TECHNICAL PROJECT BACKGROUND

The discussion of the technical project began during a discussion of the current college waste problem seen at universities across the country. According to PlanetAid (2015), "there is a significant spike in the amount of solid waste generated on college campuses specifically during the months of May and June, when their students leave behind an average of 230 tons of waste" (para. 2). Consequently, the University of Virginia is no exception. According to Sloan (2018), at the University of Virginia, a number of students throw away items that are still usable such as rugs, fans, clothing, and small home goods (Waste Reduction section, para. 1). Furthermore, Nina Morris, who works at the U.Va. Office of Sustainability, realizes and shares similar concerns.

Many of the items being discarded could be sold to others in the community. For example, students can sell used furniture, appliances, decorations and other home goods on websites such as Craigslist, eBay, or on the U.Va. Facebook page dedicated for students selling and buying. For textbooks, students can sell them back to the U.Va. Bookstore. However, students neglect all of these options for various reasons. First, the barrier to entry to sell on Craigslist and eBay is too high. Students want to sell to other students in an efficient manner without having to ship it. Additionally, Craigslist does not have a rating system which adds uncertainties to whom they are selling and discomfort about meeting potential buyers. The Facebook group does not have a filter system to categorize their items which makes it disorganized and inefficient. These pain points deter students from using the existing platforms. Thus, with minimized incentives to sell unwanted items, students choose to throw away

unwanted items at the end of the school year. The proposed service works to resolve both of these problems.

According to Forranato, Einav, and Levin (2016), the most effective ways to make the marketplace trustworthy are "limiting entry, certifying quality, or insuring against bad transactions" (p. 621). SteelKiwi (2018) also points out that this is the precise reason companies such as Uber and Lyft have been so successful:

> Most services have star rating systems that help rate users on both ends of transactions. For example, Uber and Lyft ask both drivers and passengers to rate their experiences. These ratings let the company filter out bad users and improve with every interaction. Drivers on Uber are allowed to have no less than a three-star rating. As a result, riders don't have to worry about having a bad experience (para. 34).

Using a two way rating system, the level of trust that buyers and sellers feel increases on both ends. Bad sellers can be quickly filtered and removed from the system while bad buyers may have a tough time buying anything with poor reviews. Furthermore, according to Joe Gebbia, the Founder of Airbnb, a well-designed reputation system is key for building trust. In the joint study done with Stanford, Gebbia and the team learned that people's willingness to trust someone is mostly based on similarity. Similarity in age, location, and geography. However, when they added reputation into the mix, the results changed drastically. They found out that high reputation beats high similarity in promoting and facilitating trust. The research team took these key factors into consideration when creating The University Marketplace, in order to ensure it would be a viable product for students to use.

RESEARCH AT THE UNIVERSITY

In order to better understand the work domain of the second-hand market within the University of Virginia and the users' concerns, our team created a Qualtric survey. However, this process of surveying and interviewing students required approval from the U.Va. IRB Office, for whom we had to clarify the objective, the participants, and the potential risks. In addition, our team, including our technical advisor, had to complete the Collaborative Institutional Training Initiative to better acquaint ourselves with research ethics and compliance. Although the protocol to the IRB was initially created in the Fall Semester of 2019, it was only in late February that we were cleared to start the research. This unexpected setback delayed the starting date of the implementation phase of our web application. Nevertheless, the knowledge and information gained from the process deemed useful for our endeavor.

As aforementioned, interacting with real students was integral for determining functional and nonfunctional requirements for U.Va. Marketplace. Through the online surveys, we hoped to acquire useful quantitative data insofar as current practices and problems. On the other hand, for more qualitative information, we resorted to in-person interviews in which we could observe and better empathize with users' concerns, thoughts, and behaviors.

List of Survey Questions:
- Have you ever used Craigslist for buying or selling?
- Have you ever used the Facebook Uva Hoos Buying/Hoos selling?
- Have you ever used Ebay or another online service to buy or sell?
- For any service you did not use, briefly explain why. Was it due to lack of need, laziness, distrust of the service, difficulty of use, etc.
- Are you a student or faculty member?
- What is your preferred method of contact (buying or selling) on a site such as these?

- Check the following boxes of things you might buy or sell on the site.
    - Furniture
    - Textbooks
    - Electronics
    - Clothes
    - Bikes/Transportation
    - Appliances
- Are there any other items you might buy or sell on the site?
- How many used things do you give away (or sell) at the end of each semester (this could include anything from furniture to electronics to textbooks).
- How much more likely would you be to use an internal buying and selling service within UVA as opposed to a public service such as Craigslist.

List of Interview Questions
- What do you do with your old textbooks, clothes, furniture, and other household items at the end of the year?
- What stops you from selling your old items?
- What are some challenges you face dealing with unused items?
- What are your impressions of Craigslist, FaceBook Hoos Buying/Hoos selling, eBay?
- If has sold and bought items from others
    - What was that experience like? Step by step details on the process
- If has sold and bought used items from UVa Bookstore/Craigslist/Facebook/eBay
    - What was that experience like?
- How do you find school supplies/household items to buy?
- Where do you buy school supplies?
- Where do you buy furniture/household items?
- What are some of the factors you consider when buying and selling used items?

We surveyed 56 and interviewed 6 U.Va. students. The most noteworthy finding from the survey was that out of the 56, 45 had never used Craigslist to buy or sell items and 50 for the Facebook groups. Most of these individuals who have never used these existing services ascribed their reasons to distrust of the platforms, difficulty of use, and laziness. From the interviews, we learned that those who had never used Craigslist all shared the similar concern of the website's poor design and usability. Furthermore, they expressed that they felt more disinclined to interact with the sellers online for whether the seller was a university personnel or not was uncertain. Regarding eBay, some interviewees expressed that shipping and handling was a hindrance when it came to dealing with used items for which they might need in a short period of time, such as school supplies.

TECHNICAL DESIGN

First, and most importantly, access to the proposed marketplace will be limited to users who are able to login through NetBadge. According to The University of Virginia's Information Technology Services (2019), "NetBadge is the gatekeeper between users and websites, services, or applications at UVA that need to know and verify user identity before granting access" (para. 1). Using NetBadge as the gatekeeper to limit entry coupled with the historic Honor Code and student self governance at The University, students will be able to use the market feeling confident that they will not be scammed.

Next, The University Marketplace will use a two way rating strategy to ensure that both buyers and sellers feel comfortable moving forward with their transactions. When a P2P service

limits the ability to leave reviews, Forranato, Einav, and Levin (2016) point out an important side effect that must be considered.

> One might expect manipulation to be more limited when reviews can only be written after a confirmed transaction, but because reviews are in some sense a public good, people may still under report information that would be helpful to future customers (p. 621).

In order to enforce users leaving reviews after each transaction so that no information regarding the buyer or seller is lost, buyers will not be able to engage in another transaction until they have written a review for the seller. This will ensure that every single buyer and seller on the marketplace will be rated as soon as they start using the service.

Figure 1 illustrates the entire process that users will follow to either buy or sell goods in the marketplace, including the key features just discussed to enforce trust and quality. Before the site can be accessed, the user must login through NetBadge which will increase the level of trust that all buyers and sellers have for one another. Users can then either browse for things to purchase, post things of their own to sell, or both. One of the benefits of the peer to peer market is that customers and providers can be easily interchanged allowing it to be a two way connection (SteelKiwi, 2018). The buyer
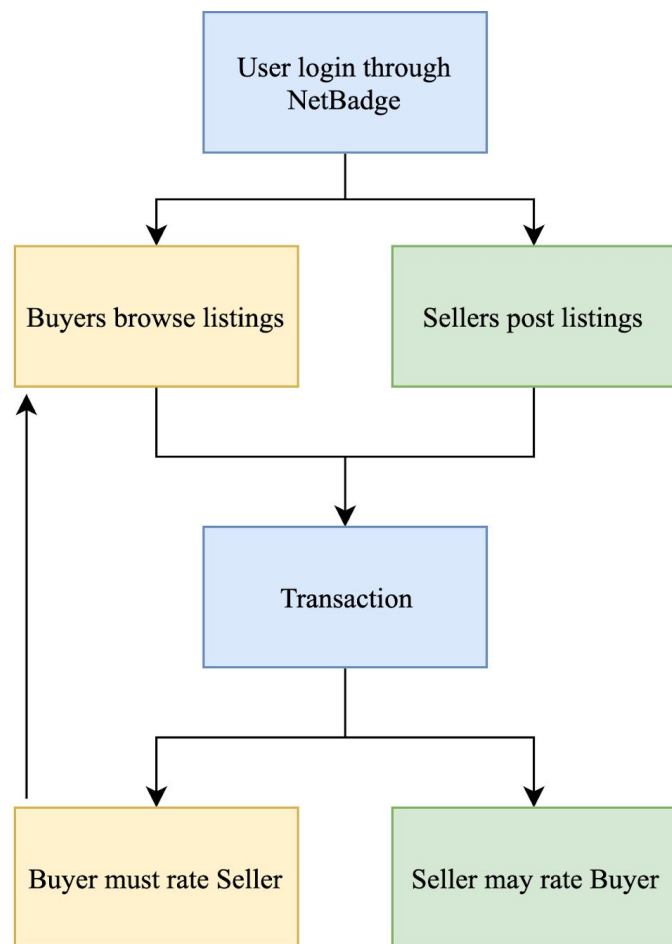

Figure 1: The University Marketplace's Transaction Flow: Highlights the need of a netbadge login to access the system and also the requirement of buyers leaving sellers reviews in order to continue browsing listings (Choi & Workman 2019).

and seller are then able to engage in a transaction after which the buyer is required to rate the

seller. The buyer will not be able to view the listings page until they have rated their previous

transaction to ensure that no rating data is lost. This will incentivize sellers to provide what they

advertise as they know they will be rated and will help keep the quality of listings high in the

long run. At the end of each transaction, sellers will be encouraged to rate the buyers but it will

not be required. If the seller was required to rate the buyer before engaging in another

transaction, then the seller would not be able to have multiple transactions open at once.

TECHNICAL IMPLEMENTATION

The site itself was engineered using Django, a Python Model View Controller (MVC)

framework. The framework allows for simple rendering of database items throughout a service,

easy integration with other services such as NetBadge login, while still allowing enough work to

be done under the hood to allow for features such as restricting access to the rest of the site

before a user has left a review for their current purchase. The team broke the development into 4

stages, initial framework design, feature implementation, web design, and testing.

During the initial framework design, the team worked to model the database that would

be required to facilitate the site. The site contains database tables for Profiles, Items, Reviews,

Images, and Transactions. Once all of the required database models had been created, the team

then worked to design a URL pattern and the actual web page framework. The site was designed

to be simple, readable, and easy to navigate by using a small number of pages. The marketplace

only consists of web pages for browsing, viewing items, viewing profiles, and purchasing or

reviewing items.

Next, the team began implementing the features of the site. During this phase the service was deployed to Heroku, a platform as a service (PaaS) for hosting web applications. Heroku allows for continuous code deployment from Github, allowing all changes made to the main version to automatically deploy to the live site when saved. By allowing the site to continue running during development, the team can continually ensure that the site is working as intended.

The two key components that were implemented during this stage were prohibiting access to the site during a transaction and preventing access to the site without a netbadge login. The first component was the reason why a transaction table was included in the database. This creates the ability to easily check and see if a user is currently purchasing something, who they are purchasing it from, and what the item is. Then, once the transaction is finished, they may easily leave a review that is connected to the item and the seller. The ratings for that seller are then updated and the review can be seen immediately on that sellers page. For the second component, the team used the Django Social Authentication library which allows integration with google logins. This is the only way that users are allowed to login to the site and on the backend, the domain of the email is checked and verified to be virginia.edu. If the domain is not from virginia.edu, they are immediately returned to the login screen and are prohibited access to the site.

Next the team focused on the aesthetics of the site. The goal was to give the site a feeling of familiarity to other ecommerce sites so that users would immediately know how to buy and sell without needing any additional time to figure it out. In addition, a major goal was to make the site appear elegant as a way to increase the level of trust that users would have in the site. While services such as Craigslist accomplish the function they exist for, a big part of the reason

why people distrust those services is that their sites do not look professional and seem like they could be a scam. By using the Shopmax ecommerce template provided by Colorlib (2019), the team was able to produce a professional looking marketplace that is incredibly easy to navigate. Filtering by category and price is laid out right next to all of the items on the browse page and personal information, past purchases, and browsing is one click away at all times via the toolbar at the top of the site.

Once all of these stages had been completed, the team tested the site intensively by buying and selling numerous example items from each other. The team was unsuccessful in trying to access the site with any email other than a personal virginia.edu address and was unable to access any page of the site other than the review page during a transaction. Ratings were observed to change with each review that was left and items that were purchased or in transaction were not seen by the other team members on the browse page. During this phase, a few minor changes were made to the aesthetics of the site as the team noticed a few places that were not rendering as intended. Once completed, the team flushed out the database of test items, reviews, accounts, and transactions and the site was then ready for full deployment.

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