Developing a Reputation Management System for piRentU
- A Renting Website for College Students

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ABSTRACT

Currently many sites exist that enable the exchange of items online. However, most of these sites inhibit how quickly these items get delivered because of the geographic separation between the buyer and seller. Since the transaction remains solely online, it makes it easier for the two parties to deceive each other and remain anonymous. This paper focuses on the development of a website called piRentU and the Reputation Management System that was necessary for the site to function. piRentU allows people around campuses to rent items from each other for variable periods of time. With piRentU, geographic proximity is no longer an issue. With these new types of in-person interactions, not only do you run the risk of getting scammed, but your personal safety also becomes an important factor. Interactions shift from online to face-to-face transactions, which required a user trust system between parties that goes beyond direct user feedback. Given this, the biggest portion of piRentU is the Reputation Management System. We developed a system in which users gain a reputation score called a “Rep Score” based off of factors such as direct feedback and their Facebook profile information. This “Rep Score” goes beyond direct user feedback, allows for an initial trust score to be established and gives the user a more customized view of each person they interact with. This “Rep Score” algorithm is fully portable to other sites in need of such a system. Only small modifications would have to be made according to the database structure of each site. An accurate and efficient algorithm for such a trust system could advance e-commerce even further and reduce doubts that consumers face when participating in online transactions.

1. BACKGROUND

According to the Oxford English Dictionary [8], e-commerce is “Commercial activity conducted via electronic media”. E-commerce has become increasingly popular for customers to gain items online. Online shopping has become an alternative for many users that simply want to shop in the comfort of their own home, or look for a bargain. In order for these systems to work, many websites implement Reputation Management Systems.

Reputation Management Systems help users measure the amount of trust they should have in the other party involved. As Venkatesh et al. [14] stated that “Today, trust has become much larger than security and privacy on the Web”. Many websites protect a user’s privacy by guarding credit card and personal information. However, providing users with the information necessary about other users in an e-commerce transaction is more difficult. Some current issues that are present when developing a Reputation System are privacy, lack of information available upon registration and verification of the identities of persons involved. However, these systems are necessary when developing an e-commerce website for users to feel safe in a transaction and to help people make more educated decisions on who to trust.

2. INTRODUCTION

This project focused on creating an e-commerce website, called piRentU, that targets college students. This site enables students to rent items from each other on campus. The benefits of face-to-face interactions are faster service and meeting new people to form social networks. piRentU operates on face-to-face transactions instead of the usual shipment of items. When e-commerce transactions switch from online to in-person, there is much more at stake. When dealing with someone online, one runs the risk of getting scammed. When dealing with someone in person for the first time, one’s personal safety is also at risk.
An accurate Reputation Management System is essential to such a website. Presently sites that involve this kind of face-to-face interaction rely on direct user feedback or do not offer any type of trust system and avoid responsibility. Not only this, but the information gathered at the time of registration to most sites is very limited. In order for piRentU to be a trustworthy site, piRentU must offer a more personalized reputation score to each user. We developed a system that pulls information from users’ Facebook accounts and friend networks to develop a trust ranking between parties involved. This ranking is called the users’ “Rep Score” and will be the main point of discussion throughout the paper. The algorithm developed in this paper is easily portable to other sites that need such a system. Only minor changes need to be made to the SQL statements according to the database that each system has in place. Not only is this system necessary for piRentU, but such an algorithm could further e-commerce and reduce some of the fraudulent activities and doubts that consumers face today in e-commerce transactions.

3. RELATED WORK

In this section, we will discuss current issues in building trust relationships for e-commerce and possible solutions.
Following that, we will investigate current websites that deal with e-commerce, their Reputation Management Systems and drawbacks that piRentU will address when calculating a user’s “Rep Score”.

3.1 Reputation Management

In order to implement a new Reputation Management System we investigated what research has already been done in this field. There have been numerous studies spanning various research domains about trust and Reputation Management Systems. Trust is a subjective subject. However, when examined in the domain of e-commerce, there is data and theories that exist which we pulled from to make our Reputation System better. These studies range from Computer Science to Psychology and are very helpful to examine when deciding how to implement a new system. It is especially useful to look at current problems, systems that work and issues in existing systems.

As Mortensen and Wai [11] point out “While multiple websites already rely on trust between individuals to support their businesses, no one has yet created an individual trust solution that is as robustly foolproof as secure transactions for institutions”. Below is an outline of possible criteria than can be used to develop an individual trust system on the web [11].

1. Mutual Incremental Disclosure: Both parties learn more information about each other in small increments through various online interactions.
2. Second Channel: Users verify who they are by using other sources of verification. For instance, a user can use a messaging system that requires a valid college e-mail for communication.
3. Individual Endorsement: Feedback from other trustworthy individuals.
4. Institutional Reputation: Develop their credibility by associating themselves with organizations known to be trustworthy. Once a user is associated with a trustworthy organization, this increases the chance that this user is a reputable one.
5. Wisdom of Crowds: Large number of people provide evaluations. As the amount of people providing positive or negative evaluations increases, the likelihood that those evaluations are reliable also increases.
7. Faith in Humanity: Operating based on the principle that most people are decent.

According to Mortensen and Wai [11], a possible answer to the challenges faced in developing online trust between individuals, is a mashup of the above criteria to develop user profiles. “Facebook, at the time it launched, had a fairly rich solution that relied on Institutional Reputation (a college e-mail address), Visual Verification (profile photos and personal galleries) and Individual Endorsement (only friends can view profiles or see other users’ friend lists)”. The solution that is proposed in this paper will include all of the above criteria via Facebook, the developer tools that Facebook Connect provides, and direct user feedback.

A common factor that makes users hesitate when deciding whether to trust another user in an e-commerce relationship is that the identity of the other trading party is unknown [9]. This puts the participants at higher risk for fraudulent activity and therefore makes these interactions lack the trust that is necessary for e-commerce transactions [9]. Another current issue with e-commerce sites is that online transactions allow for users to misbehave without having any consequence on their personal reputation [9].

It is evident that if most online transactions allow the user to misbehave, then we must create a system that holds the user responsible on a more personal level. Such a system will not maintain the anonymity of the user, however for piRentU, it is unnecessary and in fact not possible for the user to be anonymous. piRentU connects each user with their Facebook account which greatly reduces the uncertainty of the identity of the persons involved. Not only this, but linking users to their Facebook profile will motivate them to act accordingly, as there will be consequences to their personal reputation.

Depending on the nature of a website, some sites require more trust, on different levels between users than others. Figure 3.1 was created by Mortensen and Wai [11] and shows a general overview of specific sites and the level of trust required for each. This project would be a cross between P2P trust and external authority.

![Figure 1: Authors sorted a variety of Internet sites based on the necessity of trust to their function](image)

3.2 Related Sites and Existing Implementations

Below is a list of some current websites in place, their features, and how the proposed project will differ and improve on these features.

3.2.1 Craigslist

Craigslist is a website that allows users to post local classifieds. People can view and respond to the posts directly via e-mail or phone [2]. Some similarities between piRentU and Craigslist are that Craigslist allows for a wide variety of items to be posted with almost no restrictions, it depends on face-to-face interactions and it is very focused on specific geographical location for interactions. Craigslist.com provides a platform to buy, sell and rent everything you need, however the system breaks down if either of the parties involved lie about themselves [11]. Craiglist relies a lot on faith that the other person is decent, however when such a system fails you, the results can be disastrous. An example of this is the “craigslist killer” case where a man is charged with murder
and theft during an interaction that was advertised through craigslist [10]. Clearly, when such a site does not offer some kind of trust system in these face-to-face transactions, it becomes dangerous to participate in such interactions.

3.2.2 Uloop

Uloop is a website for college students to buy, sell, trade, and promote almost anything with classmates. Uloop also allows employers to post jobs for students [7]. While Uloop has some of the same functionality as piRentU, just like craigslist it does not offer a Reputation Management System for its users. Students must contact each other via e-mail in order to setup the details for the transaction.

3.2.3 Facebook Marketplace

Facebook Marketplace is the most related site to piRentU. Facebook users can post items, jobs, housing, etc. to either rent or buy. Facebook Marketplace associates each item with the user and thus their Facebook account. This way, whenever a person is interested in finding out more information about the user, they can go to the person’s Facebook page [5]. The drawback to this is that it still requires for users to be friends with each other to find out more information about the party beyond the amount of mutual friends. piRentU, pulls this information automatically in its algorithm, protecting the privacy of the other party, while also offering a specific reputation score.

3.2.4 Chegg

Chegg allows users to rent textbooks from each other [1]. Chegg eliminates the need for customers to deal directly with each other and instead, they use Chegg as the intermediate service to rent textbooks from. This system eliminates the individual trust necessary and only a trust of the company is needed. Unfortunately, this also means that the middle man is profiting. Direct trading, as in piRentU, is cheaper.

3.2.5 eBay

eBay is an e-commerce platform which allows users to buy and sell items. Unlike piRentU, eBay only focuses on one time transactions of buying and selling and not renting which would involve a pick up and drop off phase. This way of receiving and sending items eliminates the personal interaction that would be required with a renting site specific to college students. The way trust is established with eBay is through the following factors: feedback through past interactions, PayPal buyer protection, providing an eBay toolbar that guards against fraudulent websites, and a security center which provides users with guidelines on buying online safety and third party safety resources [3]. eBay heavily relies on the direct feedback system to provide users with information about buyers or sellers.

3.2.6 Problems with Direct User Feedback

When initially developing piRentU, we considered just a direct user feedback system. However, here we will highlight some of the shortcomings of using only direct user feedback as the main source of the “Rep Score”. More specifically, we will use eBay as the example site when discussing these issues. Firstly, there is the issue of newcomers to the piRentU website. Currently on eBay and in most Reputation Systems there is the issue of “punishing newcomers” because they have a lack of positive feedback [12]. In current Reputation Systems users must have participated in previous interactions in order to have a reputation associated with them. This is one of the major problems that the piRentU reputation algorithm fixes by not heavily relying on direct user feedback. Instead the “Rep Score” depends on other personal factors and direct feedback is used to enhance the “Rep Score” whenever direct feedback is available.

In the direct feedback section of eBay, there is an extreme rarity of neutral and negative feedback. In other words, there is a disproportionate amount of positive feedback which is called the Pollyanna effect [12]. Around 1999, only 0.3% of people provided negative feedback and 0.3% provided neutral feedback [12]. What causes this imbalance of positive to negative feedback? Three possible reasons are outlined below:

- eBay encourages buyers and sellers to contact each other before escalating the problem and thus leaving negative feedback as a last resort [12]. By encouraging users to communicate throughout the process you reduce the probability of having complications later on in the transaction. In the case that something does go wrong in the end, users are encouraged to contact each other about the problems.
- The frequency of positive feedback can also be a result of people being courteous. In other words, “If you cannot say something nice about someone say nothing at all” [12].
- People fear retaliation on their own reputation if they leave negative feedback [12].

While having little negative feedback may sound like a good thing, it may also not be realistic as much of that lack of negative feedback may stem from the fear of reciprocity. Users fear that if the other person knows they have rated them badly, they might also receive a bad rating. While piRentU does incorporate a feedback system as part of the “Rep Score”, it does not solely depend on it because of some of the highlighted reasons above. The above section also emphasizes why many Reputation Systems for e-commerce transactions should go beyond the direct feedback system.

4. SYSTEM MODEL

piRentU has been developed as a website for users to rent items from each other for variable periods of time. An overview of what features piRentU offers to its users is offered in Sec. 4.1. In the future users will be allowed to pick their specific campus or campuses close to them to find items in their geographic proximity. With this system model, piRentU needed a Reputation Management System that is more effective than positive/negative feedback. Users are assigned a “Rep Score” based on the algorithm that is discussed in Sec. 4.2.

4.1 piRentU Design

Below we highlight some of the main pages that a user will navigate through during their piRentU experience.

- Profile and Logging In: In order for a user to register with piRentU, they must initially have a Facebook profile. This is necessary for the “Rep Score” to be calculated. Along with being associated with their
Facebook profile, each user will have a piRentU profile. This will be their dashboard where they can post new items and view their past transactions. A user logs into the site using the Facebook Connect button as pictured in Figure 4.2.

Figure 2: Facebook Connect button to connect to piRentU via Facebook

After a user clicks this button the screen shown in Figure 4.3 is displayed.

Figure 3: The popup in which you allow piRentU to access your Facebook information

By Connecting to piRentU via this popup you are authorizing piRentU to gather information from your profile. However it is understood that this information shall not be shared and will only be used for the purposes of calculating the “Rep Score”. After this is done, the user must login with a separate user registration system that keeps their identity private throughout their experience with piRentU. A screenshot of this can be seen in Figure 4.4.

Figure 4: Registration with piRentU

- Home Page: Once logged in the user will be transported to their home page at which point they have their profile picture displayed so that they know that it is them. Once piRentU is populated and consistently used by users, your home page will be customized based on your interests and past searches within the site. You will also be allowed to post items that you need. Currently, it shows the most recent items posted by people along with the owner’s “Rep Score” relevant to you as see in Figure 4.5. This protects the privacy of each user since you do not see their Facebook page, but only their “Rep Score” and the User ID that they registered with piRentU. Under each item you have the choice of requesting that item as shown in Figure 4.6. At this point the user would be taken through the process of requesting this item.

Figure 5: Home Page

- Searching: When a user searches for an item, the results will be sorted with the person with the highest “Rep Score” being first and so on. The user will also have the option to sort by various criteria such as price and geographical proximity.

4.2 “Rep” Algorithm

When designing a reputation system, it must meet the following criteria [13]:

1. Provide information that allows buyers to distinguish between trustworthy and non-trustworthy sellers
2. Encourage sellers to be trustworthy
3. Discourage participation from those who are not

The Facebook Connect API is the perfect way to accomplish this. “Instead of using Facebook to create rose-tinted
portraits of themselves, more often people’s Facebook profiles reflect their authentic personalities [6].” This was found true in numerous studies currently being conducted about social networks, most particularly Facebook. This means that the data being pulled from user’s Facebook profiles will contain information that fairly accurately reflects their personalities. “[Researchers] found that the number of Facebook friends and wallposts that individuals have on their profile pages correlates with narcissism [6].” If this is true for narcissm, why can’t the same idea apply to trustworthiness?

The PiRentU Reputation Management System pulls data from the user’s Facebook page via Facebook Connect, runs its algorithm gathering necessary data and then creates a “Rep Score” for each user pair. This score is not reflexive, thus if A trusts B, does not necessarily mean that B trusts A the same amount. This is correct based on our intuition and understanding of human interactions.

In order to model trust between parties, we first had to gather data on what factors influence how likely you are to trust a person. Since trust is subjective there is no correct answer to what characteristics make a person more trustworthy. However, it is possible to gather data from users of Facebook and non-users of Facebook to gain insight into the subject matter. The data that we have gathered on trust comes from 3 sources:

1. Survey Results
2. Current Studies and Papers
3. Intuition

We have distributed a survey to 193 people about trust and their Facebook profiles. Only 1% of people were not registered with Facebook, while 99% were registered with Facebook. This survey asked about how much they trust their friends and how much more likely they are trust someone based on a certain feature such as amount of friends in common and pictures. This data was gathered then to create an initial model of reputation and trust. The questions asked in the survey were based on the papers that we have studied and background information. Each question ranged on a scale of 1-5 (1 means that the factor stated in the question will make them much less likely to trust this person and 5 means much more likely to trust this person). Below is a brief outline of the facts that we found important after collecting our survey results.

- **These Facebook profile factors contributed to a higher feeling of trust in the other user:** profile picture, the amount of friends in common, the total amount of pictures of that person on their profile, how often they updated their status and living in the same residence

- **These Facebook profile factors did not make the user more likely to trust the person:** geographic proximity

- If one’s friends trust the person, then one is much more likely to trust the person

- Someone’s friends not trusting a person makes that person more likely to not trust the other party then direct negative feedback does

- Negative feedback weighs essentially the same whether it’s coming from your friends or random people

Positive feedback when coming from friends is much stronger

Given the above, Figure 4.7 shows the various Facebook features that we initially thought to incorporate in our “Rep Score”.

Figure 7: Initial Facebook features looked at for the “Rep Score”.

However, after distributing a second survey for testing purposes, which will be described in more detail in Sec. 4.2.3, we found that residence had no effect on the score and neither did status updates. Thus we modified our algorithm

Figure 8: Final Facebook features looked at for the “Rep Score”.

However, after distributing a second survey for testing purposes, which will be described in more detail in Sec. 4.2.3, we found that residence had no effect on the score and neither did status updates. Thus we modified our algorithm
to include the features from Facebook Connect specified in Figure 4.8.

4.2.1 Rep Score

With piRentU a user will have a nonzero “Rep Score” from the first day that they sign up. Therefore it does not favor people that have been longer on the site. It provides the user with a “natural” reputation score based on characteristics of the person that are gathered from their Facebook profile along with feedback they have received on the website. A user can have a reputation score from $-70$ to $100$. This score however is dynamic and the user will never know what their base score is. It will consistently change depending on the person who is viewing their score as their relationship relevant to that person may be different. The negative feedback score is less than the positive to account for the fact that there are less features that contribute to a negative score. This will be discussed in more detail in Sec. 4.2.4.

A score of $0$ is very hard to achieve and thus the majority of users will have either a positive or negative score associated with them. This will be made clear in Sec. 4.2.4. Below is some information on how the scores should be interpreted.

- “Rep Score” $\leq 0$: This is very bad and this person is probably someone who recently joined Facebook and none of your friends know.
- $0 \leq \text{“Rep Score”} < 30$: You should be careful when dealing with this person, but they are not necessarily untrustworthy.
- $30 \leq \text{“Rep Score”} < 60$: Probably a trustworthy user. Especially if their score is higher than $40$.
- “Rep Score” $> 60$: A Trustworthy user with great credentials.

4.2.2 Variables

Below are the variables that are being looked at from the Facebook profile:

\[
\begin{align*}
\alpha_{\text{friend}} &= \text{Whether this person is your friend on Facebook} \\
\alpha_{\text{common}} &= \text{Friends in common with the other user} \\
\alpha_{\text{trust}} &= \text{The average “Rep Score” from your Facebook friends} \\
\alpha_{pp} &= \text{Whether or not they have a profile picture} \\
\alpha_{\text{pictures}} &= \text{How many pictures they have of themselves} \\
\beta_{fp} &= \text{Positive friend feedback} \\
\beta_n &= \text{Positive non-friend feedback} \\
\beta_{fn} &= \text{Negative friend feedback} \\
\beta_n &= \text{Negative non-friend feedback}
\end{align*}
\]

Below are the variables looked at for the direct user feedback:

- $\beta_f$: Positive friend feedback
- $\beta_n$: Positive non-friend feedback
- $\beta_{fn}$: Negative friend feedback
- $\beta_n$: Negative non-friend feedback

4.2.3 Testing of Algorithm

We developed an initial algorithm based off of factors from the first survey. The first survey featured questions like the following:

“Each of the following made up people have Facebook accounts. You will be given information on each person with respect to you. After looking at the following information you are to assign a “Trust score” to each person on a scale of $-70$ to $100$. This score shows how much you would trust this person if you were to meet them in person for a trade transaction (like a craigslist transaction). $-70$ means you definitely do not trust this person and $100$ being you would trust this person with no doubt.

Afterward you will be given additional information about how your Facebook friends ranked this person and about any direct feedback they received in past transactions and from whom it was. Each time take each piece of information into account when computing a new score for the person. FOR EACH QUESTION ONLY WRITE YOUR ADJUSTED TRUST SCORE AS YOU RECEIVE NEW INFORMATION ABOUT THE PERSON.”

The first question would be this:

Person #1:

- Person is your Facebook friend
- You have 200 out of your 500 friends in common
- Person has a profile picture
- Has over 100 pictures of themselves
- Updated their status twice over the past week

What score do you assign this person?

Each following questions would give the survey taker new information such as the average score your Facebook friends assigned this person and direct feedback information and from whom. At each point the user was asked to modify their initial reputation score in light of this new information. This was done for 5 people with different stats that would give us data into how each factor affected the score.
We received a total of 51 responses from people that had Facebook accounts. For each question the score was averaged between all the responses. Our score was then calculated to see how close it came to the average of the group. It was shown that the status updates did not matter and that negative feedback from friends is significantly more important than many of the other factors. Thus we modified our algorithm to fit with this data.

### 4.2.4 Algorithm

The specifics of the algorithm and how it is calculated is discussed in this section. The following facts must hold true to ensure that the score is between the range of −70 and 100:

\[
\alpha_{\text{friend}} + \alpha_{\text{common}} + \alpha_{\text{trust}} + \alpha_{\text{pp}} + \alpha_{\text{pictures}} + \beta_{fp} + \beta_{p} \leq 100
\]

This will ensure that all the features that positively influence your “Rep Score” will never go beyond 100.

\[
\alpha_{\text{trust}} + \alpha_{\text{pp}} + \beta_{fn} + \beta_{n} \geq -70
\]

This will ensure that all the features that negatively influence your “Rep Score” will never dip below −70.

Each variable is calculated as follows:

- \(\alpha_{\text{friend}} = 20\) if this person is your friend and 0 if they are not.
- \(\alpha_{\text{common}} = (\#\text{Friends in common}/\text{Your Total Friends}) \times 15\)
- \(\alpha_{\text{trust}} = (\text{Average of all friends relative trust score of this person}/100) \times 16\) if this is positive and \(* - 17\) if it’s negative
- \(\alpha_{\text{pp}} = 11\) if they have a profile picture and \(-10\) if they do not
- \(\alpha_{\text{pictures}} = \text{Each 10 pictures they have of themselves is worth 1 point, max value of 8}\)
- \(\beta_{fp} = (\#\text{The amount of positive feedback from your friends}/\text{total feedback}) \times 20\)
- \(\beta_{p} = (\#\text{The amount of positive feedback from people that are not your friends}/\text{total feedback}) \times 10\)
- \(\beta_{fn} = (\#\text{The amount of negative feedback from your friends}/\text{total feedback}) \times -27\)
- \(\beta_{n} = (\#\text{The amount of negative feedback from people that are not your friends}/\text{total feedback}) \times -16\)

Each of the multipliers above were calculated based on the survey results both before the algorithm was developed and modified afterwards during the testing phase.
5. SYSTEM IMPLEMENTATION

Here we will discuss the design of piRentU and the “Rep Score” with respect with how everything works together. Figure 5.11 shows the major components and how they are connected.

Figure 11: Overall flow of the piRentU website and Reputation Management System

Once a user registers with piRentU their Facebook ID which is gathered from Facebook Connect is registered with our site. Therefore we can use this ID when calling other Facebook Connect functions to calculate the score. All of the mathematics and calculating of the score comes from a single function that we have coded and therefore it is fully portable. Various Facebook Connect functions are called to gather information such as common friends, friend status, profile picture and pictures. Other data that is stored in the database is used in the calculation of the score also. For instance Direct Feedback is stored directly in our database. This in combination with the friend status of the person is used to determine how much weight it given to that particular feedback.

5.1 Database Design

We use MySQL 5.0 as the database to store all the information. The website itself is coded in HTML, CSS, PHP, Ajax and Javascript. The main tables in the database are Profile, Transactions, Items, DirectFeedback and ReputationScore. There are other tables, the details of which are unimportant when discussing the main implementation. When a user registers with the site, their Facebook Connect ID gets registered in the Profile table along with other relevant information. The Transactions table stores information about the Item, users involved, price and the status of the transaction (successfully completed or other). DirectFeedback stores whether the score is positive, negative, or neutral, the two parties involved and the transaction number. The ReputationScore holds the score between users that is calculated based on the algorithm described in Sec. 4.2.4.

5.2 “Rep” Algorithm

This algorithm is implemented using PHP and the Facebook API (discussed in more detail in Sec. 5.3). Once a user searches for an item, all the users that are renting out that item are queried from the database. After this is done, the algorithm is run on these users and the “Rep Score” from user A to user B is stored in the database. Therefore if this user shows up in another query (as they most likely will since this will be a campus wide service), the algorithm will no longer need to be run since this score is already stored in the database. However, it is very possible that this user’s reputation score is going to change either because of Facebook profile changes or feedback changes, thus if the reputation score has not been updated in over a week, the algorithm will run again to keep the system up to date. Not only will this keep the system up to date but it will also cut down how long it takes a page to load. Only scores which have not been calculated in a while will need to be calculated and thus the algorithm will not run each time.

In order to account for the lack of negative feedback mentioned in Sec. 3.2.6, we have included a flag that a user has the option to check off after an interaction. If the interaction went smoothly, but for one reason or another the user does not want to trust this person in the future, they may mark that down. This will not be visible to anyone else, but the system which is using the model. In this way we account for the fact that the user no longer fears that they will receive negative feedback from the other person involved. However, this is one of the factors that are looked at in the algorithm, specifically for how much your friends trust this person. This allows for a more honest evaluation of the transaction. This is not to say that negative feedback will never be given, it is still possible to leave negative feedback as this will still count for more and will be public. If a transaction was very bad, it is very likely that a user would like to directly warn other people about this.

5.3 Facebook Connect

Since the Facebook Connect tool is an important aspect of the trust algorithm developed, it is important to know what tools are available to the developer and how these tools can be used. “Facebook Connect is a powerful set of APIs for developers that lets users bring their identity and connections everywhere [4].” Developers can get access to user’s photos, names, friends, connections, activity and many other features. Facebook Connect allows users to find their friends more easily, to share content and provides a simple method for registration. When a user decides to use piRentU, they are prompted with a message that asks them if they allow this site to gather information from their Facebook profile. Once they allow it once, this is remembered and they will not be prompted again. piRentU only uses the information...
gathered through the Facebook Connect calls to calculate the “Rep Score”. Information is never disclosed to other users thus not compromising the privacy of each user.

Facebook Connect is simple to learn and use. The following steps must be taken in order to start using Facebook Connect on your site and with this algorithm.

- Register your site with Facebook Connect
- Create a Facebook object by using your unique website API key and an xd_receiver file created by Facebook Connect
- Start using the Facebook functions! A simple example of a function that is used in this algorithm is:
  ```php
  $facebook->api_client->friends_get()
  ```

The most common functions utilized by the “Rep Score” are:

- $facebook->require_login()
- $facebook->api_client->photos_get()
- $facebook->api_client->friends_getAppUsers()
- $facebook->api_client->friends_getMutualFriends()
- $facebook->api_client->friends_areFriends()

As visible from above, the functions are straight forward and there are many more like this that can be used to gather more information if necessary for the algorithm.

6. SYSTEM PERFORMANCE

Our system performance can be measured in two ways.

1. The actual accuracy of the “Rep Score” in providing an accurate measurement of trust between two people

2. The efficiency with which this algorithm runs in terms of performance. That is to say how does using the Facebook Connect API and calculating these scores affect the speed with which pages load and the user experience.

6.1 Algorithm accuracy

By instinct our “Rep Score” should be better than the current Reputation Systems as current systems do not give an initial personalized reputation score. The benefit of this algorithm is that it was developed using data gathered from the people that will be using such a site. Thus we know that these factors are truly the ones that are important when determining how much to trust a person. As mentioned in Sec. 4.2.3 we did testing on our initial algorithm to see how accurate it was to what users would rank each person. It was shown that the majority of our score came within 20 points of what the average was. Many came within 10. We will take this to be a fairly accurate algorithm. While doing this survey we also found that some users were more trusting of their Facebook friends than others. What future modifications can be made according to this information will be mentioned in Sec. 8.

An unofficial review was given to a group of friends. They were told to register with the site and look at what scores were given to certain people. They were then asked to whether this was an accurate reflection to how they would rate these people. The majority of the time it was accurate. However, certain individuals expressed feelings that the scores should be higher overall. The system is more on the cautious side in order to account for the people that are less trusting and that would rather have the scores be stricter.

6.2 Algorithm efficiency

When implementing this algorithm initially it was found that the performance was slow when loading the page because of the calculations that needed to be done each time a user performed a search query or for loading the home page. We improved on this by not calculating the score each time that the page loads. If the score was calculated within the past week, it was not recalculated again. This is a safe way to do this since Facebook features or a person will likely not drastically change and same with the feedback score.

Given this a new user will still have a bit of a wait time to load pages with users they have not encountered before. This is one of the biggest drawbacks of the piRentU “Rep Score” system. Facebook Connect is a fairly new technology and not much research has been done in order to improve its performance on a wide scale. Many of the websites that currently incorporate Facebook Connect into their site only use it for a comments section. Extensive function calling such as this “Rep Score” requires is not done. More research would have to be done on the backend. Along with this it would be possible to run it on faster servers. One option is to have the website run on one server and another server calculating all pairs of possible “Rep Scores” while the user is not using the site so that it will not slow down the user experience but will run in the background. This was not implemented in this project, but it is an essential part that would require more resources to complete.

7. RESULTS

The piRentU site was fully created with the basic functionalities necessary and can be seen at www.pirentu.com. The “Rep Score” algorithm was also fully developed and coded. After doing case studies in the survey it was found that this algorithm was fairly accurate in determining the Reputation Score between pairs of people. Not only did people new to the site have a reputation score, but we were successful in integrating direct feedback into this system also and modifying it to include Friend Status.

8. FUTURE WORK

Future work can be done on tweaking the algorithm even further to provide for an even more personal experience for users. Below we will highlight some elements that can be implemented both in terms of the website and the “Rep Score”.

- Allow for users to fill out a short survey of themselves and their “trust habits” so as to mathematically give user’s lower or higher scores depending on how likely this person is to trust people in general.

- Whenever a user does a search for an item, allow them to rank each user that comes up to how much they trust them. Then when calculating the average score from the user’s friends, this person’s average will count for less than other people’s average score.
• Look into other information that is available via Facebook Connect such as activities, University, etc. and incorporate this into the algorithm if it is found to be important.

• Modify the speed with which the algorithm runs by doing more parallel processing and possibly moving to a faster server. Another way to increase the speed is to look into the Facebook Connect API and see if there is any way to speed it up.

• Launch the site publicly by re-designing the look of the piRentU.

• Incorporate PayPal into the site.

9. CONCLUSIONS AND CONTRIBUTION

piRentU and its “Rep Score” is a new step in the right direction for e-commerce transactions. The popularity of Facebook is a good way to leverage information that is readily available for this purpose. Not only this, but we do not violate the privay of the users as none of their information is stored and none of it revealed in order for the algorithm to work. This base score approach allows for all of this. This site should be 100% ready to launch within half a year. The algorithm itself is also complete, but as is the case with most other works in computer science there is room for improvement both in the efficiency and accuracy of the algorithm.

The portability of the “Rep Score” code is essential and can be a great contribution to the e-commerce world. The code snippet which is roughly 200 lines of code could be pasted into other sites that require this kind of feature. With minimal effort, such as modifying the code to fit your database and registering your site with Facebook Connect, a site could use this “Rep Score” system to provide users with more accurate feedback scores and a safer and more personal experience. With new technologies provided from Facebook and advances in Reputation Management System such as the one provided with piRentU we can help users feel safer in e-commerce transactions.

10. REFERENCES

[1] Chegg - how it works. 
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