



Figure 1: Screen capture of the Android app's Requests screen. The other screens not shown are Home, Profile, Search, Transactions, accessible through the bottom bar, as well as a Log-In screen

System Information:

Developed on Android Studio 2.1
Tested on 5554 Nexus 5 Emulator
Using SQLite database

AgileFood: Facilitating Adaptive Food Donation to Address Hunger & Reduce Waste

Denisa Qori McDonald

Drexel University
Philadelphia, PA 19104, USA
denisa.qori@drexel.edu

Erin T. Solovey

Drexel University
Philadelphia, PA 19104, USA
erin.solovey@drexel.edu

Abstract

In this paper, we describe AgileFood, a scheduling app designed to facilitate the distribution of food that would otherwise go to waste from grocery stores, to people that need it. There is a considerable amount of food wasted in developed countries, from which many hungry and malnourished people would benefit. Moreover, food waste creates problems for the environment and economy. Therefore, we need to find effective ways for grocery stores to donate food to people who need it, rather than throw it away when the food approaches its best before date. We have created a system that makes it easier for grocery stores and local charities to schedule food exchange, depending on the changing charities' needs, the grocery stores' availability, and their location.

Introduction

In many developed countries, unsold food, if it is approaching its best-before date, is thrown away by grocery stores, while food banks, shelters, and charities are at a constant need for more food donations. According to Feeding America [5], in 2014, 14.8 % of Americans (46.7 million people) were in poverty. Homeless families try to find ways to prevent food insecurity by using food stamps, but that does not seem to fulfill their monthly needs [6]. In United States, 40% of produced food goes uneaten, and a reduction of 15% of this quantity would

be enough to feed more than 25 million Americans every year [3]. According to a National Resource Defense Council report, about 10% of the nation's food supply is lost at the retail level, and that, in 2008 amounted to 43 billion pounds [3]. Canadian food banks are the "primary response to hunger" [8], but also cannot always meet the needs of the community. Food insecurity is associated with poorer health for the individual, including "higher odds [...] of having poor functional health, restricted activity and multiple chronic conditions, of suffering from major depression [...] having poor social support, [...] heart disease, diabetes, high blood pressure and food allergies" [10].

In addition, the practice of throwing food away generates a considerable amount of waste, which negatively impacts the environment and the economy. Food waste contributes to excess consumption of more than one quarter of the total freshwater consumption, and approximately 300 million barrels of oil in one year [4]. Moreover, it also increases CO₂ and methane emissions from its decomposition, which impacts climate change. A study in Sweden found that supermarkets were responsible for part of the increase in CO₂ footprint because of the food they wasted. It was also concluded that waste source reduction was more effective than upgrading waste management [3].

Food Donations: Incentives and Challenges

According to Ariely [1], there are three broad categories of motives behind charitable contributions: *intrinsic motivation*, *extrinsic motivation*, and *image motivation*. In the US, several laws encourage food donation by providing liability protection and tax incentive to donors. According to the official site of USDA [9], some examples are the "Bill Emerson Good Samaritan Food Dona-

AgileFood Functionality:

- The user can input food item type, amount needed, time availability.
- The user can create, view or change their profile.
- The user can search grocery stores/charities filtering by food item, quantity of that item, time availability to perform the exchange, store/charity name, and distance.
- The system will show stores that correspond to that search, and the user can send a request to one of the resulting grocery stores.
- The user can view their sent and received requests, and respond to them. The user that sent the request will be notified when there is an answer. If a request is answered positively, a transaction is created for both users.
- Each user can cancel a transaction, and the other user will be notified.

tion Act”, the “Internal Revenue Code 170(e)”, and the “U.S. Federal Food Donation Act of 2008”. France passed a law that forces supermarkets to donate unsold edible food to charities instead of throwing it away. Thus, grocery stores have the extrinsic motivation of legal requirements and/or tax breaks to donate food. They also have the image motivation of how they are viewed by their customers. The image motivation can eventually turn into another extrinsic motivation, since the grocery store can potentially gain more customers by advertising that they are donating to charity.

There is a growing number of organizations, charitable and for profit, that are working to recover excess food at different points of production, delivery, and consumption chain, in order to reduce waste and provide that food to the needy. One of the challenges of the current situation, especially with the French legislation, is the transfer of responsibility to not waste food from supermarkets, to charities, which need to provide the conditions to properly store it. Moreover, one charity might end up with extra food that another charity needs.

AgileFood: Facilitating Redirection of Food

To the best of our knowledge, there is no system that tracks the changing needs charities have, as well as all the excess that the grocery stores want to dispose of. There seems to be a lack of direct, and instantaneous communication for optimal matching between the two groups. In order to help facilitate such an infrastructure, we built *AgileFood* (Figure 1) which, based on location, helps charities or food banks find a grocery store close to them to get extra food from. In addition, grocery stores can find a charity that needs the items that they are disposing of. See sidebar for use cases.

The purpose of AgileFood is to help schedule a food exchange between a charity and a grocery store only for the food items and amount that the charity needs, providing the opportunity for another charity to obtain the rest of their extra food. Possible challenges for grocery stores in using such a system include the time overhead that comes with finding several charities to split their food between, packaging the food separately, and pos-

sible transportation costs. The main incentives for charities to use AgileFood would be the ability to extend their help to more people, easiness of use, as well as not having the burden to find extra storage, or have to throw away food because they are unable to do so.

This system was designed and prototyped in an iterative process. After exploring the user needs and context, an initial low-fidelity prototype was developed. A heuristic evaluation with two evaluators was conducted to identify issues and these suggestions were incorporated into a higher fidelity prototype that was evaluated in a small user study with five participants.

Conclusion and Future Work

AgileFood aims to mitigate the negative effects of wasted food, and offer it to people that would benefit from it. It facilitates the transfer of extra food from grocery stores to charities. There are laws in the USA and Europe that encourage or enforce the donation of food, as well as organizations that re-distribute food that would otherwise go to waste. Our system is different from existing ones, because it makes the transfer of food more direct and potentially more frequent from the grocery stores to charities, especially locally, without needing third-parties to take care of matching, or even transportation. Moreover, this model is based on need and availability of particular food items, removing the burden on charities to handle great amounts of food that they might not need, at once.

Future work is needed to explore design considerations that lead to real-world adoption and continual use of the system. Grocery stores need to be shown that it is more profitable for them to donate the food rather than dispose of it. Their profits can be generated by tax breaks, and by possibly gaining customers because of their improved image. Other future work that would improve the system includes: 1) records of each entity's transactions, to show that entity's community involvement; 2) an optimal matching algorithm, to automatically provide the most efficient distribution of food; 3) a review system for participating organizations to monitor each-other's reliability.

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