

Computer Science and Open Source Software: Development of a Micro-endowment Platform for a Nonprofit Organization

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ABSTRACT

Giv2Giv is a new nonprofit organization whose goal is to create a web visualization platform for its users to make and monitor micro-endowment donations to charities of their choice. It provides a significant impact for charitable organizations by aggregating many small contributions from a community of donors. Through social media integration, giv2giv allows current donors to advertise their activities within the giv2giv ecosystem in order to encourage others to donate as well. The web application provides users the opportunity to organize their favorite charities into ‘packages’ that other donors can pledge and contribute to. After a user subscribes to a package, giv2giv manages the monthly deposits from the user and transfers them into an investment fund of the user’s choice, allowing the contributions to grow. Every quarter, giv2giv deducts a percentage of the invested money and distributes it to the specified charities. Giv2Giv’s emphasis on investing users’ contributions differentiates it from many other organizations in the charitable donations space. Other key components of the giv2giv system include its transparent nature and usage of open source software. The system’s transparency is two-fold. From a user standpoint, donors are able to see exactly how their investments are being utilized and how their donations over time will benefit their favorite charities. Operationally, the system’s transparency is ensuring that development follows the specific terms and licenses under which the open source software, namely CakePHP, is made available. This paper documents the creation of this novel micro-endowment platform.

Keywords

nonprofit organizations, open source software, CakePHP

1. INTRODUCTION

Giv2Giv is a nonprofit organization in central Virginia that aims to give charitable donors their own personal micro-trust fund. Its goal is to enable individuals to make small, recurring, tax-deductible contributions to a personal investment account and contribute the earnings over time to the charities of their choice. Introduced at the Charlottesville Start-Up Weekend in 2012, giv2giv is still a growing organization. Two major needs of the company are finding ways to market themselves to the community and providing an easy medium for donor and charity interaction. Giv2Giv decided that performing all of these actions manually is too inefficient a solution to gain much traction in the market. Instead, the organization would rather build an interactive web application with social media integration to facilitate making micro-donations and getting other potential donors involved.

Giv2Giv’s original proof-of-concept was a Facebook page and a separate demonstration website composed of a logo and a mission statement. This page lacked the functionality of allowing users to sign up on the site, view individual charities, or track and report financial transactions, all of which are crucial components of a fully functioning micro-donation platform. Although this webpage was primarily focused on garnering interest in giv2giv, it lacked the proper functionality because giv2giv did not have the technical resources to create its desired system. Many nonprofit organizations lack this ability to implement software solutions due to budgetary restrictions, lack of technical expertise, and need for specialized software systems [10]. Employing the use of open source software can be both a cost-effective solution and allow for a customized implementation that meets a specific need [3].

The Service Learning Practicum (SLP) course at the University of Virginia desires to address these issues that nonprofit organizations, such as giv2giv, face. SLP was designed by Professor Aaron Bloomfield to teach students professional software engineering skills through software development projects for nonprofit organizations [2]. Students are placed in groups of three to six at the beginning of the school year and remain together for the next two semesters as they collaboratively develop a polished product using CakePHP. Each group is assigned a customer who represents a char-

itable organization in the community that has a software development need to be filled. Before the start of the first semester, the customer provides a brief request including information about the organization, an overview of the desired system, and three feature lists: minimum, desired, and optional requirements. The teams are also assigned a mentor with the necessary technical skills and expertise to help aid them throughout the development process.

The deliverables of the in-class projects present the nonprofits with functional pieces of software that would have been much more costly to purchase or develop internally. It also affords the development team professional experience in creating software systems. Both of these goals coincide with the mission statement of the Humanitarian Free and Open Source Software Project to provide humanitarian organizations free software solutions created by individuals with the necessary technical knowledge [7].

2. BACKGROUND

The creation of a micro-endowment donation platform requires integrating a myriad of different pieces, such as external payment systems, Internal Revenue Service (IRS) forms, and investment accounts. Not only do donors and charities both need to register with the system, donors also need to supply payment methods in order to effectively use the application. Furthermore, charities need to be authenticated to ensure that they are federally recognized charitable nonprofit organizations. Also, in order to comply with federal tax policy, giv2giv must review all donations before money is actually delivered to the receiving charities. During this review process, giv2giv holds the donors' money in investment accounts. As a result, these funds are subject to appreciation and depreciation, changing the total value of the fund. Developing a solution to giv2giv's problem statement that adheres to all of these constraints requires understanding and addressing some of the intricacies of the nonprofit donation space.

Each charity has an employee identification number (EIN) assigned by the IRS that is used to authenticate a charity at sign-up. Giv2Giv receives a list of federally recognized charitable organizations from the IRS that contains all of the registered EINs. In order to begin receiving donations, the charity account must also supply a 501(c)(3) form. This form is then stored by giv2giv for tax purposes. This multi-step authentication process ensures that giv2giv is only giving donations to federally recognized charitable nonprofit organizations.

Another important piece of information about giv2giv's protocol is the frequency of donations. The organization requests micro-donation contributions from their donors on a monthly basis. However, it only actually transfers a portion of the money to the receiving charities every three months. Thus, during the period in between transfers, donors' money is stored in an investment fund where it is subject to appreciation and depreciation. The rationale behind this is that small, monthly contributions will grow and accumulate interest over time. This means that donors are actually giving a larger contribution than their original donations, which helps them provide a greater positive impact upon their favorite charities.

3. RELATED WORK

Although there are other charity-focused sites on the web, none of them address charitable giving in the exact way that giv2giv does. Similar systems include GuideStar, Causes, and Razoo. Although all three of these systems are online sites that focus on user interaction with charities, giv2giv differentiates itself through its unique use of charity packages and investment funds.

One of the most well-known charity-focused sites is GuideStar. GuideStar provides a comprehensive guide to all IRS-registered nonprofit organizations [6]. Its goal is to be a single source of information regarding individual charities. However, this site does not provide a direct way to donate to these charities. In contrast, giv2giv's primary goal is to allow donors to find and contribute recurring donations to their favorite nonprofits. Therefore, it is necessary to supply, within the giv2giv application, the information required to make that financial decision and provide a medium to enable the necessary transactions.

Causes is an online Facebook application that shares many similarities with giv2giv. Like giv2giv, Causes takes a crowd-sourced approach to spurring community involvement and donations towards different causes or issues [4]. Also similar to giv2giv, the application uses Facebook social integration to spread awareness about potential charitable causes. However, the major difference between the two applications is that Causes allows anybody to receive funding for any type of issue [5]. This can include non-charitable events such as boycotts, petitions, and more. Users of Causes also do not need to donate money; they can provide other activities such as volunteering or sending goods. Giv2Giv, on the other hand, only allows monetary donations to authenticated, federally registered charities. This is a key distinction between the two companies and helps giv2giv focus on a different target market and user base than Causes.

Razoo is an online donation system that is the most similar to giv2giv. Both Razoo and giv2giv focus on allowing users to create recurring donations to charities of their choice [9]. Also, both systems put an emphasis on using social networking tools to spur interest in charitable donations. However, there are a few major differences between the two organizations. The first major difference is the frequency of donation to the charities. Razoo takes a user's donation and stores it in a fund for only a single month before transferring it to the charities. This means that they do not focus on generating compounding interest on a user's initial donation. Giv2Giv keeps the donations in its investment fund for a longer period of time in order to accrue interest for the charity in the long term. A second difference is that Razoo deals primarily with donations to specific causes for a single charity. For example, users are able to donate money to Habitat for Humanity, but they can specify that they would like their donation to be reserved for the building of a specific house and not for general use by the charity. Giv2Giv, on the other hand, creates packages that focus on a higher-level cause, such as homelessness, by organizing a handful of charities together in a single package. These funds can also be used by the receiving charity in any manner that they need. Lastly, Razoo is not a system that can be purchased for use. Giv2Giv could not have used Razoo to achieve its goals because it could not

have purchased Razoo’s system as an off-the-shelf product. Thus, giv2giv was forced to architect its own system.

As can be seen in Figure 1, giv2giv’s focus on accumulating interest on its users’ donations differentiates giv2giv from more traditional donation methods. Since there is no off-the-shelf product that fills giv2giv’s specific need, we built the giv2giv web application from the ground up.

4. SYSTEM DESIGN

Donors register with giv2giv online and then are able to donate to certain charities that have been grouped together in packages. Giv2Giv requests the donation on a monthly basis from the donor’s funding source of choice. The donations are transferred into giv2giv’s own Dwolla account where they are then invested with TD Ameritrade¹. The donations accrue interest within the investment fund over time. Once a quarter, a small percentage of the invested funds are removed and distributed to the charities in accordance with the initial donor’s specifications. In order for these charities to receive their donations, they must also have an account with giv2giv and have verified their status as a legitimate charity. A graphical overview of the main funds entities in the giv2giv system and the monetary interaction frequencies between them can be seen in Figure 2.

In order to track the contributions of each user into the investment fund, a system of stakeholders and shares was created. As the value of the fund changes, the value of the share price fluctuates accordingly. When a user makes a monthly donation, he ‘purchases’ more shares in an investment fund.

4.1 Packages

Instead of requiring donors to specifically select each charity they wish to donate to, groups of charities are organized into packages as defined by the creator, e.g. impacting homelessness in Charlottesville, VA. Packages provide a preset grouping of information to allow for easier donation. This also allows groups of donors to unite behind a cause and to raise awareness for that cause. Each package has a minimum donation amount, a specified investment fund or funds for the donations, and a percentage distribution of the donations for each charity in the package.

¹<https://www.tdameritrade.com/>

4.1.1 Creation

Any user of the system is allowed to create any number of packages. The package creator can choose the name, minimum donation amount, investment fund or funds, member charities, and percent distribution to those charities. Others who donate to this package can contribute more, but not less than, the specified minimum donation amount. Different investment funds are available varying by the desired return rate and amount of risk associated with each investment. If multiple funds are selected for a package, the donations into that package are split evenly between the investment funds. There is no minimum or maximum number of charities that must be in a package. This allows users to tailor packages to be as generic or specific as they wish. A package can also be specified as private, so that others cannot search for, view, or donate to that package; it exists solely for the package creator.

4.1.2 Subscription

Upon subscribing to a package, the user pledges to donate at least the minimum donation amount each month until they unsubscribe. When users subscribe to a package, giv2giv creates a recurring donation from the user’s funding source to giv2giv’s Dwolla account. Once anyone subscribes to a package, the owner loses his ability to edit that package. This decision was made to ensure that that the package owner has no control over other donors’ money that the donor is unaware of. Package creators do not hold stewardship status, they merely serve as curators of good package ideas for the system. If someone would like to tweak the settings of a package they may clone it and then make edits.

4.1.3 Cloning/Duplication

Package duplication makes it quick and easy to take an existing package and add your own tweaks. To duplicate a package, a user can simply click the ‘Clone This Package’ button. The included charities, the percentage distribution of donations to these charities, and the minimum buy-in amount are copied over to a new package named, ‘[Name of Original Package] Clone’. Since this user is the creator of this new package, he can proceed to edit it to his liking.

4.1.4 Searching

Both individual charities, and packages can be searched to allow users to find the best match. Charity lookup searches

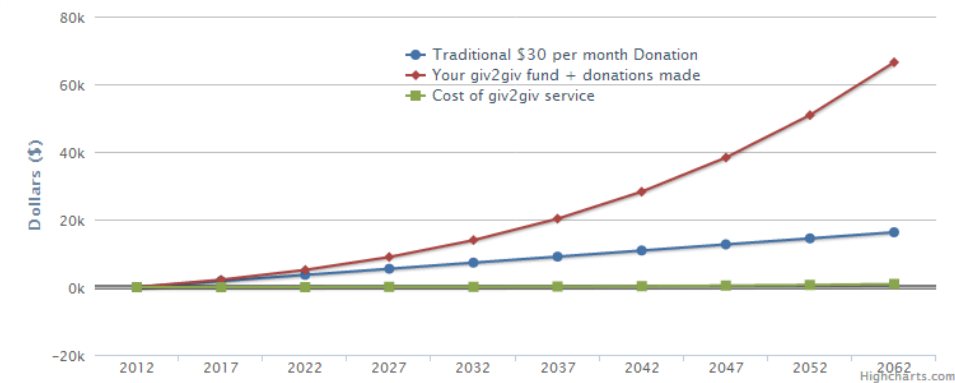


Figure 1: Comparison of giv2giv and traditional donation methods

over charity names, mission statements, and addresses. Package lookup searches over package names and any associated tags. Any user of the web application can tag a charity or package. This crowd-sourcing technique allows users to associate additional data with a charity or package. Each tag can also be voted up or down in a semblance of a reporting mechanism. Each package inherits its member charities' tags to reduce manual duplication. Currently, there is no support for ranking the search results based on relevance.

4.2 Login and Authentication

In order to do anything beyond searching charities and packages, users must be registered with the giv2giv application. For donors, a two-step login workflow was created. Users first register with the system by supplying their email and password. An email with a link is sent to that address to verify that they own it. Due to the nature of the system, giv2giv must have a way of communicating with the donors.

Charity registration is more complicated. They first request an account by providing the EIN of their charity, an email address, and their name. Giv2Giv then verifies with the charity, often over the phone, that that employee is authorized to speak on behalf of the charity. If so, giv2giv approves the request in the system. This creates a new charity user account and notifies the charity of their request's approval at the email address originally given, providing them with a password for their new account.

Each donor is required to register a funding source when they create an account on the website. These funding sources include Dwolla and PayPal. If a donor does not have an account for either, he is directed to create one before continuing. If a user fails to input or create a funding source, he will not be registered with giv2giv.

4.3 Funds Tracking

The giv2giv financial model has donations coming into giv2giv's bank account from a donor's Dwolla account, going out into one or many investment funds to accrue interest, coming back into giv2giv's bank account, and finally going out to charities for donation. In order for this process to flow

smoothly, a robust funds tracking system is required. Giv2Giv must know at any point in time the location of all its money, as well as which donor "owns" that money (i.e. that money is attributed to them and will eventually be donated to the charities of their choice).

Since each investment fund will inevitably change in value due to appreciation or depreciation over time, the tracking system was implemented with a concept of "shares". Each donor buys and sells shares of an investment fund at the current market price. For example, let's say Bob donates ten dollars to giv2giv this month. When that ten dollars is transferred into an investment fund, Bob will receive as many shares as that ten dollars will buy him at the current market price. In a month, that market price will likely be slightly higher than it is today, meaning the value of Bob's shares will have gone up. Each quarter, when donations are withdrawn from the investment funds to be donated to charities, some fraction of John's shares will be 'sold', or liquidated. Thus, the current market value of the 'sold' shares will be withdrawn from the fund and donated to charities, and Bob's total count of shares in the fund will go down by the amount of shares that were sold.

Altogether, this system tracks the total value of giv2giv's funds as well as what fraction of these funds are attributed to each user at all points in time.

4.3.1 Webhook Notifications

The giv2giv web application uses Dwolla as the payment service to transfer funds throughout the system. On signup, donors must choose either Dwolla or PayPal as a funding source to link to their giv2giv accounts. Although linking both services is supported, we have only implemented the full Dwolla payment workflow in our application. This is a design decision made by the development team and the customer because the giv2giv organization only currently uses a Dwolla account to receive donations. PayPal is a part of the plan for future work on the system.

Dwolla webhooks notifications are crucial to the funds tracking portion of the giv2giv application. From a user stand-

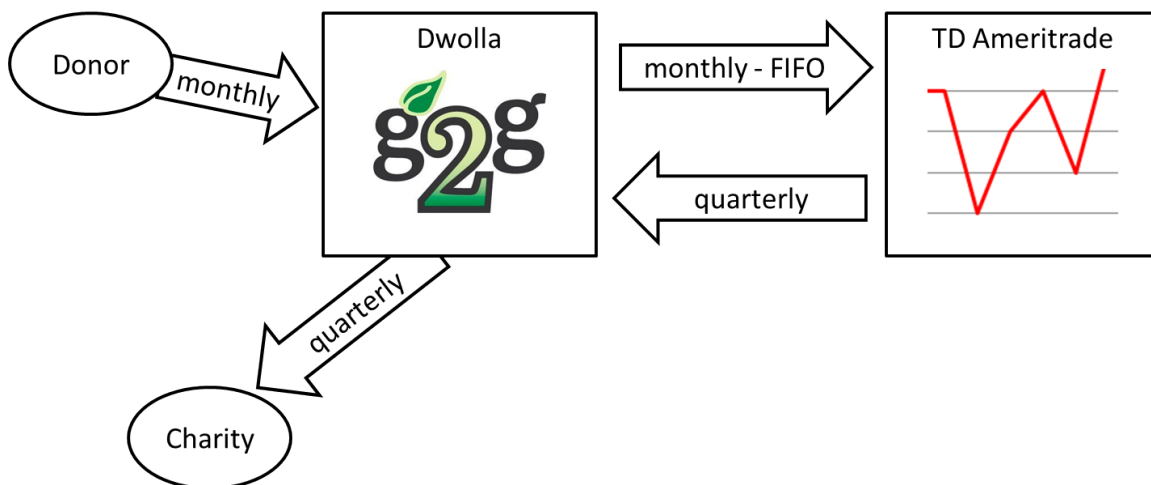


Figure 2: Monetary interaction frequencies between the primary giv2giv entities

point, it allows donors to see exactly how their investments are being utilized and how their donations over time will benefit their favorite charities. Operationally, webhooks enable giv2giv to maintain accurate records of all money transactions taking place in the system. This is important for both error checking and tax purposes.

There are two main types of activities used in the interaction between the giv2giv application and Dwolla: requests and transactions. Requests are created when giv2giv asks donors for their monthly donations; they are fulfilled whenever the donor manually accepts the money request. Transactions are created whenever money physically transfers between accounts. Dwolla creates webhook notifications whenever a money request is fulfilled, a transaction is created, or the status of a transaction changes. Our application is set up to receive these webhook notifications and handle them accordingly.

The webhooks notification workflow happens behind the scenes of the application. There are no views associated with the handling of the messages, but system administrators can view all of the requests and transactions after they have been recorded from the administrator dashboard.

4.4 Social Networking Components

An important part of this web application is to raise awareness about the services giv2giv provides and increase the visibility of the website in order to generate more charitable donations to nonprofit organizations. To address this goal, we added social networking components that utilize the following sites: Facebook, Twitter, and Google+. In addition to increasing the visibility of giv2giv, we harness the demographics of giv2giv users from the associated social networking sites.

To link giv2giv accounts to social networking sites, we use Open Authorization (OAuth), an open standard for web authorization. OAuth allows users to give 3rd-party applications access to their private resources, such as Twitter timelines or Facebook posts, without giving them passwords or other account credentials [8]. If the 3rd-party application gets hacked, it is possible to simply revoke access to that app. The application does not store login credentials, so it is a secure method that does not allow hackers access to a user's login information. Some sites make users login to their social media accounts in order to post or tweet on the user's profile. When using OAuth applications, it is important to note what permissions are being requested by the application.

4.4.1 Facebook

The Facebook component of the system is designed to give users the ability to share their donation stories with their friends on Facebook. For this to work properly, users need to have a method of connecting their Facebook accounts to the giv2giv website. This is accomplished by creating a giv2giv application on the Facebook Developers website that is used to recognize whether a user has approved giv2giv to interact with their Facebook account.

This component of the system is designed to give users a number of options for how tightly they want to link their

Facebook account with the giv2giv web application. The first, and most basic, level is the presence of a 'like' button on the giv2giv website that allows users to like the giv2giv Facebook page. Using this link, users can also write a short message to their Facebook friends that contains both a short blurb on the giv2giv idea and their own custom message. This link also includes basic features for seeing social networking relationships. Even if the user has not connected his Facebook account yet, he is still able to see which of his friends have also liked the giv2giv page on Facebook.

The second level of Facebook connectivity gives users the ability to semi-permanently connect their Facebook accounts to the giv2giv page. This is accomplished through the previously mentioned giv2giv application. When connecting their Facebook accounts, users are given a number of options for which permissions they would like to share with the application, and therefore, with the giv2giv website. Users are asked to give, at minimum, the basic information that Facebook requests when using its application, including id, name, gender, and more. Depending on whether users want to activate certain features of the giv2giv web application, they are also asked to share permissions for additional information that allows the application to publish stories to their Timelines. If users give the application this share permission, they are able to automatically share instances of when they donate money to a package on their Facebook Timelines. Alternatively, users are also able to share the story manually with the click of a button. If users do not give the application share permission, their use of the website is not significantly affected. The only change is a lack of functionality for sharing stories to their Facebook Timelines. This decision allows users the option of integrating their giv2giv actions with Facebook without explicitly forcing that integration in order to use the website. Users can also grant a limited number of permissions to the giv2giv Facebook application. If they choose to only grant permissions for the basic information, that information is stored into the giv2giv database and can be used to give users a customized experience. Again, if the user chooses not to share this information, his overall giv2giv experience is not hindered.

4.4.2 Twitter

Similar to Facebook, the Twitter interface is designed to allow each donor the ability to link a Twitter account to his giv2giv account using OAuth. This allows the user to set up automatic tweeting upon a donation or package creation. The user can also craft customized tweets about giv2giv.

When a user requests to link a Twitter account, the application directs the user to an authorization page that asks the user to grant the giv2giv application permission to read and post tweets and messages, as well as look at information about the user and their followers. Changing the OAuth request token can modify these permissions. If the user chooses to not grant these permissions, their use of the website is not significantly affected.

If the users do grant the requested permissions, they are redirected to the giv2giv website and an OAuth access token containing both an ID and key is stored in the database to enable tweeting. Once the user decides to tweet about

a giv2giv event, the interface handles this and stores the user's Twitter ID. This ID can be used in the future for demographic purposes, such as enabling the use case of suggesting the giv2giv website to a user who is following the Twitter accounts of other giv2giv donors. Automatic tweeting can be toggled on or off on the user's account management page and the user can revoke Twitter access at any time. This decision was made to respect the users' privacy.

4.4.3 Google+

We designed the Google+ interface to be very similar to that of Facebook and Twitter. The goal is to link a user's Google+ page to giv2giv. Currently, Google+ is setup to request basic information and request information about the people in the user's circles. We can eventually expand this scope for more demographic information and perhaps post messages on the user's behalf (similar to auto-tweeting). Similar to Facebook and Twitter, we store the demographics information in the database to give the user a personalized experience based on the people in their circles. Also, users can, at any time, revoke access through their application settings page.

5. PROCEDURE

The giv2giv web application has use cases for three different stakeholder groups: donors, charities, and administrators.

Donors who want to donate through giv2giv must register an account through the website. With this account, donors can create or donate to packages using either Dwolla or PayPal as their chosen payment method. Packages define a common cause for donation and contain a user-defined list of charities. Contributions to a package are distributed among the charities in that package.

Any donor has the ability to create packages. To create a package, a donor must define the minimum monthly donation amount, an investment fund for the donations to be held in, the charities the package will support, and the percentage of the monthly donation reserved for each charity. A package can be set as private or public. Public packages are visible to all users, while private packages are only visible to the creator. Once any donor signs up to contribute to a package, its owner can no longer edit that package.

Donors are able to search and view all public packages in the giv2giv system. If they find a package they like, they can sign up to begin donating to that package. Donors may choose the amount of their monthly donation, but that amount must be greater than or equal to the minimum donation amount of the package. Giv2Giv also uses social networking to allow donors to share their donations or packages via Twitter, Facebook, or Google+.

In addition to donors, charities can also register for an account to begin utilizing giv2giv's services. Charities must first request an account on the website, and giv2giv follows a sequence of steps to verify they are indeed a federally recognized nonprofit organization. Although charities without giv2giv accounts are still viewable on the system, signing up for a giv2giv account offers charities the added benefits of creating a customized profile page, defining their own mission statement, and receiving donations. Charities can also

tag themselves with certain keywords to increase their visibility in search results.

Finally, the customer has an administrator account with special privileges. The customer can keep track of all transactions made in the system. These transactions include who sends money where, which accounts are receiving money, and the monetary amount in each transaction. Every month, the customer can request the money that donors have agreed to donate from their Dwolla or PayPal accounts by clicking a button on his administrator dashboard. The customer can thus move the money from the donors' account into the appropriate investment funds or withdraw money from the investment funds and transfer it to the charities. This administrator account allows the customer to manage giv2giv's overall system from a centralized location.

6. RESULTS

The giv2giv application currently maintains records for all 828,156 charities recognized by the IRS. Each charity or package can be tagged with any of 72 different tags. The system can easily handle the addition of tags as they become necessary. It was built with a user space of 300,000,000 in mind, but is not limited to that number. The application listens for and records 12 monthly transactions for each package that each user is subscribed to. Also, an unlimited number of packages can be created, and a user can subscribe to an unlimited number of packages. All of these numbers suggest that giv2giv should be able to scale well as more users begin registering for the system.

Once it becomes open to the public, this web application anticipates helping charities receive many more donations than they are currently able to. The aggregate effect of numerous micro-donations from giv2giv's users combined with the accumulation of interest by the funds will supply charities with sizable sums of money in a relatively short period of time. Giv2Giv projects that after four full years of operation that it will reach a donor base of slightly over 209,000 individuals [1]. Also after four years, the nonprofit predicts donors contributing over 12,500,000 dollars, with over 6,900,000 dollars being given out to the actual charities [1]. These projections suggest that giv2giv will have a significant impact in terms of dollars donated to charitable organizations using the system developed as part of this project.

7. CONCLUSIONS

Our development team began with a blank CakePHP framework and now has successfully implemented a fully functional micro-endowment web application. Although there is certainly room for improvement, the system is working and can be used as a great starting point for giv2giv to build upon for the future. Users can register online for giv2giv and select their preferred payment method. They can create, donate, and track their donations to various packages and subsequent charities. Charities can register with giv2giv and edit their account information to enable greater search visibility. Donors can share their contributions on a variety of social networking sites. Transactions between Dwolla accounts can be tracked automatically via webhooks and stored in the database, which allows for transparency and tax recording. With development of the application complete, all minimum and desired requirements set forth in

the customer's initial requirements document have been met. Overall, this system is successful in enabling a true micro-donations charitable contributions platform that leverages open source software. This project also afforded the development team a year of hands-on experience in a customer-driven production environment.

8. FUTURE WORK

This project has a host of future work ahead of it. The most desirable addition would be a fully developed UI/UX framework to unify the site into a visually pleasing, cohesive, and easy-to-use system. The existing user interface is simply the default framework provided by CakePHP with minimal tweaks. A complete UI overhaul will create a system that better engages the user and improves the overall user experience.

Several administrative aspects of the system require manual participation. These actions include updating the charity information, updating fund values from the investment fund, and requesting monthly transactions. In the future, as the functionality becomes possible, these features should become automatic.

Searching over charities and packages is currently primitive. A better searching algorithm should be created. This could include ranking the results based on number of subscribers to each, positive up-votes for matching tags, or by date created.

Currently, the only fully supported payment system is Dwolla. Users can link their PayPal accounts. However, they cannot actually make donations using a PayPal account. Due to the popularity of PayPal, we would like to completely integrate it with the system in order to offer the user more payment options. PayPal was not initially implemented due to the amount of time required to integrate with external systems and because the customer prioritized Dwolla over PayPal.

Although this is a donor-advised, rather than a donor-managed fund, we would like to provide greater transparency to the user at every step of the process. This can include physically notifying the user when money has been transferred from giv2giv's Dwolla account to the investment fund, when his contributions appreciate or depreciate, and the when quarterly withdrawal and distribution out to the specified charities occurs.

The giv2giv system is expected to persist over an extended period of time. This focus on longevity creates certain boundary cases that need to be considered. Important questions include: What happens when a charity becomes inactive? Does the allotted money for that charity become redistributed to the other charities in the package? How do we handle a user choosing to delete his account? For reporting purposes, that information can never be deleted, however, it can be hidden from any future logins. This implies that the email associated with the account can never be reused for another account. A significant piece of the future work needs to focus on correctly and consistently handling all of these potential situations.

As other similar organizations offer, we believe giv2giv could

be expanded to allow donors to contribute to specific causes within a charity, and not just the general organization. This would require additional functionalities within the system to handle these causes, as well as an expansion of the charity-user role to allow individual charities to create causes within the system.

The social networking components are an integral part of spreading grassroots awareness of different packages, charities, and potential causes. These can be expanded to show the user how many of his friends are donating to giv2giv, how much his social network has contributed to a certain package or cause, or even how much people in his geographic area have contributed. These enhancements can be designed to educate the user about the power of crowdsourcing and encourage him to tell others.

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10. REFERENCES

- [1] M. Blinn. giv2giv budget. Accessed: 2013-04.
- [2] A. Bloomfield. Service learning practicum: Vision. <http://www.cs.virginia.edu/~asb/slp/>. Accessed: 2012-09.
- [3] D. Brandl. Open up with open source. *Control Engineering*, 51(5):56, 2004.
- [4] Causes. How will you use causes to make a difference? <http://www.causes.com/>, 2013.
- [5] J. Fritz. Giving to charity online: Websites where you can make a difference. <http://nonprofit.about.com/od/fordonors/tp/Websites-for-Good.htm>. Accessed: 2013-04.
- [6] GuideStar. Guidestar. <http://www.guidestar.org/>, 2013.
- [7] R. Morelli, H. Ellis, T. D. Lanerolle, J. Damon, and C. Walti. Can student-written software help sustain humanitarian foss? *Proceeding Information Systems for Crisis Response and Management (ISCRAM)*, pages 41–44, 2007.
- [8] OAuth. The oauth 2.0 authorization framework enables a third-party application to obtain limited access to an http service. <http://oauth.net/>, 2013.
- [9] Razoo. Easy online fundraising. <http://www.razoo.com/>, 2013.
- [10] A. Tucker, R. Morelli, and T. D. Lanerolle. The humanitarian foss project: Goals, activities, and outcomes. In *2011 IEEE Global Humanitarian Technology Conference*, pages 98–101. IEEE Computer Society, 2011.