Abstract—Cellular phones are bringing computing to underserved communities. As people in these communities across the globe lack access to information, but do own cellular phones, apps are filling the gap by delivering meaningful information to improve lives. In this paper, we present StreetConnect, a tool created by students from Santa Clara University to serve the homeless population in our area. This tool provides a way for organizations serving the homeless to send announcements to registered users via text message, and for registered users to filter the messages they receive based on their interests, such as employment, food, or shelter. The tool has been deployed at a local organization and has the potential to be generalized and used in other scenarios as well.

Keywords—Mobile Apps, Humanitarian Apps, Mobile Apps for Under-Served Communities

I. INTRODUCTION

Cellular phones are becoming one of the most widespread technologies ever invented. With the variety of apps available, cellular phones have become much more than conversation devices, and are actually changing the way computing serves society. One particular area in which cellular phones are making a huge difference, is dissemination of information. As people in under-served communities across the globe lack access to information, but do own cellular phones, apps are filling the gap by delivering meaningful information to improve their lives. However, it is important to ensure that these apps meet the unique needs of these populations [1].

The Frugal Innovation Lab at Santa Clara University has been collaborating with local and international partners to help cellular phones benefit different communities. In this paper, we describe a project in collaboration with CTA, Community Technology Alliance [2], an organization in San Jose, California, which aims at using technology to help homeless individuals and very-low income families. This project focuses on creating a system that allows organizations providing services to the homeless community to get information about their services out to individuals. In particular, informing people of one-time or sporadic services is problematic. CTA has conducted a survey that has shown that 68% of the homeless in the San Jose area have cellular phones; however many of them have only very basic phones [3]. For this reason, we chose text messaging as our medium. For the organizations creating the announcements, we have created a Web-based portal allowing them to log in and create their announcement, specifying whether it is related to food, shelter, etc. Once the announcement has been added to the database, a text message is sent out to all individuals who have expressed interest in that kind of announcement (food, shelter, etc).

When designing for the homeless population, we encountered numerous challenges that may be applicable to other projects that wish to target this population. One challenge is that this population does not do well with passwords; in response, we created a one-time code solution (described in Section 4). In addition, there were issues with how services are provided and who is eligible for services, which meant we needed to find ways to deal with this complexity behind the scenes, to avoid confusing our users or sending irrelevant messages.

CTA’s response to the completed system has been enthusiastic, and we are in the process of deploying our system with local service providers, starting with Sacred Heart [13]. Though this system was developed to serve the homeless population in our area, it could easily be adapted to serve other populations around the globe. While addressing the specific needs of a population is important [1], it is likely that changes focused on the interface would be enough to adapt the system.

II. RELATED WORK

Though homeless people have very little money, many of them are willing to set aside a large portion of their income to have access to a mobile phone. In a 2010 study of 100 “street” homeless (people who do not use shelters, and sleep primarily on the street), Eyrich-Garg [4] found that 44/100 homeless people interviewed had a mobile phone. Those with phones spent an average of $43.50 of their average $514.17 monthly income on a phone plan. The main reason that mobile phones were so important to people is that they allowed them to stay connected to family, potential employers, and potential landlords. Since it has been shown that homeless people who have greater access to their support networks have better mental and physical health outcomes [5], this connectivity is very important. In addition, safety was highly cited as a reason to have a cell phone; the ability to call 911 in an emergency is important, as the homeless are more vulnerable to assault [4]. Eyrich-Garg also found that not only do the homeless use mobile phones, but 61% of the participants with mobile phones also sent and received text messages, speaking to the possible effectiveness of text messages as an information dissemination tool.
The potential to leverage the existing mobile phones in the homeless population to implement new interventions or improve the reach of existing interventions is clear. Bonevski et al. [6] used phones to conduct smoking cessation counseling with homeless individuals. Freedman et al. [7] distributed mobile phones to homeless individuals participating in a study about crack cocaine use and used the phones to conduct automated surveys over a voice line. Outside the homeless community, text message alerts have been used to promote smoking cessation and provide reminders to take medication [8]. Our work seeks to bring these kinds of text messaging alerts to the homeless community.

III. DEVELOPING HUMANITARIAN APPS

A. Customized Solutions

One main step in the development of humanitarian apps is understanding the real needs of under-served communities. These communities are all different and their needs are all very specific, and addressing these specific needs is important [1]. However, most of them share a common problem, which is the lack of access to information.

Information, although taken for granted in our society, may have a major impact on under-served communities, and using cellular phones to help the spread of useful information constitutes an important way of using technology for social benefit.

In order to build solutions that address the specific needs of the homeless in our area, we worked closely with the Community Technology Alliance (CTA) [2]. CTA is an organization that works with other organizations that provide services to the homeless and low-income in the San Jose area. Their focus on creating common technology platforms for the myriad service providers in the area makes them an ideal partner in our work. One of the issues they identified is the difficulty of keeping a dispersed population such as the homeless informed of all the services that are available in their area – particularly one-time, or irregularly scheduled events, such as mobile medical services. In deciding how to address this problem, the penetration of mobile phones in the homeless population stood out; according to a survey conducted by CTA, 68% of homeless people in the area have cell phones [3]. However, only 50% of those with phones have access to the Internet on their phone. In order to take advantage of the pervasiveness of phones, within the limitation that many of the phones are basic, non-smart phones, we decided that text messaging would be the best-fit technology. However for those who do have smart phones or feature phones, having a version that works as an application on the phone itself would be much more convenient. For this reason we decided to pursue both approaches.

B. Platforms

Feature phones are the most prominent devices in emerging markets and under-served communities. However, Android phones [9] are starting to make a presence. Therefore, when developing for these communities, one should not assume a specific platform.

Due to the variety of phones, the usage of jQuery Mobile [10] with PhoneGap [11] to develop applications that can be exported to any phone has become an important part of mobile computing for social benefit and, even though so far we have developed apps specifically for iPhones [12] and Android phones [9], we have already embraced this trend in the new projects.

IV. THE STREETCONNECT PROJECT

We are working with the CTA organization to develop a set of mobile solutions that will make these phones even more useful for these individuals. Our first solution is an announcement tool. Local organizations offer all kinds of resources to under-served individuals, such as meals, beds in shelters, and job fairs, but have difficulty in getting the information to the individuals whom might benefit the most. To solve this problem, we have developed a web-based system, through which organizations may announce resources to registered individuals. To enable homeless people to interact with the tool using any phone, we have also developed an SMS interface.

A. The Web-Based Tool

The tool works as follows. Organizations and individuals register with the system. Once registered, organizations may submit announcements, which are sent to registered individuals by text message.

The tool has three databases:

- Organizations: A database for registered organizations, which are then able to create announcements to advertise resources.
- Individuals: A database for registered individuals, who are interested in receiving announcements. This database contains, for each individual, a cellular phone number and the categories for which he or she wishes to receive announcements, e.g., food, jobs, etc.
- Announcements: A database for the announcements added by organizations.

We consulted closely with CTA while designing the databases. One concern was creating a database for announcements that would eventually be able to interact with the highly structured database used by CTA to track all the organizations with which they work. For instance, a provider may be classified under both ‘food,’ and ‘lunch.’ In order to make our system flexible, we store such categories as lists, instead of individual fields, to allow additional categories to easily be added to the system in the future. Another piece of feedback we received from CTA was that they wanted the announcements to be highly structured, including separate fields for location, date, time, organization, etc. This makes it easier for them to ensure that all announced events contain sufficient information, and also allows us to prune out-of-date announcements from the database, to keep server costs down.

When creating the database for the homeless individuals registered with the system, CTA also helped us identify some important issues that determined our design. One issue is that
many people who receive services may not wish to provide their name. For this reason, the only required fields in the database of registered individuals is the phone number. In addition, there are many people who qualify for and receive services, but do not self-identify as homeless. This includes people who live in their car, and people who have no permanent address but stay with friends. For this reason, rather than asking if a person is homeless, we follow a protocol provided by CTA that asks where the person slept the previous night, and do processing from there (See Figure 1).

**Figure 1:** Protocol for determining homelessness

The tool has several webpages to provide an interface to the databases:

- Registration for Individuals
- Registration Management – Individuals
- Registration for Organizations
- Registration Management – Organizations
- Announcement Submission
- Announcement Search

As shown in Figure 2, individuals register with the system by providing their cellular phone number. Name and ZIP code are optional. They also have the choice to select the information they want to receive. Current categories are: food, shelter, jobs, and mobile clinic (as stated above we have designed the system in such a way that it is easy to add new categories in the future). For each category, they may choose to receive only information about events happening near their ZIP code, in which case they need to provide the ZIP code. The ZIP code became a complicated issue because it is used differently in different parts of the system. Most often, it is simply used to identify services which are within a certain distance. However, for people who are not homeless, their eligibility for certain services or jobs may be tied to their ZIP code. Thus in one part of the database we store the ZIP code itself for determining eligibility, and in another field we store a list of all ZIP codes within a predefined radius of the user’s ZIP code, for location of service.

**Figure 2:** Individuals’ registration

Individuals may need to change their settings, in which case they need to be authenticated to the system. One problem we encountered is that passwords are not a good choice for this population, as passwords tend to be forgotten, and it is difficult to keep track of physical objects such as a paper card with the information on it. For this reason, we implemented a one-time code solution. As shown in Figure 3, when users want to manage their account, they are just required to enter their phone number. The system then sends a text with a one-time code to their cellular phone, and shows them the page shown in Figure 4, on which they are supposed to enter the code received and get access to their account information, shown in Figure 5.

**Figure 3:** Getting the code to manage an individual’s account
Note that providing authentication to change the account configuration protects people from having their configuration changed inadvertently, and this is important, because changing the categories affects the number of messages received, which can be costly.

The announcement page is open to everyone for searching, but is only open to registered organizations for posting announcements, as shown in Figure 6. The links at the top of the page enable anyone to search for events by category or ZIP code. While most people will be informed of events through text-message, the website interface allows users to browse through all of the events listed in the database without having to register for the service. We have also created an app version of this webpage that users can use on their phone, eliminating the cost of text messaging and allowing for browsing, for users with phones that support apps. The bottom of the page restricts the creation of announcements to registered organizations by requiring an email and password. For announcements, organizations enter information about the event and submit the request. Important information are category, date, and address. From this information, the system composes a text message which is sent to all the registered individuals who want to receive information on that category for any ZIP code, or in the matching ZIP code.

**Figure 4**: Using the verification code to manage the account

**Figure 5**: Managing one's account

**Figure 6**: Announcement submission

B. The SMS Interface

Since most homeless people do not have smart-phones or access to WiFi, we have implemented an SMS interface to enable them to register to the service, unsubscribe and update their configuration without needing to access the web.
The SMS interface currently utilizes a phone number provided by Nexmo [14]. Nexmo acts as an intermediary between the service and users’ cell phones. When a user sends a text message to the phone number, Nexmo calls a PHP script located on the server. The script begins by scanning the message for commands and then executes the corresponding code. If no command is detected, the script will reply to the user stating what commands can be used, such as “add” or “remove”, and what service tags can be subscribed to, e.g., “food” or “shelter.” A user may register for the service or subscribe to another tag by sending “add <tag>”, e.g. “add food”. The system uses the phone number to identify if the user is already in the database and either creates a new record or appends the tag to the user’s current tags. Removing a service or unsubscribing from the service works similarly.

V. DEPLOYMENT

We have begun collaborating with Sacred Heart, a local NGO which works directly with the homeless and low-income families, on a pilot deployment of the system. In order to meet their specific needs, we have created a version of the application with enhanced functionality. In addition to being able to post public announcements, this version also allows individual case workers to send targeted messages directly to the specific people they need to reach. This functionality is akin to an SMS version of email; the case worker can send messages to any individual person they have added to their client list, or they can create “groups” (which function similarly to mailing lists on email). For instance, in Figure 7 the case worker is composing a message that will be sent to the group “Office Jobs.” This is a group that this case worker has created, adding whichever of the clients in her “My Clients” list who are interested in employment in an office setting.

Though we think that the ability to send private messages as well as public announcements is likely to be useful to a number of our users, we have decided to maintain two versions of the system, one which offers only public announcements, and one which offers both public announcements and private messages. There are a number of reasons that an organization may prefer to eschew private messages. One is that in order for the case worker to message clients, either the case worker must be able to search the database of individuals (which raises privacy issues) or the case worker must register the individual themselves (which makes registration more restricted). Second, we have found that the distinction between private messages, which will be sent to specific people, and public announcements, which will be sent to anyone who has subscribed for such announcements, to be confusing for some case workers, so we would imagine that it would also be confusing for some of the individuals receiving text messages. So for organizations where the individual messaging feature is not useful, we recommend that they use the version which features only public announcements.

Our deployment with Sacred Heart is just beginning, but we have already gotten some valuable feedback about the system. For instance, we have learned that Sacred Heart serves a large community of Spanish speakers. For this reason, we have added the capability to enter an alternate message in Spanish. (Figure 7) Now when a user is added, they can specify a preferred language. (Figure 8) If that language is Spanish, they will automatically be sent the Spanish version of the message instead of the English version.

The case workers also expressed concern about the charges assessed to people who do not have unlimited texting plans. In order to give clients some control of this, when they register they can now specify a maximum number of messages that they will receive in a month. Once they have been sent that...
many messages, their service will be suspended until the next month begins.

VI. FUTURE WORK

This project is ongoing, and as more organizations start using the system and more people are benefitted, we plan to work with CTA to assess the success of the project with an impact measurement, both through the number of people benefitting and the user experience.

We also want to make the system as easy to deploy as possible. We are working with CTA to tie into their database of service-providing organizations, so that a human being does not need to individually approve every organization’s request for an account. We are also considering the option of creating two tiers of organizational accounts; a free membership, and a paid membership which allows the organization to save all past announcements, and view information about how many people have received information about their services, etc. Having a paid membership would help CTA offset the costs of running and maintaining the server for the project.

VII. CONCLUSIONS

Mobile apps are helping under-served communities by enabling them to benefit from technology in different ways. These apps are enabling several communities to take advantage of their phones. Our project focuses on using the phones that are already present in the homeless population in our area to connect service providers with the homeless people who use those services. To address as broad a spectrum of users as possible, we have targeted text messages as our medium. However, we have encountered several interesting design issues pertaining to designing for the homeless while developing this system, including the need to provide authentication without requiring passwords, and the need to structure information as service organizations do. Though this system was developed to serve the homeless population in our area, it could likely be adapted to serve other populations around the globe.

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