Tap2Change: Cashless Transactions for Panhandlers

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

Prof. Yuan Tian, Department of Computer Science

Addressing a Challenge via Design Thinking

Tap 2 Change

Cashless Transactions for Panhandlers

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Executive Summary

This report details how our group used the Design Thinking Framework to design and create our application which we called Tap2Change. The Design Thinking Process consists of five main parts: Challenge Definition, Generating and Selecting Requirements, Generating and Selecting Solution Concepts, Prototyping, and our Final Recommendation. Within each of these sections, we conducted research and expert interviews to better understand our stakeholders and identify what we needed to do to fit their needs. By using this framework, we ensured that we encompassed all the considerations needed when building a viable product.

In the Challenge Definition, we explored and researched the main social causes of homelessness and current efforts to ameliorate it. In addition, we also looked into systemic issues that lead to homelessness such as the rise in housing costs. By conducting this research, we gained a better understanding of the population we wanted to serve and what we needed to do to incorporate into our application to create an effective solution.

To Generate and Select our Requirements, we referred back to our Challenge Definition and used it to identify requirements from the viewpoint of our application as well as our outreach strategy. While we came up with around 25 total requirements, we filtered through them to come up with 8-10 critical requirements which we used later to evaluate our solution. Apart from the requirements themselves, we also came up with metrics and ideal and accepted values to score each one.

The next step in the Design Thinking process was to Generate and Select Solution Concepts. In this section, we brainstormed different avenues of delivering our application both in terms of software and community outreach strategy and scored these concepts based on the requirements we generated previously. We used decision matrices with point values for requirements to standardize the scoring across each solution concept. Upon scoring them, we also conducted a sensitivity analysis to ensure that our highest scoring solution was indeed the best option.

Next we worked on prototyping our selected solution concept, working as a team to code the application itself as well as conducting focus groups to get the thoughts of the community. In this section, we utilized software development techniques such as agile development to build our application in several different iterations. While we ran into issues with our implementation, we

were able to refer back to our prior research to identify alternative methods of achieving our goal. In addition, we conducted a focus group in order to gauge the interest of potential donors, and on the individual features we plan on implementing. The results provided us with guidance on which features of the application we need to prioritize as we continue development, and validated our effort by providing generally positive feedback.

The final part of the Design Thinking process was to make our Final Recommendation in which we delivered our judgement of how viable and effective our solution would be. We once again referred back to our requirements to evaluate whether the end solution met all our critical requirements and how many nice-to-have requirements we were able to include.

Definition of Challenge Space

Homelessness always has been, and will continue to be, one of the most important social issues that our world faces. Billions of dollars have been spent by the government, non-profits, or individuals towards reducing the total homeless population, or alleviating the pain of the burdens by the homeless individual. While these efforts have been effective in some manner, as overall homelessness in America has declined over the past ten years, according to a report done by the White House in 2019, still “over half a million people go homeless on single night in the United States” and approximately 65 percent are found in homeless shelters; meaning that each night “just under 200,000” people spend the night on the streets (Council of Economic Advisors). Homelessness is both a health and economic problem; it is a health problem since the homeless do not have access to proper sanitization and are often forced to relieve themselves in public areas, and it impacts economics because the presence of homeless people can deter individuals from entering businesses and it has a negative impact on tourism (Dam). Homelessness is an incredibly complex issue, but it is an issue that needs to be addressed, as the impact of the homelessness crisis reaches all aspects of society.

Before we begin further analysis into the problem of homelessness is it important to define certain terms that will be brought up throughout the following paragraphs. While many of these definitions are disputed amongst social scientists, the ones we have selected have come from detailed bodies of work that study the phenomenon of homelessness.

Definitions

Episodically homeless: people are those who frequently go in and out of homelessness (Institute of Medicine)

Chronically homeless: people how have spent one or more years without any intervening periods of residential stability (Institute of Medicine)

Homeless: a process characterized by a progressive waning of resilience capacity to cope with life challenges created by series of adverse incidents in one's life (Institute of Medicine)

Panhandling: a form of solicitation or begging derived from the impression created by someone holding out his hand to beg or using a container to collect money (Pufong)

There are a number of factors that can contribute to an individual entering into homelessness. One major component that has a proven direct relationship with an increase in homelessness is a reduction in affordable or available housing. Since 1980, the supply of low-income housing has declined by about 2.5 million units, and each year it is estimated that half a million housing units are lost from the US aggregate supply, and "the production of new housing has not kept pace" (Institute of Medicine). Another factor that can lead someone to enter homelessness is if they have a mental illness, as around 25% of the homeless in America experience mental illness (Homelessness and Mental Illness), or suffer from substance abuse. Furthermore, the leading factor that causes homelessness for women, which makes up 30% of the homeless population, is domestic abuse. Since these women are forced to flee their homes, often very quickly due to fear of their life, they are forced to live on the streets or in shelters (USC Department of Nursing). While this is a simplified list of factors that lead to homelessness, all of the research conducted pointed to these three factors as the most important.

Once a person enters a period of homelessness it becomes increasingly more difficult to break out of this, particularly if an individual is episodically homeless. One study which was conducted to better understand how the impact being homeless had an individual's behavior,

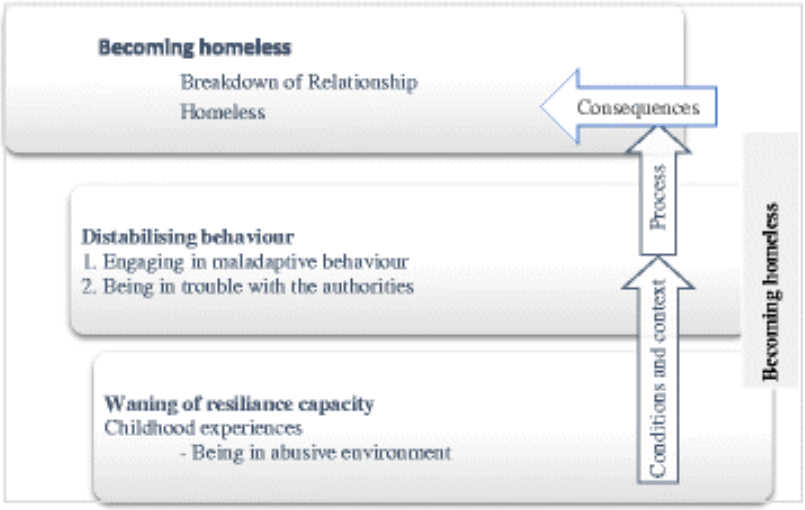


Figure 1**:** This chart maps the process by which the deterioration of social connection occurs for homeless people (Mabhala)

discovered that the leading behaviors developed during a period of homelessness are "1. Engaging in maladaptive behavioral lifestyle including taking drugs and/or excessive alcohol drinking 2. Being in trouble with people in authority" (Mabhala). The consequence of these behaviors in a breakdown in social relationships, and ultimately becoming chronically homeless. Furthermore, if a person engages in this cycle to a point where they become dependent on panhandling, they most likely will never stop their reliance on this practice. This is shown by a study where 44.5% stated how if they were no longer able to panhandle, they would go hungry (Canada Research).

Panhandlers derive their income by asking for donations and they often occupy street corners and hold signs to garner attention. Many local and state governments have tried to prohibit the act of panhandling due to its impact on the look of the city or town, however the Supreme Court has found that asking for help is protected speech under the First Amendment. Regardless of this, ordinances which criminalize panhandling have been on the rise in the US, increasing 43% in the past 10 years. This, however, is the wrong approach to solving homelessness as these laws add fines and arrest records to the already struggling individuals. This solution is not sensible for governments either as it would cost between one-third and one-half the price to provide support and services for a homeless person than to move them through the legal/criminal justice system. The system currently works against impoverished

individuals, and while communities can help to uplift each other, systemic reform in affordable housing, medical insurance, and wages are necessary to make a significant and wide scale impact.

There have been previous initiatives to possibly help empower panhandlers to get back on track. The National Homelessness Law Center (NHLC) has set up a #IAskForHelpBecause campaign in response to the many anti-panhandling ordinances that have been passed in different communities throughout the United States. Their goals have been to allow the homeless to ask for money because it is a First Amendment right, shift funds from law enforcement and criminal justice to housing and job services, decreasing the amount of people punished for panhandling. Another initiative was a study conducted by the "New Leaf Project" which compared a group of homeless people that got $7500 to a control group. It showed that the experimental group actually secured permanent housing almost a full year ahead of the control group and had overall much greater food security. There was also a 39% decrease in purchases of alcohol, cigarettes, or drugs. This came as a surprise to many people and showed that we can actually help panhandlers despite the stigma that surrounds them.

E-Commerce & Digital Banking

What is E-Commerce & Why is it Important?

E-commerce is defined as "the buying and selling of goods or services using the internet, and the transfer of money and data to execute these transactions" ("Ecommerce Definition"). This includes any type of purchase online, sending money to another person using technologies such as Venmo or Zelle, or even transferring money between accounts at a bank through their app.

Ever since the very first electronic transaction occurred on August 11, 1994, e-commerce has been growing at a steady rate, with the most growth in the past ten years. Figure 2 at the top of the next page displays the percentage share that e-commerce has of the total global retail sales ranging from 2015 to 2023 ("The Future of Ecommerce in 2020"). Each year since 2016, the share grew by about 2%, and in 2019, worldwide e-commerce sales was just over $3.5 trillion USD. This steady growth over the last five years demonstrates that e-commerce and digital purchasing will only continue to become bigger parts of society. This along with the continued

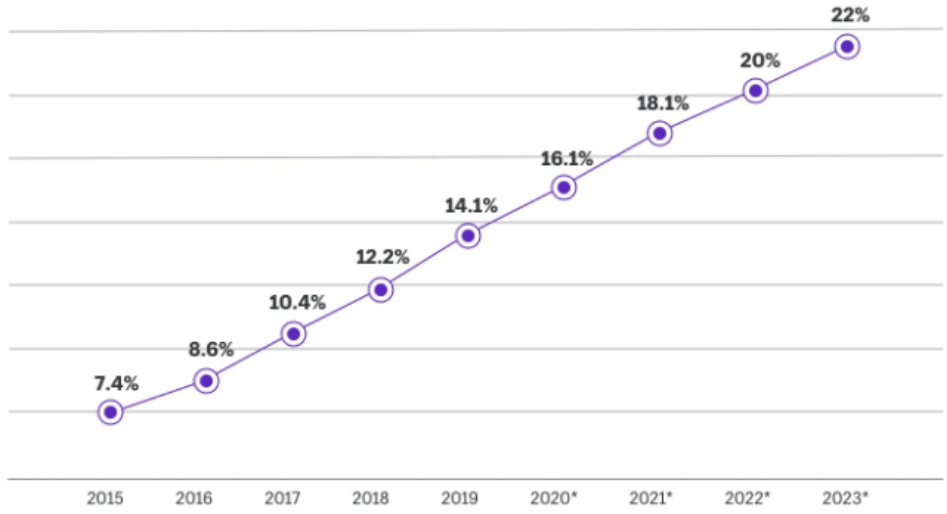


Figure 2: Ecommerce percent share of total global retail sales

use of credit/debit cards is a big reason why people are carrying significantly less cash on them. According to a study performed by US Bank, 50% of respondents stated they carry cash less than half of the time they go out. In addition, 76% said that when they do carry cash it's less than $50. This makes e-commerce crucial for this challenge space because it is clear that the increasing growth and adoption of e-commerce and digital banking is decreasing the need to carry hardly any cash when going out. Another statistic that solidifies the importance of e-commerce is that people with an income of over $75,000 are more than twice as likely than those making less than $30,000 to say that they make zero purchases using cash in a typical week. Not only are the people who are more capable to make donations to the less fortunate carrying less cash, but those who are less fortunate are also potentially getting left behind in regards to the benefits of e-commerce.

Advantages & Disadvantages to E-Commerce

There are several advantages to e-commerce, both on the consumer side and the business side. For one, the ability to process payments essentially instantaneously along with reducing the costs associated with accessing bank services provides a big upside for corporations when compared to using cash (Chavan, 2013). Another advantage for corporations is that they can view the balances and transactions for all their accounts with the simple click of a button,

allowing them to have quick and continuous access to information (Chavan). On the consumer side, e-commerce provides the convenience of being able to perform transactions and manage their money between accounts 24 hours a day from any location (Chavan). People no longer need to go to a physical bank, except for withdrawing cash from their accounts since most other operations can be done online now.

As with most emerging technologies or ideas, e-commerce also comes with its fair share of disadvantages and risks. On a high level, e-commerce requires an extensive amount of infrastructure in place in addition to human capacity to properly manage and integrate e-banking into a country (Chavan). Many developing countries lack the level of technical expertise required to process e-payments and support full-scale e-commerce. This again displays how the less fortunate are potentially getting left behind in this wave of cashless and online banking. There are also risks to consider involving confidentiality, integrity, and authentication because of how sensitive the data being transmitted during an e-commerce transaction is. People's personal information, such as their name, address, bank account numbers, and e-signature, is often required in order to complete a transaction fully. Malicious people could do a lot of harm if they were to acquire that information, so maintaining a robust system without security compromises is crucial for maintaining customer's confidence in e-commerce.

Security Regarding E-Commerce

The most important aspect concerned with e-commerce systems is their ability to transfer and protect sensitive data about their users (Hassan et al., 2018). If a system is unable to securely transfer a client's credit card number or bank account information, or the system becomes compromised in some way, it would pose potential risks to the users as well as diminish any confidence that users had in the system. A review of 131 e-payment research articles conducted in August 2020 concluded that there are eight primary aspects that every e-commerce system should consider (Hassan et al.):

- Authorization - System must verify that everyone involved in a transaction can participate before executing the transaction. This includes verifying the users' information as well as ensuring there is enough balance in the appropriate accounts to carry out the transaction.

- Confidentiality - One user's bank or credit card information should not visible to any other unauthorized user
- Integrity - There must not be any unexpected changes in data before, during, or after a transaction. For example, a user's account balance must reflect the correct amount in the account.
- Authentication - This step must be performed before any other action can take place in the system, because proper authentication ensures that only authorized users can access their respective accounts and perform actions.
- Non-Repudiation - This serves as a mechanism for ensuring the user can be confident that they are connecting to the correct server when performing a transaction, such that neither the client or server could refute that a transaction occurred.
- Robustness/Efficiency - Pertains largely to the performance of the system itself, in that it should be able to process several transactions in parallel very quickly. This will decrease any wait times that users may have in performing transactions.
- Supporting Transaction - This is essentially the basis or core functionality of an e-commerce system, which is actually being able to perform transactions between clients and merchants.
- Availability - Users should be able to fully perform transactions at any time they wish, so the system must allow for that.

If an e-commerce system hopes to be successful and gain the confidence of users, these principles of authorization, confidentiality, integrity, authentication, non-repudiation, robustness/efficiency, supporting transactions, and availability must be considered and implemented correctly.

Legal Implications of the Challenge Space

There can be some legal implications that come with being a financial transaction platform and holding other people's money. A lot of these problems stem from the fact that when you are using online technologies, you are also using infrastructure that is run by other people or companies. It is important to use the Secure Electronic Transactions (SET) specifications and have a contract which will reduce the liability that we will face when different problems may

arise. Specifically, it is vital to have exclusion clauses for general liability prevention and force majeure for extraordinary circumstances. It is usually safe to include a written acknowledgement in the contract that internet transactions are inherently insecure and you will not accept liability (except in cases of negligence, trespass, etc.). Plus, with regards to network performance, it is critical to not make any promises about stability and reliability of service. Additionally, the software should not cause any damage to the consumer due to possible fraudulent malfunction of the code. Lastly, there is an obligation to keep confidential communications between financial institutions private and there are guidelines you must follow in terms of privacy of consumer data, especially sensitive information. By recognizing these guidelines that financial platforms have to follow, we can define what needs to be done in order to mitigate any potential risk.

Mission Statement

We will continually strive to meet our goal of providing a platform that allows for convenient and seamless online transfers of money between less fortunate members of our community and those who can afford to give. By creating this platform, we aim to bridge the technological gap between panhandlers and the rest of the community by providing a service that allows them to collect funds for food, money, or even educational resources. Furthermore, we aim to work towards empowering the less fortunate to break the cycle of poverty by partnering with homeless shelters and charities to provide essential items and goods.

Generation & Selection of Requirements-Based Design Concept

Generate: Design Requirements

Critical Product Requirements, Metrics, & Preliminary Specifications

- **Increase the income of panhandlers** - With the benefit of cashless transactions, panhandlers may be able to receive more donations
- **Empower homeless individuals to break out of cycles of poverty**

    - Find more stable sources of housing, income, food
    - Incentive the use educational and health resources, and social engagement (destruction of social relations is the last step in the poverty cycle)
- **Authentication** - This step must be performed before any other action can take place in the system, because proper authentication ensures that only authorized users can access their respective accounts and perform actions.
- **Confidentiality** - One user's bank or credit card information should not be visible to any other unauthorized user
- **Availability** - Users should be able to fully perform transactions at any time they wish, so the system must allow for that
- **Authorization** - System must verify that everyone involved in a transaction can participate before executing the transaction. This includes verifying the users' information as well as ensuring there is enough balance in the appropriate accounts to carry out the transaction.
- **Integrity** - There must not be any unexpected changes in data before, during, or after a transaction. For example, a user's account balance must reflect the correct amount in the account.
- **Supporting Transaction** - This is essentially the basis or core functionality of an e-commerce system, which is actually being able to perform transactions between clients and merchants.

Engineering Value Legend:

A - Acceptable

I - Ideal

Metrics

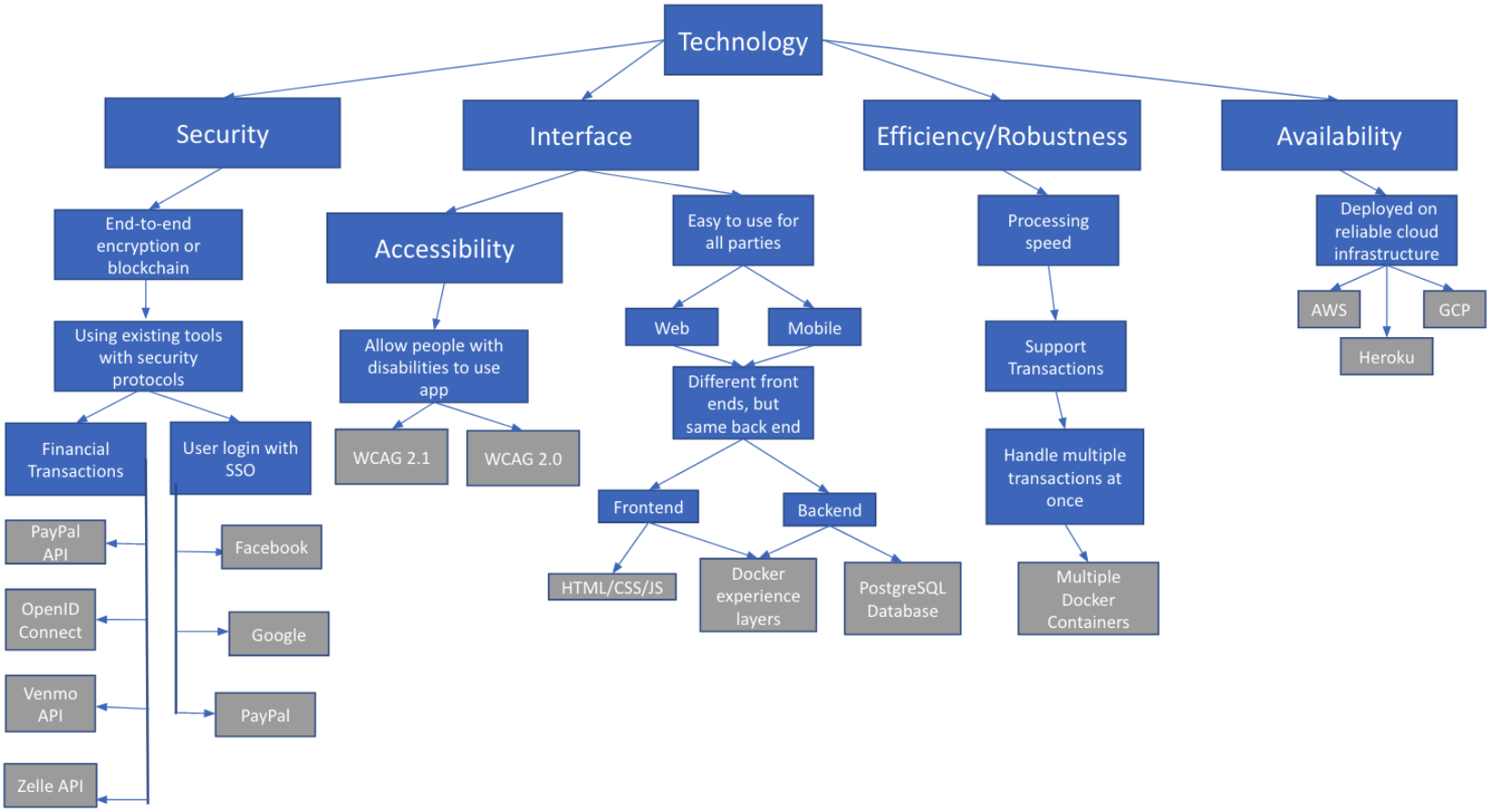
Requirement	Metric	Specification
Increase Income of Panhandlers	Percent increase of average income based on infield research	A: 10-15% I: 20%
Empower homeless individuals to break out of cycles of poverty	Resources redeemed per person per week	A: 1-3 I: 4

Authentication	Amount of times an unauthorized user can access another user's account	A: 0 I: 0
Confidentiality	Percent of users' bank information visible to other users	A: 0% I: 0%
Availability	Percentage of time the system is up	A: 99.999% I: 100%
Authorization	Percent of invalid transactions processed (Bank balances are not sufficient, wrong receiver, e.g.)	A: 0% I: 0%
Integrity	Percent of data that's inconsistent with what's expected	A: 1% I: 0%
Supporting Transaction	Percent of transactions that fail due to the system erroring out	A: 0-1% I: 0%

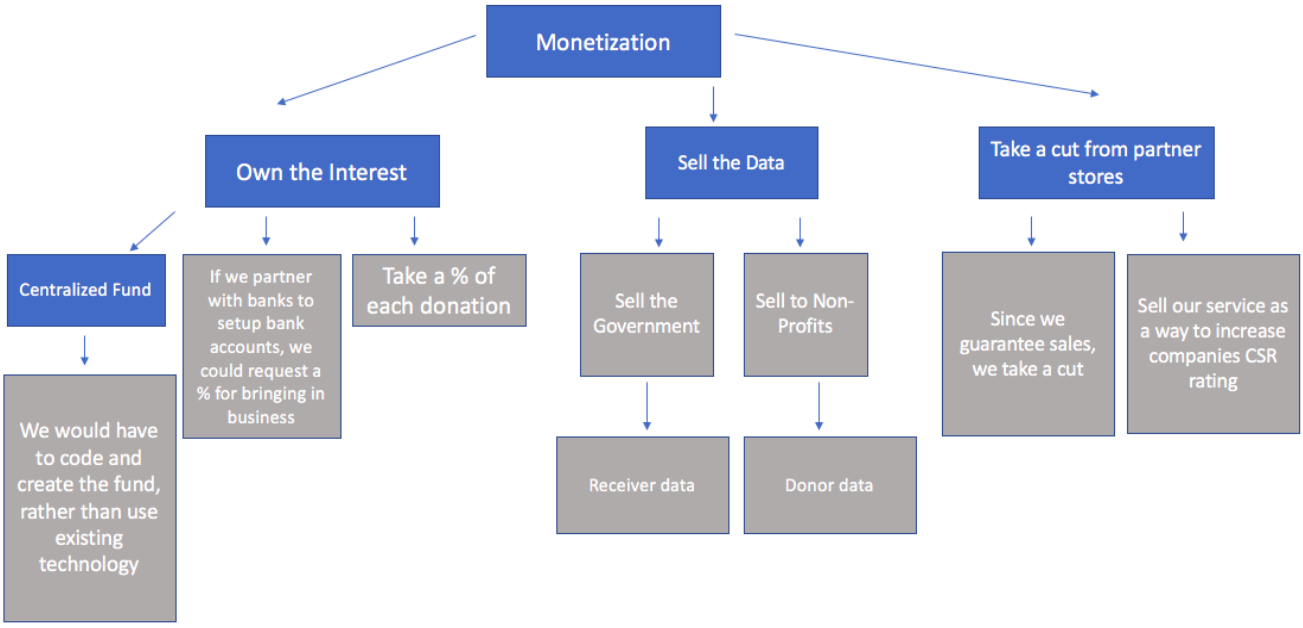
Select: Most Promising Solution Concept

Concept Classification Trees: Summary of Ideas

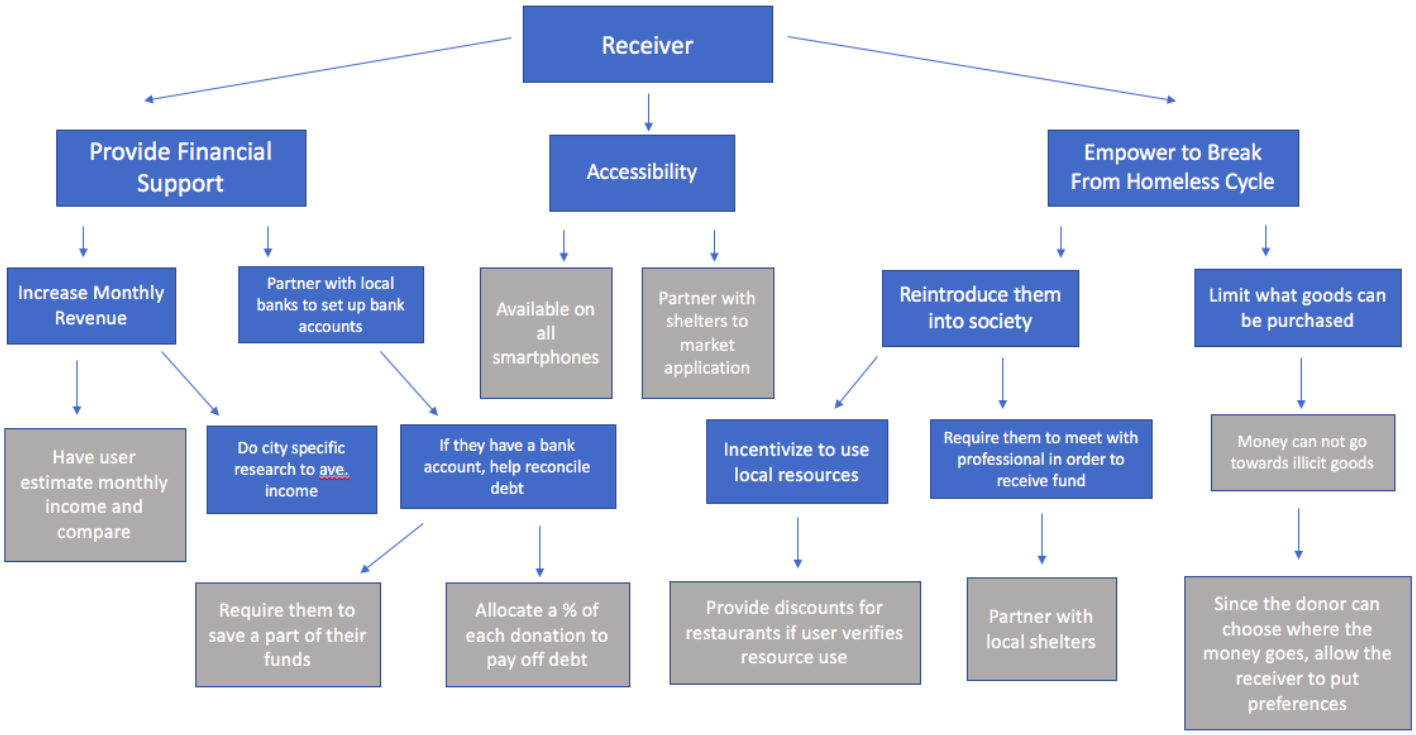
Technology Classification Tree



Monetization Strategies Classification Tree



Empower to Break From the Cycle of Homelessness Classification Tree



Decision Matrix: Key Metrics vs. Best Solution Concepts

Deployment Options

	Requirement #1	Requirement #2	Requirement #3	Requirement #4	Total Score
Requirement Weight ->	0.40	0.15	0.30	0.15	**1.00**
Alternative #1	-	-	-	-	
Ability to Deliver	9.00	9.00	10.00	8.00	
Weight * Ability	3.60	1.35	3.00	1.20	**9.15**
Alternative #2	-	-	-	-	
Ability to Deliver	9.00	8.00	8.00	10.00	
Weight * Ability	3.60	1.20	2.40	1.50	**8.70**
Alternative #3	-	-	-	-	
Ability to Deliver	9.00	4.00	2.00	0.00	
Weight * Ability	3.60	0.60	0.60	0.00	**4.80**
NOTES					
Requirement Weights	Should sum to 1.0		**Ability to Deliver**	Rate each alternative on 0 (lowest) to 10 (highest) scale	
Alternative #1	Cloud (AWS/GCP)				
Alternative #2	Heroku				
Alternative #3	In-house solution				
Requirement #1	Supporting Transaction				
Requirement #2	Efficiency				
Requirement #3	Availability				
Requirement #4	Cost				

Reasoning for Requirements:

We chose cost, availability, efficiency, and the ability to support transactions as the four criteria in grading the deployment options for our application. The possible solution concepts were to deploy on a cloud platform such as Amazon Web Services (AWS) or Google Cloud Platform (GCP), use a free deployment platform called Heroku, or to buy and maintain our own servers. Being able to support transactions between accounts is a fundamental part of our idea and app working so it was important to consider which platform would provide the best computing power and speed. We also want our user to be able to complete transactions quickly and at any time of the day, hence why we chose efficiency and availability of the platforms as our next two criteria. Our final criteria was cost as some of these options would require a large initial investment.

Reasoning for Weights:

The two most important factors our group chose were the application's ability to support transactions and be available to users at any time. This was reflected in our decision matrix for the requirements listed above as we used weights of 0.40 and 0.30 respectively. We then evenly weighted the other two requirements as we felt they were of equal importance. All the solution concepts scored evenly on the ability to support transactions but they varied widely on the availability of the application. Due to the proven success and reliability of the cloud options, they scored the maximum score as they allow us to have the application deployed 24/7. Meanwhile, Heroku scored slightly lower because of some occasional outages. In hosting our own servers, we would be limited to operating during specific hours unless we decided to run our servers constantly which would in-turn cause the cost to skyrocket.

Interface & User Experience

	Requirement #1	**Requirement #2**	**Requirement #3**	**Total Score**
Requirement Weight ->	0.40	0.40	0.20	**1.00**
Alternative #1	-	-	-	
Ability to Deliver	8.00	6.00	5.00	
Weight * Ability	3.20	2.40	1.00	**6.60**
Alternative #2	-	-	-	
Ability to Deliver	6.00	8.00	5.00	
Weight * Ability	2.40	3.20	1.00	**6.60**
Alternative #3	-	-	-	
Ability to Deliver	10.00	10.00	10.00	
Weight * Ability	4.00	4.00	2.00	**10.00**
NOTES				
Requirement Weights	Should sum to 1.0		**Ability to Deliver**	Rate each alternative on 0 (lowest) to 10 (highest) scale
Alternative #1	Web Application			
Alternative #2	Mobile Application			
Alternative #3	Both			
Requirement #1	Accessibility			
Requirement #2	Ease of Use			
Requirement #3	Device Compatibility			

Reasoning for Requirements:

The three requirements we considered for the interface and user experience are accessibility, ease of use, and device compatibility. Accessibility is important because people with disabilities should be able to use all parts of the application fully. Ease of use relates to how intuitive the overall experience is depending on the platform the user is accessing the application from. Finally, device compatibility refers to how the application looks and runs on all sorts of devices.

Reasoning for Weights:

In terms of accessibility and ease of use, we weighted both of these requirements equally because we felt that making the app accessible to as many people as possible would also improve the ease of use. As for device compatibility, we weighted it lower since most devices' web browsers are consistent with each other in how they would display the application.

Security Measures

	Requirement #1	**Requirement #2**	**Requirement #3**	**Requirement #4**	**Total Score**
Requirement Weight ->	0.25	0.25	0.25	0.25	**1.00**
Alternative #1	-	-	-	-	
Ability to Deliver	10.00	10.00	10.00	10.00	
Weight * Ability	2.50	2.50	2.50	2.50	**10.00**
Alternative #2	-	-	-	-	
Ability to Deliver	8.00	7.00	8.00	5.00	
Weight * Ability	2.00	1.75	2.00	1.25	**7.00**
NOTES					
Requirement Weights	Should sum to 1.0		**Ability to Deliver**	Rate each alternative on 0 (lowest) to 10 (highest) scale	
Alternative #1	API's and SSO's				
Alternative #2	In-house solution				
Requirement #1	Confidentiality				
Requirement #2	Authorization				
Requirement #3	Authentication				
Requirement #4	Integrity				

Reasoning for Requirements:

The security of our application is likely one of the most important factors in whether this idea is successful and from the research we conducted on security, we arrived at the following

four criteria: confidentiality, authorization, authentication, and integrity. Each of these was one of our previously generated requirements and were grouped together under the classification of security considerations.

Reasoning for Weights:

Each of the above requirements has a specific functionality in the login process and use of the application and without one of them, it would be very easy for unauthorized users to access sensitive information or tamper with transactions. As a result, we decided to use an equal weighting of 0.25 for the four requirements. The two options we chose to score were 1) using existing application programming interfaces (API's) and single sign ons (SSO's) or 2) building an in-house solution. While it would be possible for us to develop an application with these security protocols in place from scratch, we decided it would take less time to use existing tools and packages to accomplish this. Furthermore, by using industry standard tools such as the PayPal or Venmo API we can ensure that our data is protected and secure.

Monetization Strategies

	Requirement #1	Requirement #2	Requirement #3	Requirement #4	Total Score
Requirement Weight ->	0.20	0.40	0.10	0.30	**1.00**
Alternative #1	-	-	-	-	
Ability to Deliver	6.00	4.00	1.00	2.00	
Weight * Ability	1.20	1.60	0.10	0.60	**3.50**
Alternative #2	-	-	-	-	
Ability to Deliver	10.00	6.00	4.00	8.00	
Weight * Ability	2.00	2.40	0.40	2.40	**7.20**
Alternative #3	-	-	-	-	
Ability to Deliver	8.00	6.00	4.00	6.00	
Weight * Ability	1.60	2.40	0.40	1.80	**6.20**
NOTES					
Requirement Weights	Should sum to 1.0		**Ability to Deliver**	Rate each alternative on 0 (lowest) to 10 (highest) scale	
	Monitization				
Alternative #1	Own the interest				
Alternative #2	Sell the Data				
Alternative #3	Take a cut from partners				
Requirement #1	Morally okay with this				
Requirement #2	Covers costs				
Requirement #3	Generates Profit				
Requirement #4	Executiable				

Reasoning for Requirements:

The four requirements that we chose in order to determine which monetization strategy would work best for our application were that the strategy covers operational costs; generates profit; is executable; and that we are morally okay with the strategy. Our group chose these requirements for a number of reasons. First, we need the application to at the very least be able to generate enough revenue in order to cover the operating costs of the server we use and the purchasing of QR codes. Furthermore, we want to be able to generate some sort of revenue so that we would be able to pay ourselves for the hours we put into development, as well as provide funding to develop other features in our application that may prove necessary once we expand our platform across the country. However, since our application, at its core, is about helping those in need, we found it very important that we would be making money in a morally just manner, where we are not taking money from those who most need it. Finally, since we are a

startup, the monetization strategy needs to be executable from a very early stage and can continue as the application gains more user traction.

Reasoning for Weights:

While each of these requirements are important, we came to the conclusion that the monetization strategy covered costs was most paramount. We need our application to at the very least be self-sustaining, where we are not reliant on outside grants in order to keep our servers up and running, so covering costs was given the most weight. The second highest weighted requirement was that the strategy is executable, because we will not be able to cover costs if we cannot actually execute the strategy we ultimately go with. The morality requirement was given the third most weight because while we want our application to live up to the highest moral standards, if the application fails to exist if we are unable to generate any sort of revenue from it, which will hurt all parties involved. Finally, we gave the generate a profit requirement a .1 weight, because as much as we would want to make money for ourselves from this application, we are much more concerned with making the lives of others better rather than our own.

Empower to Break From the Cycle of Poverty

	Requirement #1	Requirement #2	Requirement #3	Requirement #4	Total Score
Requirement Weight ->	0.20	0.20	0.10	0.50	**1.00**
Alternative #1	-	-	-	-	
Ability to Deliver	6.00	9.00	3.00	6.00	
Weight * Ability	1.20	1.80	0.30	3.00	**6.30**
Alternative #2	-	-	-	-	
Ability to Deliver	4.00	2.00	5.00	7.00	
Weight * Ability	0.80	0.40	0.50	3.50	**5.20**
Alternative #3	-	-	-	-	
Ability to Deliver	8.00	9.00	8.00	1.00	
Weight * Ability	1.60	1.80	0.80	0.50	**4.70**
NOTES					
Requirement Weights	Should sum to 1.0		**Ability to Deliver**	Rate each alternative on 0 (lowest) to 10 (highest) scale	
Alternative #1	Incentivize to utilize local resources by providing discounts at resturants				
Alternative #2	Limit what goods can be purchased with donations				
Alternative #3	Require to meet with professionals to receive funds				
Requirement #1	Help reciever find more stable sources of housing, income, food				
Requirement #2	Incentive the use educational and health resources, and social engagement				
Requirement #3	Help reciever stabilize there finanical situation				
Requirement #4	Will it be effective/ adopted by the reciever				

Reasoning for Requirements:

The most important requirements that we identified for choosing a strategy that would help empower the receiver to break from the cycle of homelessness that led them to panhandle are helping the receiver find more stable sources of housing, income and food; incentivizing the use of educational and mental health resources by the receiver; helping stabilize the financial situation of the receiver; and finally if the strategy we implement will actually be adopted by the receiver.

Reasoning for Weights:

We allocated the most weight to the requirement that the receiver would adopt the strategy we use because, based on our external research, we found that forcing receivers to act in a certain way often turns the receiver away from using a platform. Next we gave the second most weight to the requirements aimed at reintroducing the receiver into society, because we do not want to simply increase the income of the receiver, but incentivize them to actively seek out help. Finally, we gave a .1 weight to the requirement of stabilizing the financial situation of the receiver, because we see this as a final step in the reintroduction process. Having a stable bank account is very important for being a member of society, and we believe that our application should work towards improving the financial standing of the receiver because it provides opportunities for housing and education.

Sensitivity Analysis: Confirming the Selection

Our decision matrices were accurately scored across the board and our picks were as follows:

1. Deployment
    a. MVP - Heroku
    b. If usage is high - Cloud
2. Interface and User Experience
    a. MVP - Web application with mobile view
    b. If time permits - Mobile application
3. Security Measures - Use existing API’s and SSO’s
4. Monetization Strategy

    a. Selling the data
    b. Taking a cut from partners
5. Empower to Break the Cycle of Poverty
    a. Limiting the goods purchased
    b. Discounts at restaurants

The deployment options, monetization strategies, and empowerment decision matrices were the only ones which caused us to reconsider our scoring. Upon reviewing the scores, we noticed that many of the options were closely graded and this may have been due to some arbitrary scoring. In our deployment option, although cloud options scored the highest, we decided to use Heroku for our initial deployment as it was the free option. If we realize that we need more availability and speed due to high usage, we can easily reconfigure the endpoints to work with the cloud options. In terms of the monetization strategy, selling the data would be a long-term strategy and taking a cut would be our initial strategy. In addition, we plan to rely on grant money and initial investments to sustain our product until we can implement these strategies properly. Finally, for empowerment we decided to use two strategies as we wanted to appease two sides: the giver and the receiver. By limiting the goods purchased we can instill confidence in the givers and by offering discounts at local restaurants we can convey to the receivers that the community cares about them. Our other decision matrices pointed to a clear best option, which we had inferred before completing them.

Exploration of a Design Concept

Physical Prototype

Our physical prototype took the form of a web application with a responsive mobile view and went through several rounds of iterations as the technical team, Jeffrey, Rohit, and Harish, developed it over the course of the semester. This initial focused prototype was developed around implementing the core functionality of our solution, which is enabling digital donations to be made to the less fortunate. Our end solution aims to make this service/application available to as many people as possible, including those without bank accounts, so that is why this prototype isn't classified as a comprehensive prototype. This prototype targeted most of the technical critical requirements that we outlined last semester, including confidentiality,

authentication, authorization, availability, supporting transaction, and integrity. This sort of application relies on user uptake from two different types of users: potential donors and those seeking donations. To better understand the audience that we are developing this solution for, we conducted a focus group that will be discussed in detail later.

In researching the problem space and planning out this semester, we consulted computer science Professor Yuan Tian, whose research involves user privacy and security. Her previous work has even been adopted at places such as Google, Facebook, Microsoft, and Samsung. Between our own research and the input from Professor Tian, we generated the following technology stack that we implemented in order to make our application more robust.

- Language: Python

The language we used to write our application is Python because there are several libraries that we can integrate into our code that will simplify the work for us. Python is also used incredibly widely in industry when making software applications, so there is a large community and documentation available if problems arise.

- Web framework: Django

Django is a model-view-controller framework written for Python that helps to build and structure web applications because it separates business logic from data interaction and front-end styling. We chose it because we all have extensive experience developing applications in Django and it integrates well with the other technologies we utilized, such as Heroku, PostgreSQL, and TravisCI.

- Database: PostgreSQL

The database software we utilized was PostgreSQL because Django integrates well with these databases. Since Django doesn't allow direct SQL statements to be executed to the database, this helps preserve the integrity of the data that we store.

- Continuous integration: TravisCI

TravisCI was chosen for continuous integration and testing because the software interfaces very smoothly with GitHub and Heroku. One of the advantages to using TravisCI is that it will run all the tests we have written each time we make changes to the application before deploying to Heroku. If a test were to fail, then those changes would not get deployed to Heroku which ensures that the application running on Heroku remains intact.

- Front end: HTML, CSS, and JavaScript

The technical team chose to develop an original front-end instead of implementing a template because we wanted to practice and gain experience with coding and modeling a front-end based on designs that we created previously. HTML, CSS, and JavaScript are the standards for front-end development, and we created our own class selectors in order to style our application. This also allowed us to implement custom styles and design our application to fit the wireframes we came up with.

- Containerization/Environment: Docker

Docker is a powerful tool that allows developers to run different operating systems with specific software bundles installed in what is known as containers. This allowed the technical team to both maintain identical development environments (software packages installed, versioning, dependencies, etc.) across all three of our computers, as well as build a multi-tier architecture web application.

- Payment APIs: Coinbase (https://developers.coinbase.com/api/v2)

When consulting Professor Tian, one of the points she stressed most was that we should avoid storing any money in the app because this makes us responsible for protecting that money while it's in our system. To avoid storing money in the app while still supporting transactions, we integrated the Coinbase API to handle transactions between people on the app. This allowed us to satisfy the supporting transaction requirement, as well as deliver upon part of our mission statement of bridging the technological gap between the less fortunate and the rest of the community because Coinbase is a cryptocurrency exchange platform where users can buy, sell, and trade Bitcoin. Cryptocurrencies are a new and emerging technology, which means they are not necessarily the most stable form of currency, but they serve the purpose of handling transactions for our MVP. Further payment integration options will be discussed later in section 4 of this report.

- User Account Creation/Sign-in: Google SSO

Professor Tian recommended that we implement Single Sign-On (SSO) for handling user account creation and logging in. SSO is an authentication scheme that allows users to login with a single user ID and password across multiple independent software applications, such as with your Google, Facebook, or Apple account. This satisfies our authentication, authorization, and confidentiality requirements because the process of signing up and logging in is handled by third

party industry standard platforms, and using SSO minimizes the security issues that arise from holding users' personal data.

Docker & Django

Our early iterations for developing the app revolved heavily around setting up our development environment to use Docker and Django. For this application, we designed a Docker image built using the Dockerfile pictured in Figure 3 below. A Docker image is simply a set of instructions that Docker uses to create the container, including installation scripts or specifying whether to use another container as a base. In this case, we built off another image called 'tp33/django' that was utilized in a previous computer science course that already had some of the environment set up. We encountered a few issues in building the Docker image primarily due

```
FROM tp33/django

# Bundle app source
RUN apt-get update && apt-get install -y \
  locales \
  sudo \
  nodejs \
  libxft-dev \
  libfreetype6-dev \
  libffi-dev \
  npm \
  curl \
  wget

RUN npm config set strict-ssl false
RUN sudo apt-get install -y autoconf \
  automake build-essential libffi-dev libtool pkg-config python3-dev

#Upgrading node version to latest stable
RUN sudo npm cache clean -f
RUN sudo npm install -g n
RUN sudo n stable
RUN sudo ln -sf /usr/local/n/versions/node/7.8.0/bin/node /usr/bin/node

#Installing yarn using npm
RUN sudo npm install -g yarn

#Upgrade yarn to latest stable
RUN npm install -g yarn

#Install python dependancies
RUN pip3 install -U wheel setuptools pip
RUN pip3 install --upgrade pip setuptools wheel
RUN pip3 install pgsql
RUN pip3 install psycopg2
RUN pip install django-allauth
RUN pip3 install django-openid-auth
RUN pip3 install whitenoise
```

Figure 3: Dockerfile for jtr5ee/tap2change

to versioning conflicts, but once those were resolved we pushed the image to Docker Hub so that all three developers could access the same image. Next, we had to decide whether to implement a two-tier or three-tier architecture system for our application. There are many considerations that need to be evaluated in order to ensure an application is scalable. Ideally, this application would follow a three-tier architecture in which there is a frontend layer, experience service layer, and backend layer. This implementation is favorable when there are different frontends that need to be implemented (a web and mobile application frontend for example) and all need to be connected to the same backend. The backend layer of the application is responsible for performing Create, Read, Update, and Delete (CRUD) operations so that the application can properly communicate with the database whenever necessary. The primary function of the experience service layer (the middle layer) is to relay requests between the backend and the frontend. Different frontends process information in different ways, so the experience service layer helps with making sure the information is properly formatted for the respective frontends. Our MVP was focused only on a web frontend in a mobile view, so an experience service layer was not required. We consulted Professor Tian about this as well, and she recommended that a simple architecture for the prototype would be ideal. This is why a two-tier architecture was chosen for the purposes of the MVP because it allows for upgrading to a three-tier architecture down the line if a mobile application front-end was needed. Figure 4 to the right is the docker-compose.yml file which lays out the structure of the overall application. We can tell this is a two-tier architecture because there are two application layers models0 and web0. The models0 represents the backend layer and is connected to the postgres database as seen in external_links. This is the layer of the application where all the CRUD functions were implemented in order to interact with the database. The web0 is the frontend part of the application so this is what the end user interacts with.

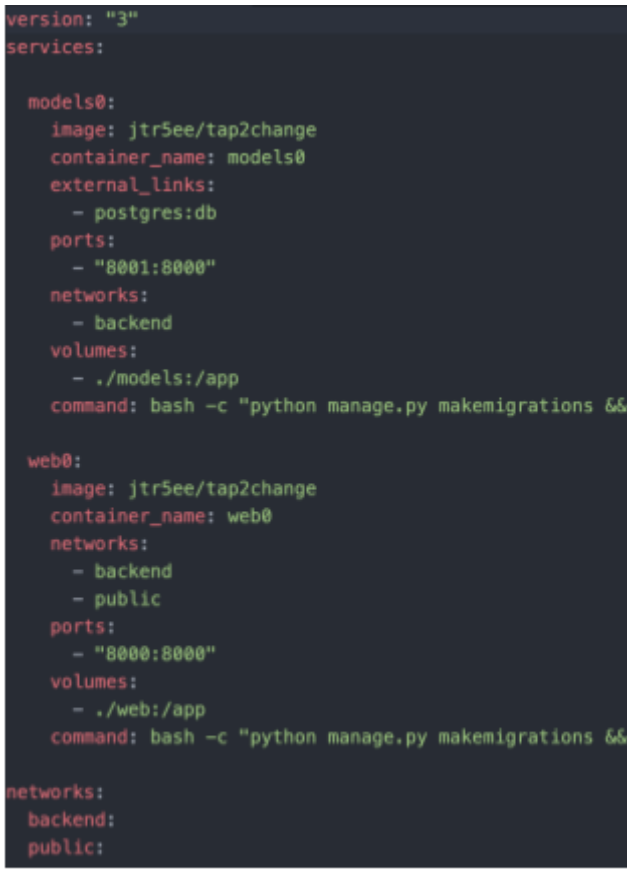


Figure 4: docker-compose.yml File Contents

Once the Docker containers were configured correctly, we initialized both Django applications that would be running on their respective containers. The models0 container serves only as an API to interact with the database, so that is where we wrote and designed the models that were stored in our database. For our MVP, there are three different types of models: Profile, PaymentMethod, and Transaction. Figure 5 below is our models.py file where we defined the fields for each model and how they link to each other. Django then communicates the structure of our models to the PostgreSQL database to set up the database properly. Next, the CRUD operations were implemented on the models layer so that API calls to it would perform the operations necessary to the database. With the models layer mostly configured, we shifted to developing the web layer by first implementing Google SSO for user account creation and logging in/out. To do this, we had to retrieve OAuth credentials from Google for our application so that API calls could be made to allow our users to sign in with their Google account. If a user

```python
from django.db import models

# Create your models here.

class Profile(models.Model):
    profile_id = models.IntegerField(primary_key=True, default=None)
    bio = models.TextField()
    displayName = models.CharField(max_length=20, unique=True)

class PaymentMethod(models.Model):
    PAYMENT_CHOICES = [('Coinbase', 'Coinbase'),]
    name = models.CharField(choices=PAYMENT_CHOICES, max_length=20)
    profile = models.ForeignKey(Profile, on_delete=models.CASCADE)
    emailAddress = models.EmailField(default="")

class Transaction(models.Model):
    PAYMENT_CHOICES = [('Coinbase', 'Coinbase'),]
    srcProfile = models.ForeignKey(Profile, on_delete=models.CASCADE, related_name='%(class)s_src')
    dstProfile = models.ForeignKey(Profile, on_delete=models.CASCADE, related_name='%(class)s_dst')
    paymentMethod = models.CharField(choices=PAYMENT_CHOICES, max_length=20)
    amount = models.DecimalField(max_digits=6, decimal_places=2)
    timeStamp = models.DateTimeField(auto_now=True)

    def formatTimeStamp(self):
        return self.timeStamp.strftime("%b %d, %Y")
```

Figure 5: Models and fields defined in models.py

is signing into our application for the first time, they are redirected to a form to finish creating their profile. Once that form is submitted, a request is sent to the models API layer with the data necessary to create the new profile in the database. Upon successful creation, the models layer sends a request back to the web layer to confirm a user has been created.

Payment Integration

Our next iterations dealt with integrating financial payment systems into our application to enable the core feature; the ability for users to easily conduct cashless transactions. In the research stage of this project we had identified the Venmo and PayPal APIs but while developing, noticed that there were issues with both approaches. First, the Venmo API was deprecated for new users as of 2018, so only existing users can still access the endpoints. Second, the PayPal API showed promise in offering a feature called Adaptive Payments which enabled peer-to-peer payments, however we soon realized that PayPal has taken down that API to restructure and remodel certain core functionalities. While these problems presented large setbacks in our application design, we decided to explore the possibility of enabling transactions through cryptocurrencies and settled on the Coinbase API. By using Coinbase, or more generally cryptocurrencies, we would be able to achieve anonymity, a feature we had hoped to integrate, and arguably bridge the technological gap by giving homeless people access to tools they might not otherwise have access to.

Experimental Procedure

Testing Procedure

```
def create_profile_test(self):
    response = self.client.post(reverse('modelsapp:create_profile'), data={"profile_id"=4, "bio": "test profile 4", "displayName": "profile4"})
    self.assertTrue(response.created)

def read_profile_test(self):
    response = self.client.get(reverse('modelsapp:read_update_profile', args=[1]))
    self.assertTrue(response.returned)

def update_profile_test(self):
    response = self.client.post(reverse('modelsapp:read_update_profile', args=[1]), data={"profile_id"=1, "bio": "test profile 1 updated", "displayName": "profile1"})
    self.assertTrue(response.returned)

def delete_profile_test(self):
    response = self.client.post(reverse('modelsapp:delete_profile', args=[4]))
    self.assertTrue(response.deleted)

def create_paymentMethod_test(self):
    response = self.client.post(reverse('modelsapp:create_paymentMethod'), data={"name"="Coinbase", "profile": 1, "access_token": "abcd", "refresh_token": "abcd", "wallet": "abcd"})
    self.assertTrue(response.created)

def read_paymentMethod_test(self):
    response = self.client.get(reverse('modelsapp:read_update_paymentMethod', args=[1]))
    self.assertTrue(response.returned)

def update_paymentMethod_test(self):
    response = self.client.post(reverse('modelsapp:read_update_paymentMethod', args=[1]), data={"name"="Coinbase", "profile": 1, "access_token": "cdef", "refresh_token": "abcd", "wallet": "abcd"})
    self.assertTrue(response.returned)

def delete_paymentMethod_test(self):
    response = self.client.post(reverse('modelsapp:delete_paymentMethod', args=[1]))
    self.assertTrue(response.deleted)

def create_transaction_test(self):
    response = self.client.post(reverse('modelsapp:create_transaction'), data={"srcProfile"=1, "dstProfile": 3, "paymentMethod": "Bitcoin", "amount": 5})
    self.assertTrue(response.created)

def read_transaction_test(self):
    response = self.client.get(reverse('modelsapp:read_update_transaction', args=[self.test_transaction_id]))
    self.assertTrue(response.returned)

def delete_transaction_test(self):
    response = self.client.post(reverse('modelsapp:delete_transaction', args=[self.test_transaction_id]))
    self.assertTrue(response.deleted)
```

Figure 6: Unit tests for CRUD endpoints

To test our application backend, we wrote unit tests. Unit tests are a form of software testing to validate the functionality of a single feature. Figure 6 shows the unit tests written to ensure that our CRUD endpoints are working properly in our application. Each endpoint has a separate test to make sure that we can create, read, update, and delete entries correctly from the database for each of our models (Profile, PaymentMethod, and Transaction). If all of the tests pass, we can ensure that our frontend can access our database accurately by hitting all of our CRUD API endpoints. These endpoints can also be tested through Postman, curl, or any other request tool by performing each request manually and making sure a suitable response is returned. We chose to utilize unit tests because they are much easier to run with continuous integration. Travis CI, a platform used to perform continuous integration testing, can be easily connected to our GitHub repository so that when any new commits are made to the repository, Travis can run the unit tests we have already written to make sure that nothing has broken with the new changes.

To test this functionality in the frontend application, we can call our backend endpoints to manipulate what the user sees. This allows users to interact with the database because they can edit their own profiles and create payment methods in our database through our CRUD endpoints. In order to test the functionality of our transactions, we conducted manual testing through Postman and our frontend to make sure our application was interacting with the Coinbase API and to make sure transactions are performed correctly. Refer to the section on performing transactions below for the application workflow.

Sprint Procedure

In order to complete our application, we used the agile development process so that we can develop our application in an efficient manner. Agile development is a way we can list out requirements and manage the project using sprints (a set time in which work should be completed). Sprints consist of sprint items where each item is a feature of the application to be developed. Each item has a number of points corresponding to the workload required to complete that feature and people that are set to complete it. This process helped us to divide our work evenly between the developers based on features and point values. Our sprint setup can be found in the table below:

Sprint Item	**Points**	**Assignee**
Backend: Postgres Database Setup	3	Jeffrey
Backend: Docker Setup	5	Jeffrey
Backend: Creating Models/Tables	3	All
Backend: CRUD API Endpoints	8	Rohit
Frontend: SSO	5	Jeffrey
Frontend: Create Profile/Login	3	Harish
Frontend: Footer	5	Jeffrey
Frontend: Profile Page	5	Harish
Frontend: About Us Page	3	Harish
Frontend: QR Code Generation	3	Rohit
Frontend: Setting Up Coinbase API	13	All
Backend: Unit Testing and Travis Integration	5	Rohit

Experimental Results

The Github repository that contains all of our code for this project is located at https://github.com/hchandra88/Tap2Change. The repository is private currently, but collaborators can be added if needed for review.

Google SSO

Shown below in Figure 7 is the flow of screens that a user would see when first signing into our application with their Google Account. The first screen is the initial login screen that users see when first entering our app. The second screen demonstrates what users see after

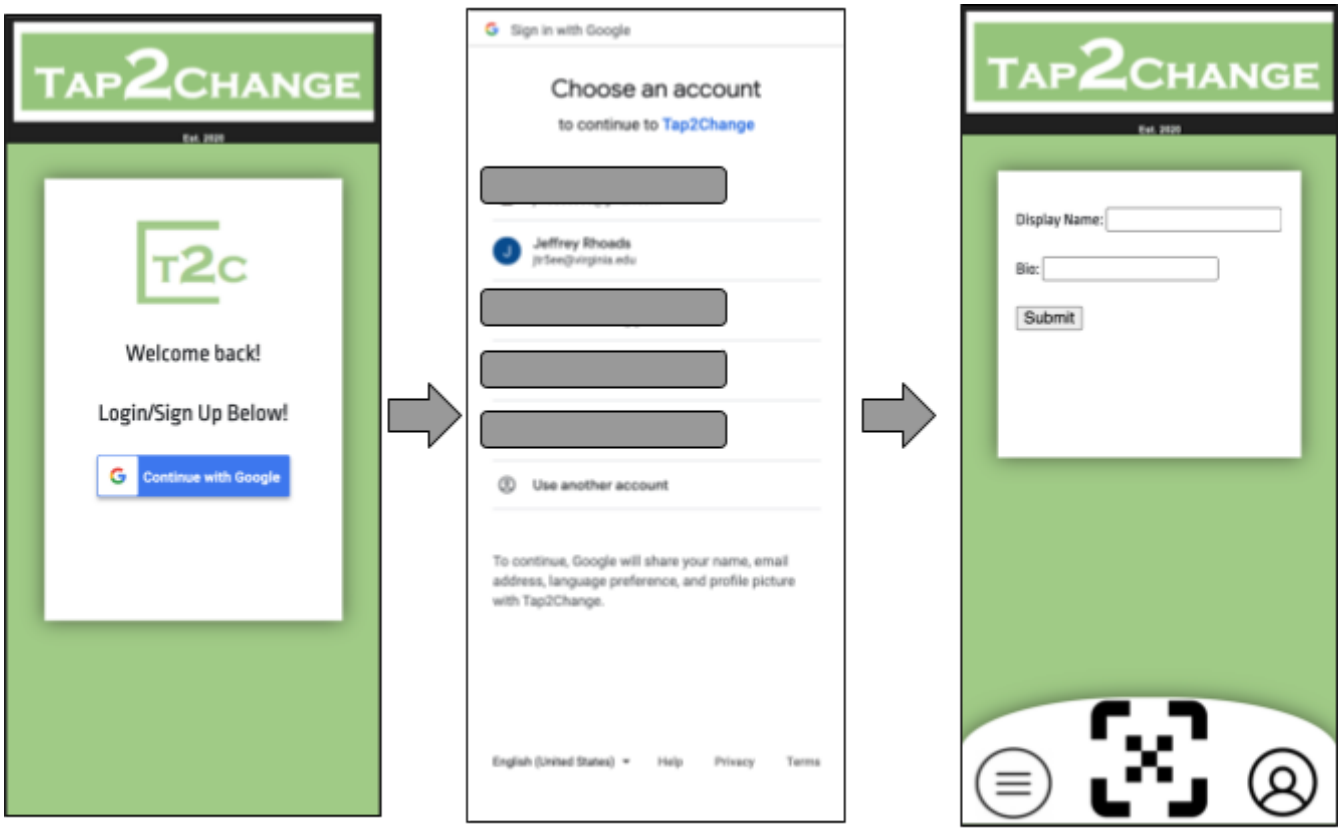


Figure 7: Google SSO flow diagram showing user logging in for the first time

clicking the "Continue with Google" button, and this is where the user can select which Google account they want to use with Tap2Change. If the Google account has not been used to sign into our app before, the user is redirected to the third screen where they can fill out their display name and bio for our application. If the user has already logged in before, they would be redirected to the home page after selecting their Google account.

Home Page & Dynamic Footer

Figures 8-10 below are screenshots of the home page and demonstrate the dynamic behavior of the footer as well. Figure 8 is the home screen of the application once a user has logged in. On this screen, the displayName of the currently logged in user is displayed at the top, with their transaction history displayed below. Figures 9 and 10 display the dynamic behavior of the footer that our application has. The pop-up displayed in Figure 9 is what appears when a user taps on the center icon in the footer. The QR code displayed is the unique code tied to their profile. When scanned by a smartphone, this links them to the transaction page to donate money to the user whose QR code they just scanned. The scan button that is below the QR code would open the user's camera to scan another user's QR code. Figure 10 shows the pop-up displayed when a user taps the left icon, which has links to logout, the about us page, and home. The other icon in the footer, the profile button, takes the user to their profile page where they can edit their profile and add payment methods.

Figure 8: Home Screen

Figure 9: Scanner Pop-Up

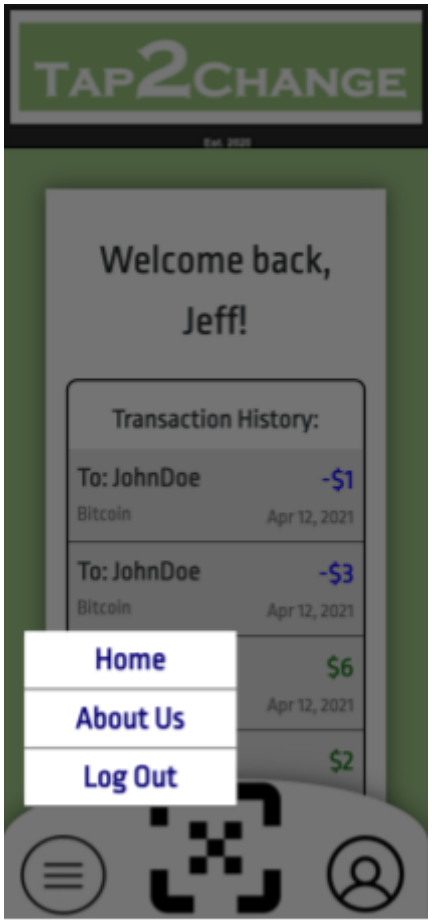


Figure 10: Left icon pop-up

Profile Screen & Adding Payment Methods

The screens in Figure 11 demonstrate the profile screen in addition to the flow of adding the Coinbase payment method to a user's profile. The left screen is the profile screen that displays the user's displayName, bio, and their payment methods if they have added any. Also, the edit profile button takes the user to a simple form to update their bio or displayName. Once a user clicks the "Login with Coinbase button", they are redirected to the center screen where they can login and authorize their coinbase account to be linked to our application. After authorizing, the user is redirected to their profile page and their payment method can be seen. The reason the displayNames don't match in these screens is because Jeffrey already had linked his Coinbase account to a different Tap2Change account and we wanted to demonstrate what the user's profile screen looks like before adding a payment method.

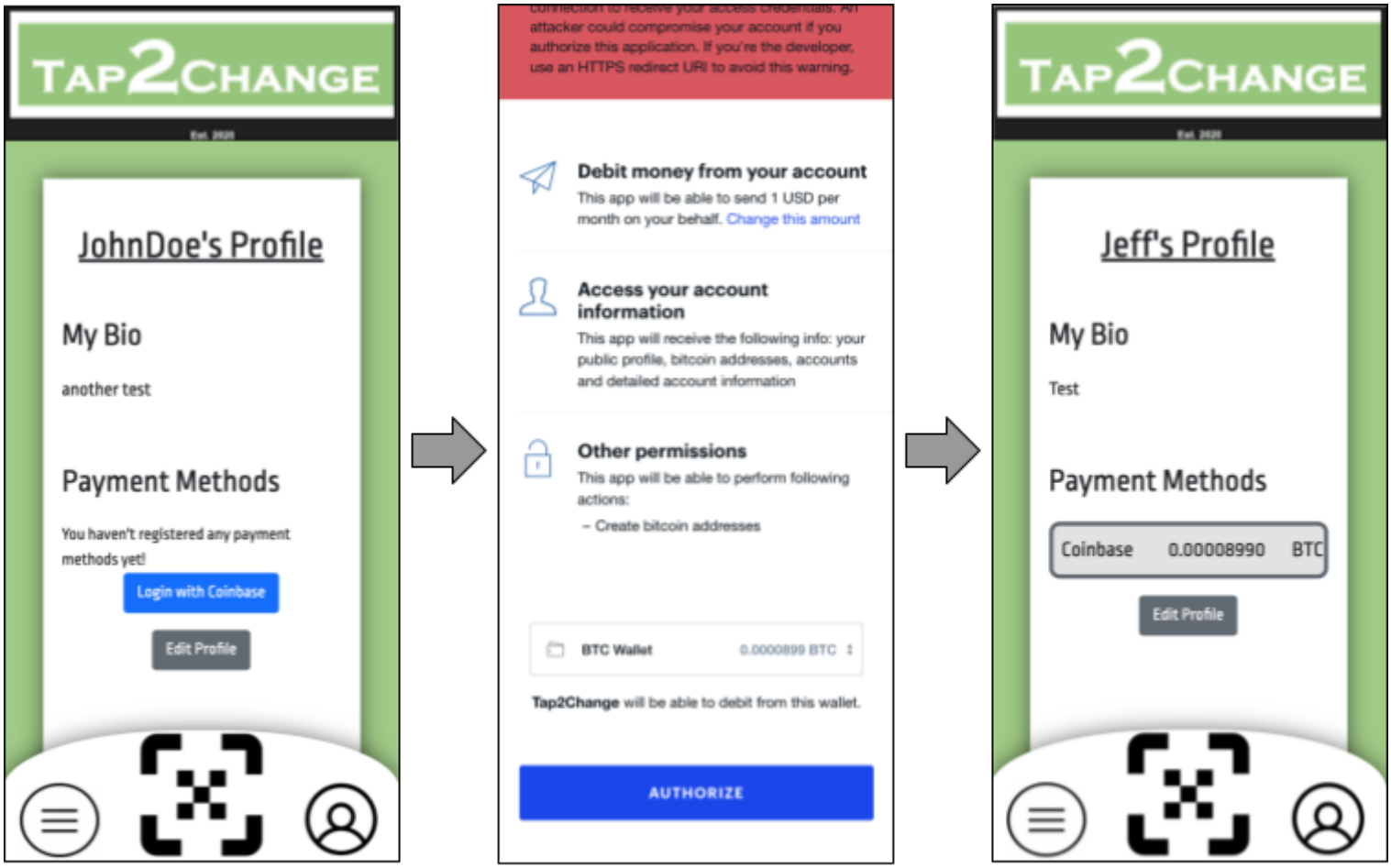


Figure 11: Flow of adding Coinbase Payment Method

Performing Transactions

To perform a transaction, the donor can scan the QR code on the receiver's phone from the scanner popup in the footer to route to a payment page. On this page the donor can see the display name and bio of the recipient along with a field to enter the amount that the sender wants to donate. In order for funds to be sent, Coinbase requires a Two-Factor Authentication, so the user is routed to a confirmation page where they can enter the text code that they have received from coinbase to actually perform the transaction. After entering the code and hitting submit, the user will have donated the desired amount of money and will get routed back to the home page.

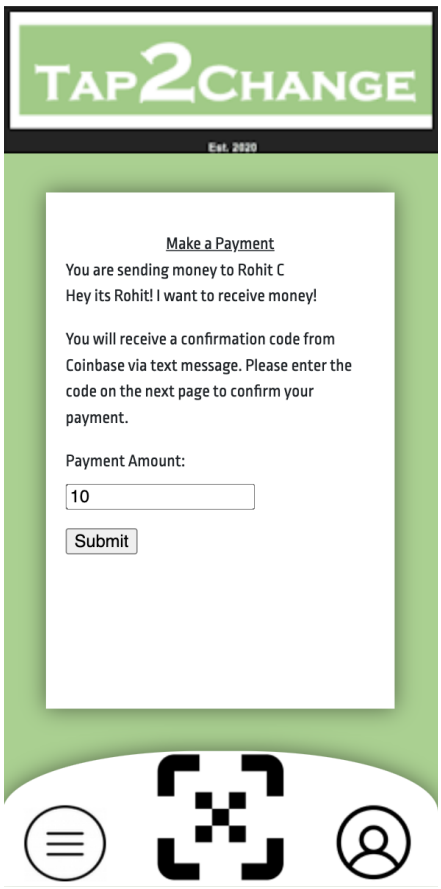


Figure 12: Payment Page ($10≈0.00017BTC)

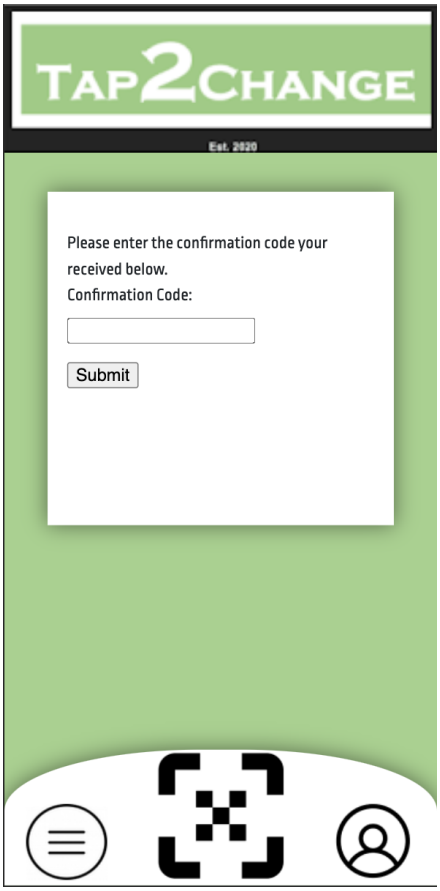
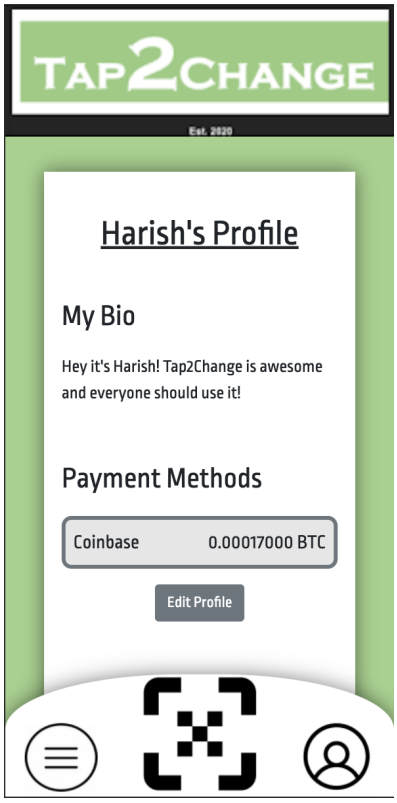
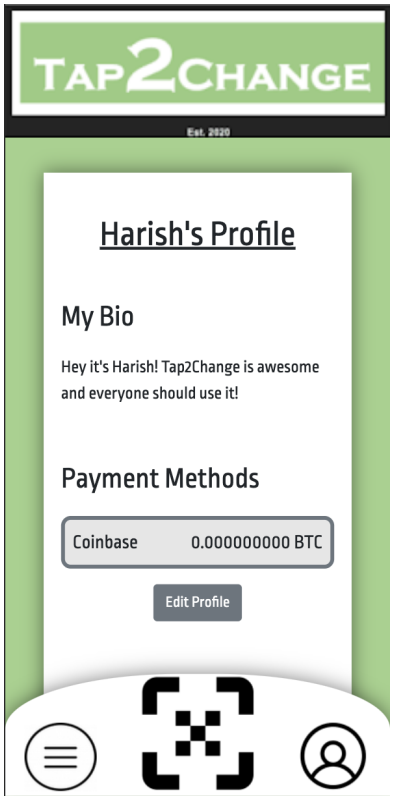
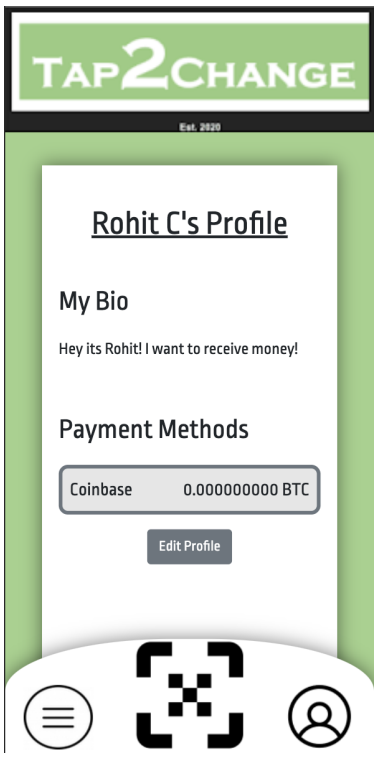


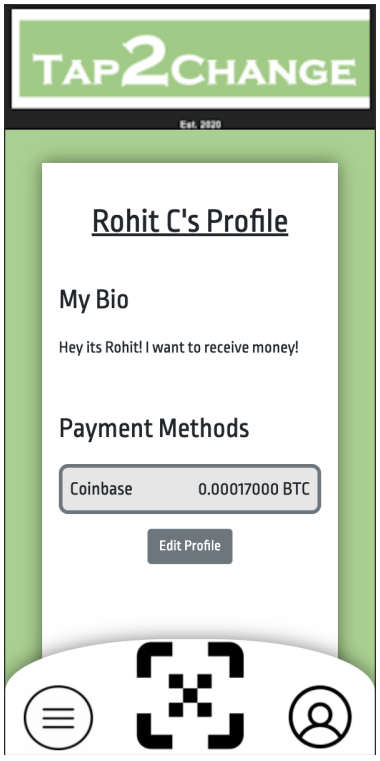
Figure 13: Confirmation Page





Donor profile before transaction → Donor profile after transaction (note updated balance)





Receiver profile before transaction → Receiver profile after transaction (note updated balance)

To develop all these views, we coded the controller on the web layer to call the models API in order to gather the necessary data for each page. For example, the home page requires the currently logged in user's displayName along with all the transactions tied to that user (dummy transactions were added to the database for front-end development purposes). Once we get that data from the models layer, we pass it through to render in HTML on the page. The QR code generating and rendering was implemented using a Google Charts API. Within this library, there is an infographics feature where a unique QR code can be generated for each user with an associated url which we will use to link users to our payment API integration. Since this is a frontend library and QR codes are generated for each user "on the fly" there is no need to store any extra information in the database. To style these pages, we utilized our own coded Cascading Style Sheets (CSS) and JavaScript to adhere to the designs we presented in previous reports. This also allowed us to have more flexibility with our app design than using an open source framework like Bootstrap.

Accessibility

In developing this prototype application for our solution, we aim to make it as accessible to as many users as possible, especially because some of our intended user base (those seeking donations) has a higher rate of disabilities. To do this, we followed the Web Content Accessibility Guidelines (WCAG) 2.0 requirements and techniques. Time constraints on this prototype limited how extensively we could adhere to the specific guidelines, but we followed the ones that applied more directly to our situation. Listed below are the 4 general principles outlined by WCAG that were followed throughout development, along with the representations of these principles in our prototype.

1. Perceivable - "Information and user interface components must be presentable to users in ways they can perceive"
    a. Our app displays all text in a readable format that contrasts enough with the background so it does not blend in. Text alternatives are also provided for all non-text items present on the screen.
2. Operable - "User interface components and navigation must be operable"

    a. Designing the footer to always remain at the bottom of the screen allows users to easily navigate through the different pages of the app quickly. We also wanted the QR code display to be one touch away when on the application.
3. Understandable - “Information and the operation of the user interface must be understandable”
    a. All text is presented in English currently for this prototype, but for the full solution multiple languages would be supported. One guideline mentioned under this principle includes input assistance, which we perform when validating forms that users fill out.
4. Robust - “Maximize compatibility with current and future user agents, including assistive technologies”
    a. We utilize a CSS reset stylesheet that provides browser compatibility for our front-end styling so that across browsers, all elements appear the same. We still have yet to implement some of the other guidelines, such as status messages and other tags to add for HTML elements, but due to time constraints these were of a lesser priority.

Analytical Prototype

As we progressed in our development of the Minimum Viable Product (MVP) of our application, we thought it was important for us to ensure that the product we were creating would be adopted by the user; and we ultimately came to the conclusion that conducting a focus group would be the most effective method to accomplish this. Most of the research we had done prior to conducting our focus group has been focused on the receiver side in order to understand what features need to be included in order to achieve the goals we laid out in our mission statement: to increase the income of the panhandlers and also help them break from the cycle of poverty. This research provided very valuable insight into certain aspects of our product that are foundational; however, we needed to better understand the other side of the transaction because without adoption from both parties our platform will not function. We determined that we would conduct our focus group with the overall goal of learning what we can do during development to garner high user adoption rates, in order to help guide us in our development process. The results of our focus group provided raw data on our ability to meet the critical requirements “increase income

of panhandlers" and "empower homeless individuals to break out of cycles of poverty"; and therefore, have strong implications for the rest of our design and prototyping stage and beyond as its results will tell us which features of our application we need to focus on.

We chose to use focus groups as our main means for gathering user feedback because we believe that hearing people engage in thoughtful, open-ended conversations is the best way to understand how people plan on interacting with the application and get their opinions on the various features that we have designed such as the incentive program for the receiver. Furthermore, focus groups allow the researcher to get a gauge of what matters to people (UX Alliance), and since we are still very much in the infancy of our application, we will learn which features are most important to our customer base, which will further help us with our development timeline. Figure 14 below, provided by Firefox UX (Lovglio), further reaffirms our decision to use focus groups as opposed to other research methods as we are looking for much more broadstroke feedback in order to guide us as we develop the application as opposed to testing specific features. We need to explore the needs, thoughts and feelings of our customer base in order to ensure that our decision making process is considering all major factors.

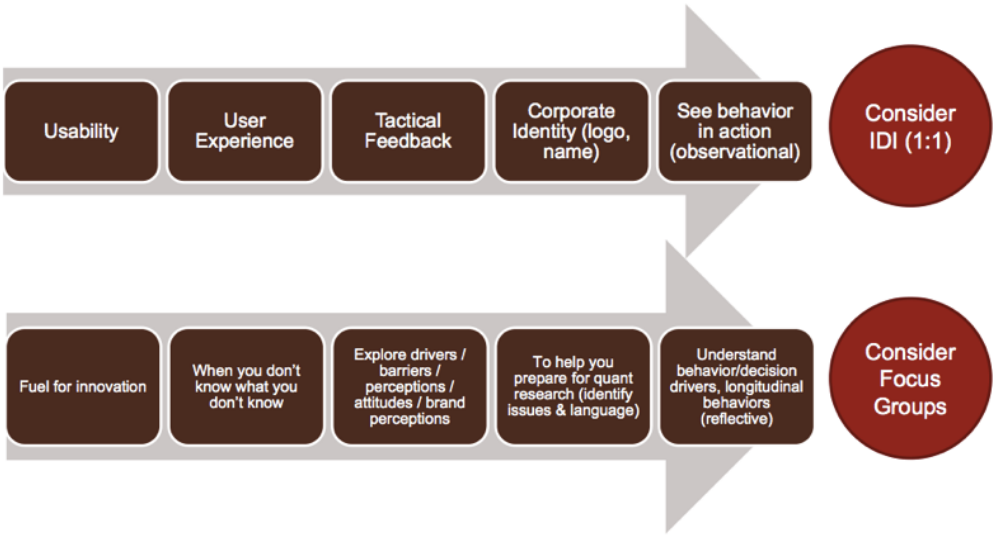


Figure 14: The figure below shows a flow chart of different objectives that market researchers may have and provides a suggestion for the data collection method that fits best. Note: IDI stand for conducting 1 on 1 in depth interviews with individuals

After completing our preliminary research on focus groups, we drafted a script as well as questions that were aimed at gauging the opinions of potential users on various features of the application (see Appendix for the complete script, questionnaire, and focus group structure breakdown). Before we conducted the focus group, however; we sought the advice of an expert in conducting statistical field studies, Sarah Shultz Robinson, who is an Assistant Director of University of Virginia's Institute for Research and Analysis. Mrs. Shultz Robinson has nearly 14 years of experience as a data analyst, and specializes in qualitative data collection and analysis; making her a tremendous resource on how to effectively conduct a focus group and analyze the results. During our discussion with Mrs. Shultz Robinson, she approved our script and questions, and also provided advice on how to best avoid biased answers from the participants in the focus group. She explained that bias in any qualitative study is inevitable, and stated that it is most important to acknowledge this factor and aim to run the study in a way that minimizes bias, without attempting to get rid of it completely. Furthermore, Mrs. Schultz Robinson explained best practices in analyzing the raw data collected from the focus group, which will be explained below.

After completing the focus group, which lasted approximately one hour and ten minutes, we were left with over fifteen pages of transcript. We obtained this transcript because the session was conducted over Zoom, which allowed us to utilize the built-in transcription feature that the platform offers. One issue that we encountered by using this technology was that the transcript did not record which individuals spoke, only the time at which it occurred. Due to this, we were unable to use qualitative data analysis platforms that can be used to identify themes and reoccurring language that occurred during the focus group. Fortunately, Mrs. Shultz Robinson had already walked us through the processes of conducting this data analysis by hand, which consisted of using various colored highlighters to color-coordinate the transcripts and identify any commonalities that we identified in language or general opinions. While this process was tedious, we ultimately were able to come to very insightful conclusions regarding the various features of our application, which we will use as a source of guidance as we continue with the development of our product.

Experimental Results

Focus Group Results

Pre-Analysis

Before we begin analyzing our results from our focus group, it should be noted that the focus group was conducted by a moderator who had no prior experience. This is important to note because the results that are stated below should be viewed understanding that the raw data collected is imperfect. This does not mean that the data is invalid rather that in the field of qualitative research no results are perfect.

Analysis

The analysis of the focus group will be broken down into the major themes that we identified during our analysis:

1) **The positives of limiting the purchases of illicit substances**

Each member of the focus group explicitly stated how this feature would be the biggest driver to attract donors, and also incentive donors to donate more frequently and in higher amounts. Overall, this group felt that this feature would provide a sense of reassurance that their money would be going towards helping the receiver, as opposed to possibly enabling negative behaviors that led them to poverty in the first place. While these results were to be expected, we gathered one major takeaway from the line of questioning that focused on the limiting of purchases. This takeaway stemmed from the focus group participants unanimous agreement that this would be the most attractive feature that our application offered. This was unexpected because prior to the focus group our group had been concerned that donors would feel as though we, Tap2Change, would be holding the money hostage from the receiver. As opposed to purely mimicking the interactions that already occur between donors and receivers, but facilitating it using a cashless platform.

2) **Convenience is key**

When we shifted the focus of the discussion to convenience, we received very useful feedback regarding the importance of maximizing the convenience for the donor, and also reassurance that our product would help improve people's lives. Participant 3 (see Appendix for participant general information) stated how "the biggest problem would be the lack of less than

10 second convenience", which we understood before but this comment, combined with the agreeance from the other participants, reaffirms that we must be committed to mimicking the speed and anonymity that a traditional donation would occur. Furthermore, two participants voiced concerns that people may be "deterred" from using the platform if the sign-up process is too tedious.

In addition to confirming our assumption that the speed of the interaction was a critical requirement, each participant stated how they felt that this application, in general, would improve their experience when donating to panhandlers that they encounter. The two female participants stated how this would help them feel more comfortable when interacting with panhandlers, as they would be able to remove themselves quickly from a situation if they felt uncomfortable pressure to donate. And the other members of the focus group said how our application would be very convenient, especially since people have begun to shift away from carrying cash with the rise of cashless transactions mediums. We had not previously thought about the implications that our platform would have for female donors, so it was an interesting revelation to hear how our platform would be able to benefit a group that we had not previously thought of.

Overall, we found that as long as our application allows for interactions with receivers to be approximately the same time that the process currently takes using cash, we will be able to increase the number of donations that panhandlers would typically receive. However, since this data is purely qualitative we can not conclude for certain that we will reach the benchmark percentage increase that we have listed with the critical requirement.

3) Tracking Purchases

Another major topic of discussion that yielded interesting conversation, was about including a feature that would allow donors to track the donations that they make. There was a split in the group regarding this feature: some believed that it would be nice to have an account and others felt that it could disincentive them from donating. Regarding the disincentivizing, participant 1 said they might donate less if they track and feel as though they are donating at a higher rate than when they used cash causing them to feel as though they are "overdonating". This discussion did not last very long but it clearly has implications for a feature that we felt would have been unproblematic to implement.

4) **Security Concerns**

The final theme that we identified from the focus group, and felt important to include in this report was in regards to the various concerns about security that were discussed. Four of the participants mentioned over the course of our discussion how they liked how cash allowed their donations to be completely anonymous. The interactions that they currently have with panhandlers are typically very straightforward and end just as quickly as they begin, and they felt that if our application comprises those features people would be less inclined to use our service. Going deeper into this subject of security, people stated how using companies like Google or Facebook, even if just as a sign in mechanism, they would feel uncomfortable using our platform. We have gotten to a period in time where people have become hyper aware of the ways in which their data gets used so we will have to be cautious as we proceed in order to maintain trust in our application.

Implications of Results

1) **Limiting Purchases of Illicit Substances**

We will continue to develop this feature as we have intended, but we will prioritize it over developing the incentive program, and this also has implications for how we proceed in our pursuit of partnering with other businesses. Instead of focusing on restaurants and local stores to provide discounts to the receivers who use our platform and also complete a verified resource, we will need to try to reach out to larger brand grocery stores and pharmacies, in order to ensure that the limiting purchases feature is in operation as soon as possible. While ultimately we have the goal of having both the limiting of purchases and the incentive program features fully implemented in our platform, the results of the focus group showed us we have to pursue limiting purchases first.

2) **Convenience**

The results from our analysis on the convenience factor of our application told us that it is going to be critical moving forward to constantly be innovating ways to make our platform as easy and quick to use as possible. As a result, we will move this requirement from the important category to the critical, because constantly striving to reduce interaction time will only lead to further adoption of our platform. Furthermore, it was reassuring to hear all of the members of the

focus group say at least one thing about how this app could potentially help them in their daily life, and also help others by increasing the amount they donate.

3) **Tracking Purchases**

In regards to the split comments about whether to track purchases or not, we can conclude that the best way to ensure that the donors are satisfied with our platform is to include a feature where the donor can turn on or off tracking of the donations that they make.

4) **Security Concerns**

The implications of the security concerns are mainly to constantly be figuring out ways to ensure that the financial transactions that we are facilitating are as secure as possible, and meet the critical requirement standards we have laid out for each other.

Implications from the Focus Group

Overall, the results we received from the focus group have been incredibly useful in focusing us on which parts of the application development need to be prioritized, and also general feelings about our application. Due to the success of this analytical testing, we will continue to run focus groups in the future in order to gauge our customers' attitudes towards our platform. In addition, we will begin conducting interviews with people who work closely with panhandlers in order to better understand the receiver perspective on our application.

A Design in Detail

A Description of the Concept for Implementation

The ideal solution concept we wanted to deliver builds upon the foundation created in our MVP application as detailed in the sections above. The frontend and views shown in the screenshots above will stay the same apart from some stylistic changes, however there are certainly some areas in which we would like to improve both on the technical aspects as well as in empowering users. One simple improvement would be making the transition to a three-tier architecture to enable the creation of a mobile frontend. In addition, we would want to build the mobile frontend for iOS and Android as these are the two most common platforms and would make our application more widely accessible. Another change would involve offering more

options for payment integration such as the Venmo or PayPal APIs to have a wider range of tools for users. In addition, a partnership with the Venmo implementation would enable receivers to set up Venmo cards which can serve as debit cards for those without bank accounts. Finally, another change we could implement would be partnering with homeless shelters or charities to provide resources in the form of food/hygiene products or education/vocational training to receivers in an effort to improve their quality of life. By making these changes, we believe that it would be possible to deliver an application that not only enables quick cashless transactions but also goes beyond in helping the homeless community to break out of cycles of poverty.

Design as an Embodiment of Requirements

Requirement	Metric	Specification
Increase Income of Panhandlers	Percent increase of average income based on infield research	**A: 10-15%** **I: 20%**
Empower homeless individuals to break out of cycles of poverty	Resources redeemed per person per week	**A: 1-3** **I: 4**
Authentication	Amount of times an unauthorized user can access another user's account	**A: 0** **I: 0**
Confidentiality	Percent of users' bank information visible to other users	**A: 0%** **I: 0%**
Availability	Percentage of time the system is up	**A: 99.999%** **I: 100%**
Authorization	Percent of invalid transactions processed (Bank balances are not sufficient, wrong receiver, e.g.)	**A: 0%** **I: 0%**
Integrity	Percent of data that's inconsistent with what's expected	**A: 1%** **I: 0%**
Supporting Transaction	Percent of transactions that fail due to the system erroring out	**A: 0-1%** **I: 0%**

Figure 15: The figure above shows a table of the critical requirements and metrics which were selected in evaluating the project.

During the research stage of this project we generated critical requirements with which we wanted to evaluate our solution concept. Two of these requirements dealt specifically with empowering the homeless population and six were regarding technical aspects of our application. Since our application has not been released to the public, it is difficult to derive quantitative metrics for the empowerment requirements but given the feedback we received from our research we were able to conclude that developing a system where we can increase the donations and ensure that the money does not go to illicit substances we will be beneficial to the receivers; and allow for the company to grow while we find other more effective ways to empower the homeless. On the other hand, our use of Google SSO for user login satisfies several of our technical requirements (Authentication, Authorization, Confidentiality) as they mainly deal with

security. Further, with the addition of the Coinbase API as our payment system, we are also able to satisfy the Supporting Transaction requirement which was part of the core functionality of the application. Overall, our MVP achieves the main requirements of our project, however without testing it in the local community, we cannot be sure of our results and therefore we would like to see the ideal model which was outlined above put into development and testing.

Reflections on Design Thinking

An Assessment of Design Viability

Overall, we feel that our design concept is viable because it satisfies all of the critical requirements we determined necessary for solving the problem. The initial prototype incorporated all the technical requirements (authentication, confidentiality, availability, authorization, integrity, and supporting transactions) into its design through the use of third-party APIs such as Google and Coinbase. We were also able to incorporate QR codes in performing transactions, and over the course of this project, QR codes have become more commonplace at places like restaurants and public areas. This improves the viability of our solution since it partially relies upon users adopting the use of QR codes. Professor Tian reviewed and approved the prototype application that we developed as well, further contributing to the viability of our design concept. Our full solution would build off the prototype to increase the income of panhandlers and empower them to break the cycle of poverty by being available to more users through the addition of more payment method options, as well as partnering with homeless shelters to provide essential resources. By satisfying all the critical requirements, our final design concept would also fulfill our mission statement by providing an online platform for peer-to-peer donations and helping the less fortunate through partnerships.

Furthermore, we feel confident that the features we plan on incorporating as we develop our application will ultimately lead to an increase in panhandler income due to high donor adoption. We believe that our application will gain donor traction based on the positive feedback we received from our focus group. The focus group results not only provided us with feedback on the specific features we planned on incorporating throughout development, but also allowed us to gauge the interest that potential donors would have in using our application; which yielded positive feedback. In addition, we met again with expert Sarah Shultz Robinson to go over the

efficacy of the focus group, to ensure that the conclusions were unbiased (see appendix 'Focus Group Expert Review' for more information). Overall, we received approval from Mrs. Shultz Robinson for our data collection and analysis methods, which further validates the conclusions we came to from the focus group. In conclusion, we are pleased with the results from the focus group and feel confident that our application has the potential to make a significant impact on panhandling individuals.

Individual Recommendations

Harish Chandrasenkaran

If this project were to continue, I would recommend making changes to the application itself as well as the community outreach strategy and company partnerships. Regarding the application, I would want to improve the financial system integration to allow users to link more payment options. Currently, users have to make a Coinbase account in order to use our Tap2Change, but by adding more well-known payment methods like Venmo and PayPal we can increase the amount of users we have. In regards to the community outreach strategy, I would look to team up with local businesses and charities to provide resources such as clothing, medical care, and educational training. As we alluded to in our mission statement, this effort is aimed at helping the homeless break out of cycles of poverty by formulating stable sources of income. Finally, I would want to partner with companies such as Venmo or Coinbase as both are beginning to offer their own card which draws from the balance of the account. Since no bank account is required for either of these services, these cards can essentially be used as debit cards. By partnering with these companies, we could work to set up these cards for the homeless as they often tend to stay away from banks due to prior debts or financial issues. Overall, I think this MVP serves as a good starting point, but there are several areas that could be improved to truly make an impact on the community.

Rohit Chhatre

There are a few new features that our application can include in order to improve the overall design and possibly make it more widely accessible. Firstly, with Covid-19, scanning a QR code off of a receiver's phone may not be feasible with social distancing guidelines. A new

feature to find phones nearby (similar to AirDrop or Bluetooth) may be useful so people can donate while following safety protocols. It would also be useful to integrate more APIs into our application for both logging in (Facebook SSO, traditional email/password sign on, etc.) and for payment integration (PayPal, Venmo, in-house transaction service, etc.). Since we only have Google SSO and Coinbase payment right now, this app may not be accessible to all individuals. In order for donors to have more trust in our application, it is important that we add a feature to where donors can specify the limit of purchases of goods so the money won't go towards illicit substances. We may need to partner with businesses to actually limit these purchases. I think it would also be cool for nonprofits to create profiles and have wallets in our application so it can be easier for individuals to donate to any cause that they want. In addition, we should also include other resources in our application like access to mental health services and housing resources to further empower the homeless.

Caden Moses

I believe that the next steps for the project on the non-development side should be focused on building partnerships with local stores, so we can begin building the infrastructure needed to implement the feature that limits the purchases of illicit goods. Based on the results from the focus group, it is clear that this is the feature that donors care the most about so our goal should be figuring out the best way to execute this. We will need to figure out how our product can create value for these potential partners because they most likely will not enter a partnership unless we are able to offer them something in return. One potential option that warrants investigation is finding a way to make the purchases that the receivers make at partner stores tax deductible. Of course, this would require a great deal of research and consultation from lawyers and potentially even the government, so this is a much longer term solution to generating a strong value proposition.

Jeffrey Rhoads

For next steps in continuing this project, I think the primary focus should be implementing a smoother payment method system. This could be either building a way for users to make transactions using their bank accounts right within the application, or incorporating more third-party payment APIs like Venmo, PayPal, or Stripe. In addition, providing more ways

for users to create accounts would make our application more widely available since we currently require users to have Google accounts in order to sign in. Finally, developing an Android or iOS application would further encourage users to sign up for our application. This is because a mobile application is more optimized for smartphones and would perform better than a web application being used from a browser on a smartphone. People also tend to have more confidence behind mobile applications because they have to be reviewed in order to be listed on app stores.

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Appendix

Harish Chandrasenkaran's Reflection

This course has really changed my idea of the Design Thinking Process and given me more insight into the types of research and work that go into creating a product. One of the most overlooked, but highly important parts of this project was the initial challenge space definition and research we conducted. This gave us a lot of information about the stakeholders we were dealing with and allowed us to better understand the community we were trying to serve in order to create a product that fit their needs. We then used this information to generate and select not only our critical requirements but also ones that were nice-to-have. Having had experience with requirements engineering in the past, this process was relatively straightforward but I still learned that each requirement should have metrics with ideal and accepted values to help in the testing process down the line. Through the creation and selection of our solution concepts, we arrived at our prototype which we built throughout this semester. While we conducted prior research and thought we knew exactly what to build, we constantly ran into issues during our implementation. For example, we had selected the Venmo and PayPal API based on initial research, however upon integrating them, we found that the Venmo API was no longer available to new users and the PayPal API required the user to pay fees in addition to their donation. This is the point at which we decided to switch to Coinbase for our financial system integration. One area I would have liked to focus more on would be the partnerships with local businesses as we wanted to provide a method for people to donate meal or clothing vouchers to ensure the money was being used as intended. We were unable to do this due to time constraints, however, this would have been a very useful feature as we found out in our focus groups. Overall, I think the Design Thinking Process was a very good framework for this project and it helped to organize our efforts throughout the year while staying true to our end goal.

Rohit Chhatre's Reflection

Through the last year of following the Design Thinking process, I have learned a lot about the different steps and why each of these steps are crucial in developing a viable product. Firstly, it is important to define the challenge space that you are trying to tackle. Thorough research needs to be done in order to gain the most valuable information on what the challenge is

and why it is an issue. If the challenge is not properly addressed, then the solution concept will not properly solve the problem. The second step of generating and selecting a solution concept was very interesting to me. In my opinion this is the most important step in the process because the solution concept chosen should try to address the challenge space as fully as possible. The critical requirements, specifications, and metrics should be considered in order to choose the most viable solution. I think our group could have put more effort into designing the decision trees and researching solution concepts because of some of the setbacks we had, specifically with our transactions. If we had done more research, we would have found out about the discontinuation of the Venmo and PayPal APIs. We could have also found other features to include in our application that could further empower the homeless like mental health resources and housing services. The third step of the process was to explore the solution concept we have chosen, so this is where the development of our application occurred. Our team did a great job in this section. We developed the application and conducted focus grouping according to the RMS combos we had set forth in the generate and select step. Even with the setbacks encountered, the team was able to perform the necessary steps in order to create a good MVP. The last step is to report and recommend, such that any other developers can view our documentation and recreate the solution we have set forth. I think the documentation we have provided is thorough and overall I think our team completed the Design Thinking process very successfully.

Caden Moses's Reflection

Learning about and implementing Design Thinking practices over the course of the past two semesters has truly been one of the most worthwhile experiences I have had during my time at UVa. Before I took this course, I had never considered the in-depth level of research and planning that is required in order to bring a successful product to market, and operated under the assumption that all it takes for a product to be successful is a good idea. However, after going through the design thinking stages as we developed our product; I now understand just how important it is to utilize a process when bringing an idea to fruition. Had we not conducted research into the problem that we were seeking to address, we not only would have been unable to brainstorm the various features that we want to include in our application, but we ultimately would have failed to capitalize on an idea that has the potential to help a lot of people in need. The next stage of the Design Process, prototyping and testing, taught me the importance of

constantly seeking feedback from your customer base as you move forward in the development process, and also how useful asking experts for guidance is. Had I not met with Mrs. Shultz Robinson, and ran the focus group only using online resources, I am confident that the results I would have obtained would have been fruitless. Due to this project I now understand how crucial it is to use every resource that is available. Furthermore, had we not tested our product ideas against a focus group, I believe that we could have become sidetracked developing features for our application that are less essential than others in order to gain user adoption. Running the focus group taught me that I cannot rely solely on my vision or ideas to be the guiding factor when developing a product.

Overall, the work we have done over the course of the past year has been a tremendous learning experience, and I will take Design Thinking strategies that we learned and implemented into other projects that I work on in the future.

Jeffrey Rhoads's Reflection

Over the course of following the Design Thinking process the past two semesters, I discovered and reformed a lot about my own problem solving process. I learned through experience that each of the steps to design thinking hold equal importance when it comes to finding solutions to problems, and because of that ample time should be allocated for each step. Defining the challenge is a crucial step because this is when the team decides and researches the challenge space they are about to enter. Plenty of research must be completed during this step to provide a solid knowledge base regarding the problem and surrounding issues the team hopes to solve. The next step, generate and select, focuses on determining the most important requirements that a solution must have in order to solve the problem. This step is also important because this is when the first solution concepts are generated and evaluated based on their viability. Exploring a promising solution is the next step in the process, and this is when the team builds out one of the solutions generated in the previous step. During this step, the actual implementation occurs which may reveal problems with the solution concept. For our team this year, we discovered that our initial idea for incorporating transactions was not going to work, so we had to pivot slightly and provide a different option. This step and the previous two steps might be returned to at any time if necessary because conditions or requirements may shift. The final step, report and recommend, is when the team evaluates the solution they developed and

provides enough documentation and detail such that another team could continue the original team's work. I felt that our team completed each step of the design thinking process well. In future iterations, I would suggest focusing more on selecting the most viable solution because this is the solution to be created and tested in the explore stage. This would likely result in a more viable solution being produced in the end.

Focus Group Intro Script

Moderator: "Hello everyone, thank you so much for joining us today. My name is Caden Moses I am a third-year economic student at UVa, and I will be your moderator for today."
Caden: "Before we begin, lets go around and can everyone introduce themselves by saying their name and a little bit about themselves"
~30 seconds
Introductions ensue
Moderator: "Before we begin our discussion, a little background: So we are conducting this focus group as a part of our Design Thinking course, where myself, and 3 other team members have spent last semester and this semester developing a solution to help better facilitate donations to panhandlers that people encounter on the street. At \\\\ core our product is a mechanism where a donor can use their smartphone to wirelessly transfer any amount of money they want to a panhandler's account by scanning a unique QR code that we will provide for them. There are many other features of our application though, which I will go into greater detail on later in the discussion. Since our product is still in development, our purpose today is to hear your honest opinions about our platform which we will use as a guidance as we continue to develop our product. Again I want to thank you for agreeing to participate, the feedback you will be giving will undoubtedly be incredibly useful as we move forward with our development process."
"Before we begin we have a few rules and guidelines to help facilitate our discussion:

1. Participation is voluntary
2. It's all right to abstain from discussing specific topics if you are not comfortable.
3. All responses are valid—there are no right or wrong answers.
4. Please respect the opinions of others even if you don't agree.
5. Try to stay on topic; we may need to interrupt so that we can cover all the material.

6. Speak as openly as you feel comfortable.
7. Help protect others' privacy by not discussing details outside the group."

"Are there any questions?"

Focus Group Questions

1) **Main Product:** "As I mentioned before our product allows a user to donate money wirelessly to panhandlers by scanning a QR Code"
    a) Do you see our product being useful in your everyday life? If so how? If not, why?
    b) Now that you have heard more about the product: Do you have any initial concerns with it?
    c) Do you feel that having access to this application would increase your donation to panhandlers?
2) **Security Concerns:** Our application will operate using preexisting financial transaction apps such as PayPal or Zelle, and also require the donor to sign in to the application using their preexisting Facebook or Google account.
    a) Do you feel as though these steps are enough to instill confidence in the donors that their financial data will be secure?
    b) Do you have any general concerns about using an application tied to a bank account?
3) **QR Code:** Our current product uses a QR code to facilitate the transaction, where the receiver would have a QR on a stand that the donor would scan and take them to our platform.
    a) Do you feel as though a QR code is an easy way to begin the transaction?
4) Incentive Feature: "A major goal of our product is to help empower people to break from the cycle of poverty, and one way we believe we can do that is by creating an incentive program for the receiver, where if they use an approved resource, such as attend an AA meeting or speak with the head of a shelter, they will receive a discount to local restaurants and stores."
    a) What are your initial thoughts on this feature?
    b) Would it make you more or less likely to use our platform?

5) Limiting purchases: “Another feature we are planning to include in our product is limiting where the money a receiver gets can be spent, in order to discourage the purchase of illicit objects”
    a) Do you like this feature?
    b) Do you think this feature would lead you to donate more?
    c) Would you like to have the option to choose if you wanted to limit where your donation can be spent?
6) **Tracking**: “Another service that our application can provide is an accurate accounting of how much money you donate to the homeless”
    a) Do you believe that this is a worthwhile feature? Would it encourage you to donate more?

Closing Questions:

1) Are there any other features you would like to see us include in our product?
2) Do you have any lingering thoughts from earlier in the discussion you would like to discuss more?

Focus Group Breakdown

Group Set Up during COVID (UXalliance)

1) 5 participants, with 1 moderator and
2) Timeframe should be from 60-90 minutes

Participant Number	**Grade**	**Gender**
1	Freshman	Male
2	Freshman	Female
3	Sophomore	Male
4	Junior	Female
5	Senior	Male

Focus Group Expert Review

Overall, Mrs. Shultz Robinson was glad to see the large amount of raw data we received, and that we were able to identify themes that appeared throughout the focus group, rather than simply compiling the answers that the participants had for specific questions. Furthermore, Mrs. Shultz Robinson also was excited to see how our expectations for how the participants would respond to questions were not necessarily met. This may sound counterintuitive, but it shows that the results we received from our focus group were somewhat unbiased because our questions did not lead the participants to answer in the ways that we may have wanted them to, which would have produced incorrect validation for what we believe the application should be.

However, this does not mean that bias was not present within our study, which was to be expected. As explained in the pre-analysis section of the Focus Group Results, this was the first time that our moderator conducted a focus group, which Mrs. Shultz Robinson knew before the focus group was conducted. When going over certain sections of the raw transcript, Mrs. Shultz Robinson identified moments where the moderator asked a question in a way that guided too much. She explained that this does not ruin the efficacy of the focus group, but explained that for future focus groups we must try to avoid this. Bias will naturally occur in qualitative research but we need to do everything in our power to make sure that we limit this bias.

Overall, after speaking with Mrs. Shultz Robinson for a second time we were pleased to receive confirmation that we could use our results and that the analysis we conducted was solid. We also learned of some of the pitfalls of our study, which we will be sure to mitigate the next time we conduct a focus group to gain a better understanding of the customer perspective of our product.

Expert Interview: Yuan Tian, CS Technical Advisor

To gain a better understanding of how we should build out the web application for our solution, we consulted computer science professor Yuan Tian at the University of Virginia. Being an expert in the field, she has knowledge of best practices for developing software applications along with the best technologies to consider using in implementing the features. In explaining our initial concept outline to her, there were a few recommendations and considerations she

suggested. The point that Prof. Tian stressed the most was to avoid holding or storing any sort of money in the application itself because this poses a severe security risk if our system were to be compromised at any point, which could in turn cause people to lose their money. Another point that she noted was to limit the amount of information required from a user to sign up for an account on the application. To satisfy this, she suggested we utilize single sign-on for registering within our application. Single sign-on is a way of using someone's account on a different application to sign in on another account (Facebook, Google, etc.). This way, we minimize the amount of information stored in our database about users. Some general guidelines that Prof. Tian also provided to us were to ensure that the interface is clean and intuitive, along with encrypting and securing any data that we do end up storing. This is to prevent any attacks on the system and data breaches that could potentially occur.

Expert Interview: Rob White, The Haven

In order to gain a better understanding of the population who would benefit from our application we chose to conduct an expert interview with Rob White, who is the day shelter coordinator at The Haven: a low-barrier day shelter and social resource center based in Charlottesville, VA. Everyday Mr. White interacts with the local homeless population of Charlottesville and he was able to provide key insights into the struggles that the homeless face. One interesting point that Mr. White brought to our attention is how some homeless people have pre existing bank accounts but their accounts are often overdrawn. While Mr. White did not find this to be a pressing issue, he explained how if we were somehow able to help balance these accounts, it would provide more housing and work opportunities for the homeless. Furthermore, Mr. White explained how The Haven has a program that raises money to give homeless people smartphones, which we feel opens the possibility for a partnership where whenever a smartphone is given The Haven can suggest downloading our application immediately. Finally, Mr. White explained to us how The Haven seeks to fill the gap in funding that the government provides for people of less means to secure housing, because the US Department of Housing and Urban Development does not provide adequate funding for people to put down deposits for housing.

Restaurant & Store Partnership Feasibility

Many of our solution concepts require us to partner with grocery stores and restaurants, so we found it important to conduct research regarding the willingness of companies to partner with organizations that are aimed at combating homelessness in America. We first began our research by looking at if and how small businesses use their resources, and position in the community to help those in need. We discovered much anecdotal evidence of small businesses employing various techniques to help the homeless, which is encouraging. Many small business owners want to give back to their communities, and this not only benefits the community but the business itself as customers want to shop at stores that are generous with their resources (Kabbage). However, due to COVID-19, and the unprecedented number of small businesses closing as a result, it may be difficult to convince businesses to provide discounts during such difficult times. Overall, our research did show us that partnerships with local small businesses is a great avenue to explore, as they are deeply ingrained in the community and more often than not are willing to use their resources to help the homeless.

We next turned our research to analyzing the willingness of larger corporations to forgo profits in order to help the homeless, and the results we found were highly promising. Over the past two decades, the importance of a company to be socially responsible has only grown, with even specific rating agencies, such as the Association of Certified Chartered Accountants (ACCA), now giving companies a grade on their Corporate Social Responsibility (CSR) (Scalet). People today, especially younger generations, want the businesses that they patronize to have a positive impact on the world, and we believe that our application can be marketed to larger corporations as a way to improve their CSR rating. Furthermore, companies are more likely to receive investment if they have a strong CSR rating, as it makes them less prone to scandals, so it is important for us to look for startups, seeking investment, that we can partner with.

Similar Application Research

One application that we have identified to be similar to ours is called Samaritan, which is based out of Seattle, Washington. Our application and Samaritan attempt to accomplish similar goals: increasing the income of panhandlers and helping them become reintroduced to society. However, one major issue we have identified with their platform that we believe to be a critical limiting factor is that they require the receiver to meet with a nonprofit partner once every 30

days in order to receive the funds they received (Greenstone). This requirement has led many of the applications users to allow their account to expire. Furthermore, many nonprofits have been hesitant to partner with Samaritan because they feel it will require too much effort to meet every 30 days with application users.

In addition to Samaritan, we have identified a patent for a mobile phone application that is very similar to ours, except instead of facilitating person-to-person donations, this application is for person-to-nonprofit donations (Chan). Despite this glaring difference, this patent contains various flow charts describing the processes in which a donation is made (shown below). Our application will follow the exact same process described in this flowchart, as well as mimic the mobile interface that is illustrated in the patent. When we begin building our application, this patent will provide a great reference for the various processes and requirements that we must include when dealing with online financial transactions.