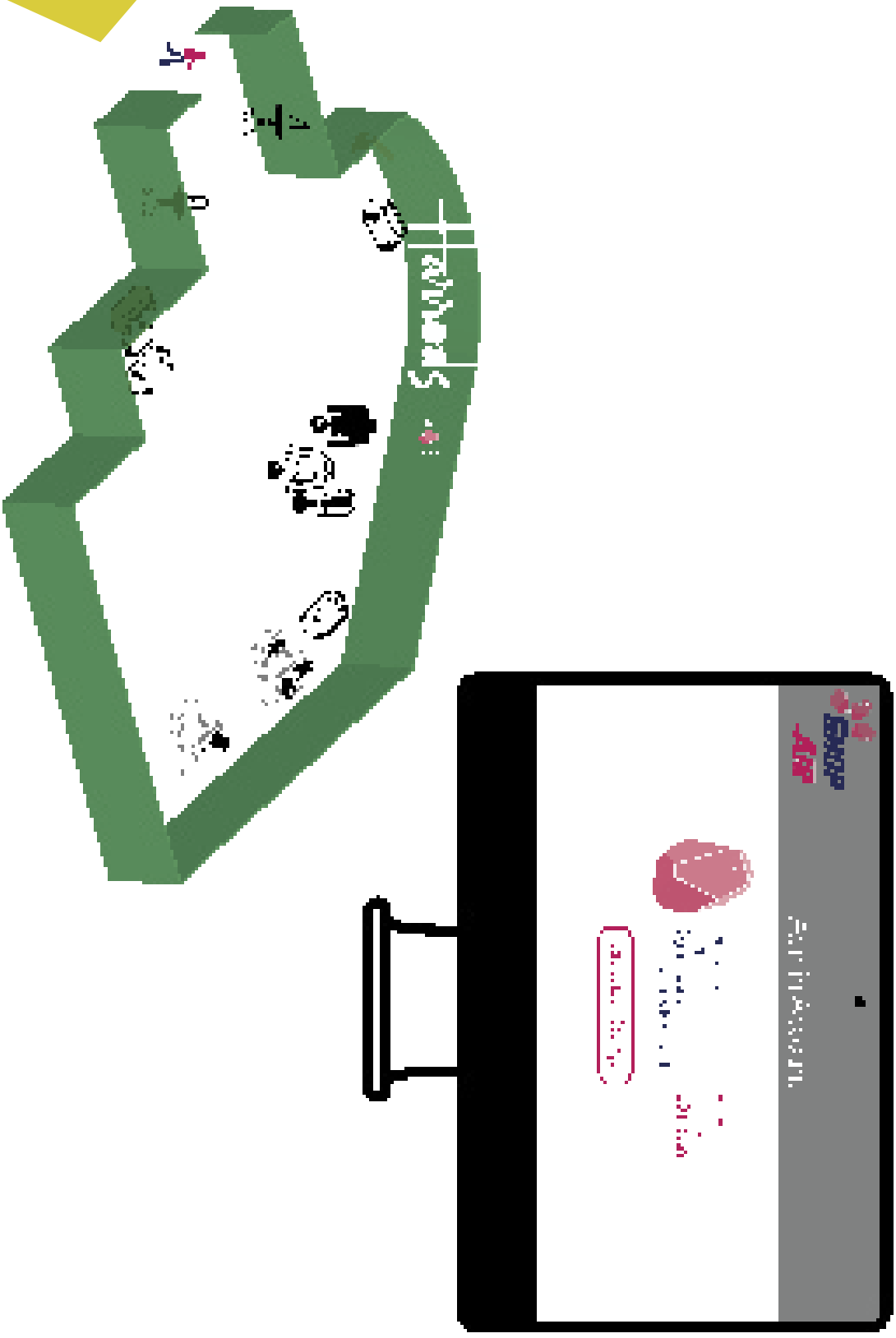
Contactless Payment





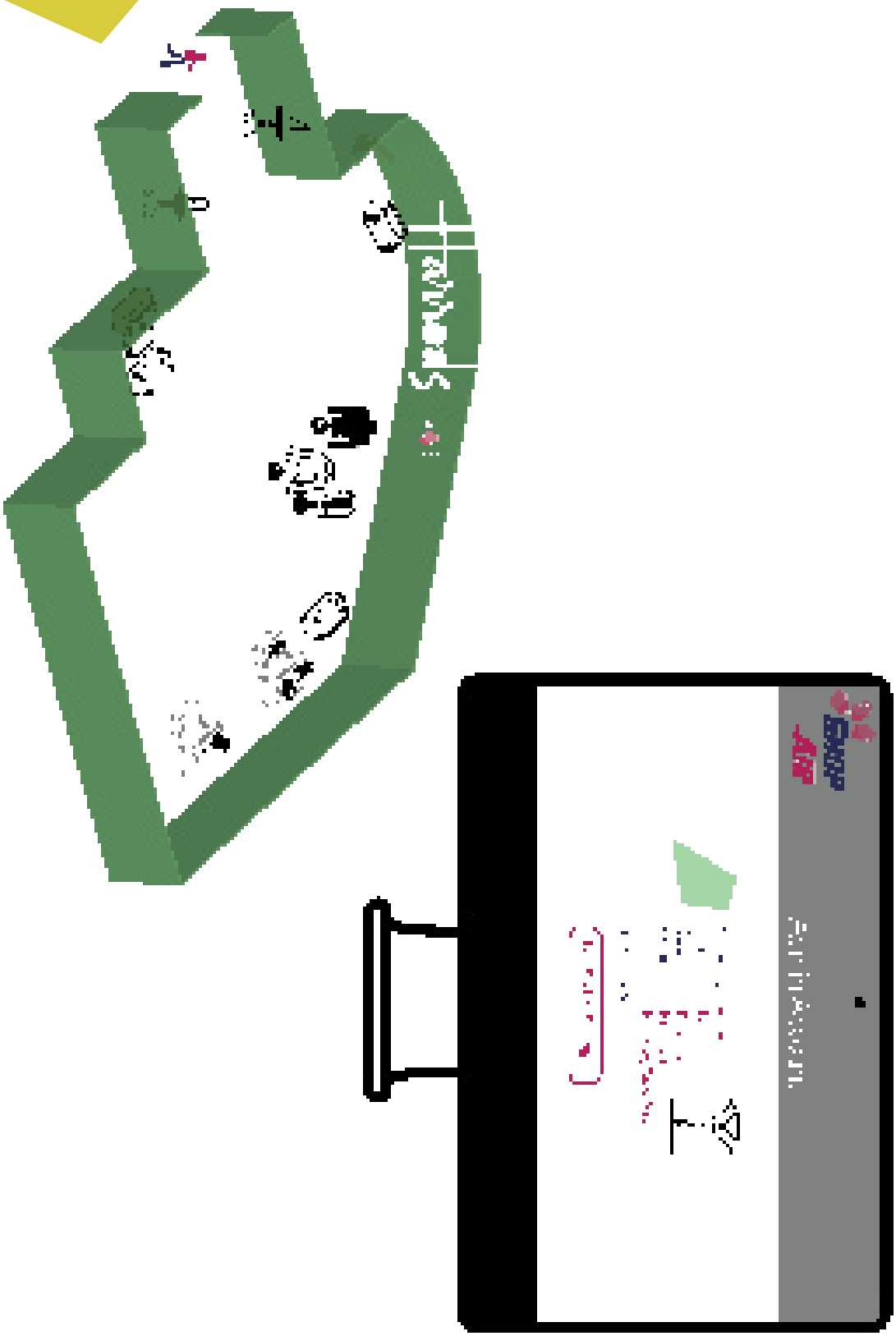
Illustrated Prototypes

Admin Account - Beacons



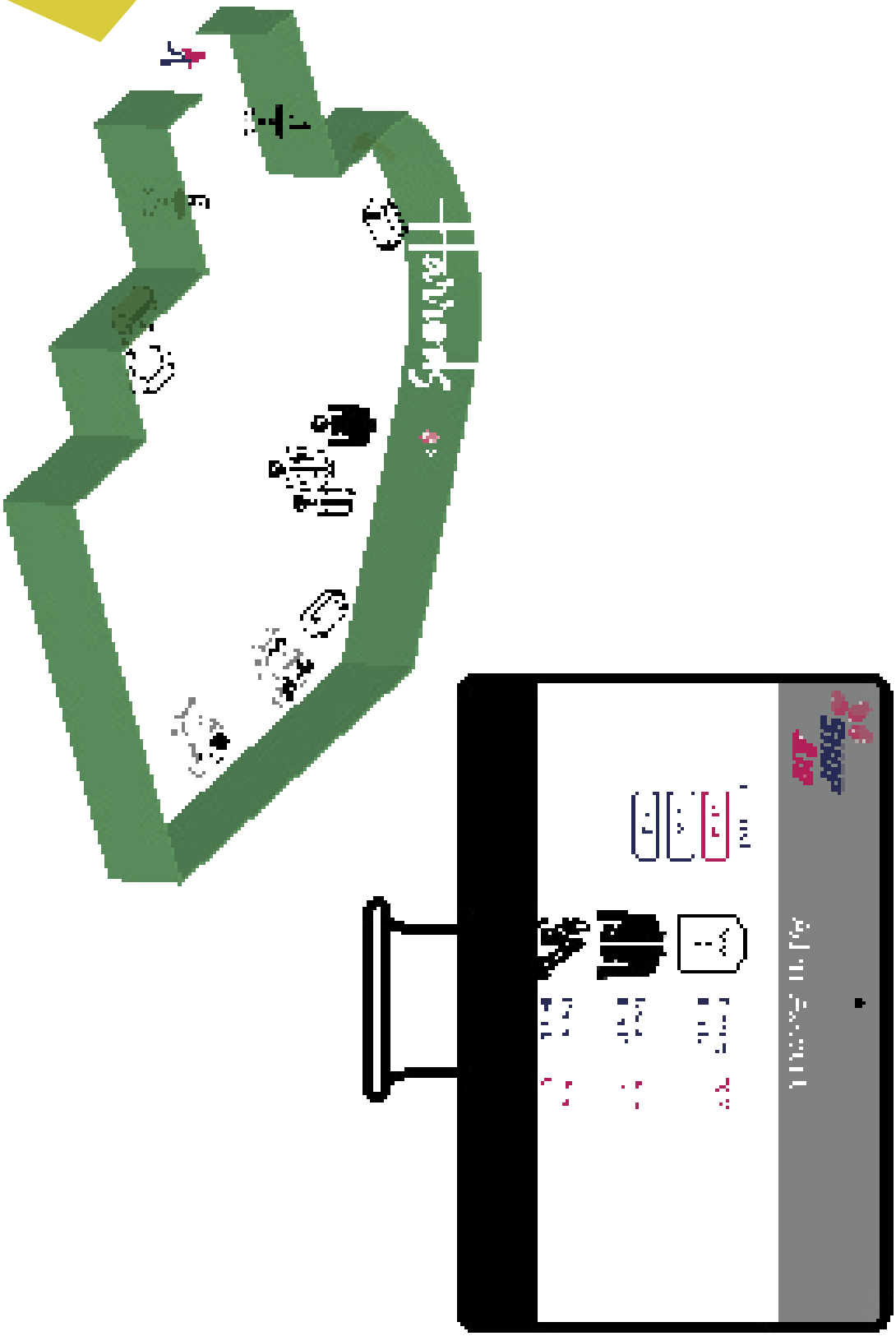
Illustrated Prototypes

Admin Account - Stickers



Illustrated Prototypes

Admin Account - Items



Use Cases Implemed In ShopAir

Scenarios	Extent of Implementation
Sign up for ShopAir through Facebook	Prototyped
Fill in preferences in Preferences Page	Prototyped
Receives ID from beacon	Prototyped
Sends notification to the lockscreen or phone	Prototyped
View notification of the offers related to his preference	In Process
Distance of the phone from the beacon	Prototyped
App lets user know if in the beacon range or no	Prototyped

Use Cases illustrated in Document

Scenarios	Extent of Implementation
Shows the location of a certain product	Illustrated
Avail discount offer	Illustrated
View information about product	Illustrated
Is able to make contactless payment	Illustrated
Admin side Use Cases	Illustrated

Dependencies and Technical Issues

There were 3 major Dependencies and lessons learned during our Project:

Take claims made by Startups with a pinch of salt

Estimote promised that the beacons will be delivered in 2-3 days after they were ordered; They took 4 weeks. Moreover the Stickers (mini-beacons) were supposed to launch in mid-October but they never did.

Proper Documentation is a Necessity

There wasn't proper documentation available online throughout the project sprints. This included information about iBeacons, its issues, and the coding language (Swift) that Apple Inc. recently introduced. This led the team to develop the project in Objective C.

Have a flexible timeline

Due to the lack of documentation of iBeacons, our team discovered their limitations and issues during our developement process. Alongside this, there were issues with the app permissions, and debugging code. Having a flexible timeline and an understanding client helped the team throughout the process.

Please see attached Appendix B for detailed documentation of errors and fixes for the Estimote Beacon-ShopAir development

Cost-Benefit Analysis

The Benefits

Data Collection

Every shop that installs the Estimote Beacons and related ShopAir app in the Qatar Duty Free Area will provide it with unique methods of Data Collection. The Estimote Beacon-ShopAir combination can collect and store at least three types of data from customers (users who use the app): what the user 'likes', what the user prefers, and whether the user goes where he's prompted to go by the app.

The ShopAir app requires a login through Facebook. This allows the app to register the user, and obtain basic information from the user's Facebook Profile. After the ShopAir App is deployed on the Apple App Store, Facebook can be contacted to request access to further information about users such as their 'liked' pages.

The ShopAir app shows users the Preferences Page where first-time users enter their preferences about the types of items they would like to receive notifications about. The app collects this data.
The Estimote Beacon-ShopAir combination works with Bluetooth and is based on proximity. The iBeacon sends out signals that are then received and responded to by the app. This beacon-app interaction can store data about user behavior and his proximity changes.

Once inside the shop, the Estimote Stickers attached to the products can gather more data about user behavior. As customers come in range of the stickers, the nature of the interaction e.g. availing discount through app, or touching the item to inspect, can be collected.
This data from customers can then be used in the following ways:

Personalized Marketing

Traditional Marketing techniques such as billboards or magazine ads do not allow Qatar Duty Free Area shops to gather data about their customers. The Estimote Beacon-ShopAir combination not only allows this but also opens up a channel of highly personalized marketing to users through their phones.

All iBeacons have a range that extends beyond the walls of the shop. This allows the shops to advertise their products in detail to customers without having them physically present inside the shop. Through the data collected through the Estimote Beacon-ShopAir combination, informative 'profiles' of users can be formed in the database. These profiles can then be used to market the most relevant items to the user. This prevents the user from being put off by large billboards of products he's not interested in or don't provide the necessary information, and increases the chances of him actually buying the product as personalized discounts can be offered to him based on his 'profile' of preferences,

Cost-Benefit Analysis

The Benefits

Micromarketing

Passengers with large waiting times between flights (the heaviest users of QDF Area), are approximately 38,000/ day in number. And Hamad International Airport (HIA) has the capacity to serve around 30 million passengers a year.

Potentially, The Estimote Beacon-ShopAir combination can provide QDF with a lot of Big Data. All this data, when analysed, can provide in-depth information about Customer behavior and be used to predict Customer Habits.

The profiles formed in the database can be matched with thousands of other similar profiles and condensed into 'micro-groups'. These groups can then be notified of discounts, new items they may be interested in, and loyalty packages based on what they would want out of a shopping experience. Simply put, the Estimote Beacons-ShopAir can allow the Qatar Duty Free to curate shopping experiences for customers by providing personalized information and in turn encouraging them to shop at QDF.

Cost-Benefit Analysis

The Risks

Maintenance

There are recurring maintenance costs associated with implementing this technology in HIA. Every shop that decides to adopt the Estimote Beacons-ShopAir combination will need to hire an administrator solely responsible for the iBeacon and the app. The administrator will be responsible for the inputing in information the beacon will send out and the data the app is collecting. This would be often and on a regular basis. This will increase the operational costs of the businesses.

Scalability

The technology hasn't been fully field tested yet. There is no credible documentation with regards to implementing the system on a full scale. Hence there is no adequate way of knowing how the technology would scale.

Security

There are issues and concerns related to privacy and hacking with Beacon Technology. The iBeacon and the app deal with large amounts of data. Access to this data, its storage, hackability and privacy violations are all issues that need to be dealt with before deploying it on a large scale.

Reliability

With foreground monitoring, the technology responds within seconds. However with the beacon monitoring running in the background, the detection can take upto 15 minutes. This is documented online on all major forums. Our team had similar issues delayed responses during our testing process.

Usability

The prototype app needs to be locating the beacons constantly, even when user is not using the app. This drains the battery as the location needs to be turned on throughout the user. This is because the beacons don't recognize the device if it's already in the region and must keep track of the movements of the smartphone to be responsive. This usability flaw needs to be fixed in the updated iBeacon Technology.

Cost-Benefit Analysis

Recommended Action Steps

Don't deploy in the Qatar Duty Free Area

Given the risks associated with the technology, the team recommends the client to hold off on using the iBeacon Technology in the Qatar Duty Free Area at HIA.
This is primarily because the iBeacon Technology is not mature enough to be adequately deployed in the Commercial Department. Also because the risks mentioned in the previous section have to be safely managed before considering the deployment and use of the technology in Hamad International Airport.

Other Possibilities for exploration

Wayfinding

The iBeacon Technology still holds potential in terms of providing a unique experience to passengers. During our User Research Phase that included User Interviews, most of the interviewees suggested that seemed a bit lost in the vast and spacious Hamad International Airport and required assistance in getting to where they wanted to get to.

The iBeacon-Smartphone App combination can be used to provide real time wayfinding instructions to passengers that help them get to their destination in time.

Baggage Tracking

If Hamad International Airport decides to innovate the back-end processes of baggage processing and tracking, iBeacon Technology may be able to help. One way to do this would be to tag the passengers' bags with stickers (mini-beacons) and connect them to the users' phones. This was users can keep track of their baggage in airports.