Waste to Sustenance: Draft Proposal

HMW: How might we reduce the amount of food waste that is generated by consumers in the US keen on saving money by utilizing organization and inventory technologies?

Problem Statement

Problem:

(WHO) Consumers are wasting money on food that is being thrown out, while generating greater mass that will end up in landfills.

(WHAT) This wasted food is the major entity we are trying to prevent.

(WHEN) Consumers are wasting food on a daily basis, and tend to throw out spoiled food weekly. This takes place year-round.

(WHERE) Commercial businesses, specifically in the Atlanta region, have numerous programs in place making progress toward reducing waste. However, little has been done to make any impact on the waste coming from homes and living spaces. Attention must be turned towards the refrigerators and pantries found in private spaces that are generating vast amounts of waste.

(WHY) Consumer food waste impacts numerous stakeholders within society, but its primary impact is on consumers themselves. Consumers can save themselves money by paying closer attention to the amount of food they are purchasing and consuming. This reduction of food waste will allow for a reduction in the mass that ends up in landfills. There is an environmental impact, as well as commercial and agricultural impacts, which are to be later discussed.

Significance:

(A) Society suffers financially, as well as in terms of resources, and environmental health due to the production of food waste. Food produces a greater amount of methane in landfills per ton than any other type of waste. This methane contributes to the greenhouse gas effects that are the main causes of global warming. Resources are wasted when food is thrown out. The energy expended to produce that food, as well as to package it and transport it to the place of purchase is all for naught if the food is then thrown into the trash. Consumers also are wasting money when throwing food away. Approximately 20% of all food goes to waste at the hands of consumers, resulting in around 90 billion lbs wasted annually. This wasted money could be dispersed elsewhere in the economy to help the US grow financially.

(B) This problem is caused on numerous economic trophic levels. Food is disposed of on farms where aesthetic standards regulate the produce considered acceptable for market. In grocers food spoils on the shelves if it is not sold. In restaurants and dining establishments food is wasted in preparation, as well as when it is left at the end of a meal. Focusing on consumers:

food is wasted for a plethora of reasons. Most people tend to lose food within the confines of their refrigerator or pantry, and this food is discovered once it is spoiled and deemed inedible. Consumers tend to neglect leftovers or fail to simply open containers to determine their contents. And expiration dates/use-by dates/sell-by dates are holistically unregulated and therefore misunderstood by the general public.

(C) Addressing this problem would prove entirely beneficial to society for a host of reasons. Consumers would be able to save money on groceries weekly, and this money would then be available to spend elsewhere in the economy. A long-term impact may be the reduction of supplies wasted by grocers due to a lesser demand causing a lesser supply of fresh, perishable items. And environmentally, there would be a lessening in the annual production of methane in landfills, slowing the production of greenhouse gases and thus positively impacting global warming.

Stakeholders:

(1) Consumers are the most obvious of the stakeholders in solving this problem. Consumers are incentivized to pay attention to this issue due to the fact that a reduction in food wasted translates to a reduction in money wasted. While the root of the problem's economic and environmental impact may seem irrelevant to consumers, saving money on a weekly basis gives consumers a reason to pay attention. Also, if demand decreases due to a change in consumer habits, then grocers will be likely to decrease the price of common household items, benefitting individuals of lower income.

(2) Commercial grocers would be significantly impacted by attention to this problem if consumers drastically changed their purchasing habits. It is difficult to predict the effect grocers will experience. While consumers may take to purchasing less perishable food on a weekly basis, grocers may choose to decrease their supply as a result. This may prove to be monetarily beneficial to grocers, however if their supply does not decrease with their demand then they will be at a monetary loss. This would decrease the support of commercial grocers across the market.

(3) Agriculture centers and major farms may see a decrease in demand if the impact of our solution were to reach such a magnitude. A cycle of decreasing demand resulting in decreasing supply may allow farms to produce less food, therefore producing less waste. However, this could also result in a decrease of revenue for farms, acting as a reduction in incentive.

(4) Local markets may find that as people are purchasing less perishable food from grocers, a consideration for global and environmental impact is developed in consumer culture. Due to this change, a drive toward locally sourced food is to be expected. Local markets may therefore see a slight increase in the demand for food grown locally and organically. This would generate support within the local farming community.

Context and Existing Solutions:

Current solutions to this problem currently exist in the commercial sectors, but the consumer marketing is lacking of much awareness that the problem even exists.

(1) Atlanta's Zero-Waste-Zones program aims to target businesses in four areas of the city. This program has been widely successful and has grown to include hundreds of businesses. This is because businesses are incentivized to join by the ability to market themselves as eco-friendly and "green". This incentive unfortunately does not exist in the consumer market.

(2) Numerous apps have been developed previously in attempts to garner consumer interest in the problem and begin making an impact in the problem space. However none of these previous attempts have been markedly successful. Most require too much attention and efforts by the users, and are not considered beneficial enough to the consumer to consider using. Apps such as Green Egg Shopper, Fridge Pal, and Still Tasty require users to input data manually, search for foods by name, and must be utilized with diligence in mind. We know that for consumers to want to make a difference there needs to be a substantial reason for them to expend effort, and even so it must be a minimal amount. For our idea, that reason is money. By incentivizing consumers with the concept of saving money, we are giving them a reason to care. No other attempt to impact the problem has taken such a substantial approach, and made it so easily accessible to the consumers. By the bait of economic advantage we can provide users with the ability to influence their personal budgets, meanwhile opening the door for us to educate them on the good they are doing for society and the earth as a whole.

Why is it still a problem?:

As previously stated, consumers need a reason to care. They tend to be self-concerned and narrow-minded when it comes to altruistic actions. Any change to one's lifestyle requires a great deal of convincing that there's benefit to be found. Gaining consumer support, and being able to maintain interest will be a great challenge. Also, apps tend to be a very common solution because they are so easily accessed by the general population. The majority of the population has access to smart technology and thus apps are able to reach a great deal of people as opposed to other types of technology. However, other apps have gotten lost in the seeming abyss that is Apple's App Store, Google's Play Store, etc. It is difficult for new apps to break through in the market and generate a great enough following to have an impact. Finally, grocers may have opposition to efforts such as those we are proposing. Since the basis of our proposal is that consumers will be more aware of food and money being wasted, they will likely choose to spend less and purchase less. This is of course a negative to grocers who rely on consumers for their revenue. Therefore finding ways to partner with grocers and gain their support in marketing has before, and will continue to prove to be a challenge.

Proposed Work

Goal:

It is our hope through this proposal that by the creation of an app we can target consumers and change consumer culture enough to reduce food waste in Atlanta homes. We hope to incentivize consumers with the concept of saving money, and in doing so demonstrate to them the money wasted on food waste, thus convincing them to either purchase less food or become more wary of consuming all that they purchase. The scale of our success is entirely dependent on the success of the app itself. It must be user-friendly enough that it is not considered a hassle to use, while providing consumers with enough appropriate information to incite change in their habits. If successful, this would change consumer culture to reduce the amount of food regularly wasted in homes; reduce methane production in landfills. This may also result in an increase in the types of technologies available for consumer use.

Objectives:

Our main goal for this project is to design and develop an app that manages individual consumers' food inventory. We also need to look into consumer psychology to incentivize people to use our app. Measurements for these objectives will be identified as money lost by consumers, and consumer feedback on usefulness of the app. In order to track changes in consumer behaviors we will retain information on the amount of money wasted by consumers on a biweekly basis. This will allow us to see the impact our app has on consumer behaviors. We will also attempt to solicit feedback from the app users, in order to gauge opinion on the app's usefulness, productivity, and effectiveness. These criteria will allow us to quantify the success of our product.

Background:

Society's relationship with waste has a direct correlation to its relationship to consumption. Industrialization, urbanization, and the post-World War II production boom are all seen as factors in encouraging consumption. Industrialization resulted in an influx in manufactured goods because consumer goods were affordable and people no longer had to produce all of their individual needs. As cities rapidly grew, sanitation increasingly became an issue. The most major are recent methods of disposing waste is the sanitary landfill. Sanitary landfills are comprised of alternating layers of dirt and waste. The dirt prevents the flow of oxygen to waste, reducing vermin and the threat of disease.

Sanitary Landfills had two major effects on food waste. It allowed for wasted food to be easily collected from individuals and never seen again. The easily vanishable waste made the existence of the waste forgettable. Consumers no longer noticed how much was wasted, and subtly, the amount of waste produced increased. The other effect the sanitary landfills had is the way food waste decomposed. Since the waste is sealed by the layers of dirt, food does not

decompose as it would normally. Methanogens that thrive in anaerobic conditions consume the food and excrete methane, carbon dioxide, and water. The gases form plumes that disperse into the air, adding to current greenhouse gas issues.

Although food waste has been a growing problem for a centuries, the United States government just enacted its first food waste specific initiative in 2015. The U.S. Department of Agriculture and the Environmental Protection Agency plans to reduce waste by 50% by 2030. The solutions proposed however are abstract and voluntary. There are more small-scale solutions enacted out by individuals. From apps that connect hungry people to individuals that have excess food such as *Leftover Swap* to programs that connect businesses with food banks like *Waste No Food*, people have already taken it amongst themselves to solve the global issue. Most programs however are intended to be enacted locally, or focus mostly on businesses. Much of the waste is created in homes, thus our problem space.

Methods:

The app requires various technologies that already exist. Our aim is to combine these technologies into the app. First, we need a technology that will scan the the text on a consumer's grocery receipt. The text scanning technology is called optical character recognition (OCR). It is a mechanical or electronic conversion of typed, handwritten, or printed text into machine-encoded text. It is a form of data entry, and it can read paper documents. OCR can work through two different methods: pattern recognition and feature detection. Pattern recognition would be more relevant for monospace font or very common fonts, but it does not recognize different and unique fonts. Feature detection is required for our project. This will allow a computer to recognize letters in various fonts. For example, the letter A consists of two angled lines that meet in a point at the top, in the center, and there's a horizontal line between them about halfway down. Most OCR software will be effective if it scans a file type that it supports. So for this project, the phone's camera will take a picture of the receipt, converting it into a supported format such as JPEG or PNG. It will analyze the picture and then detect characters using feature detection. More technical analysis is required to determine format however. This is an automatic process that does not require any effort from the consumer except for taking the picture.

We would also need a database of food items. Once a consumer scans his or her receipt, the app will only recognize the items if they are already stored in its data. Food databases are available from external sources. The United States Department of Agriculture's Agricultural Research Service provides a free database. It is also possible to license the database. We will also need a database on predicted expiration dates. A wide variety of items and their expiration dates in the database will reduce manual input from the consumer, making the app more automated and appealing.

Another function of the app includes reminding shoppers to scan their receipts after they have made their purchases. This would require a GPS type feature that recognizes the shopper is

in a store. Geolocation will be used to identify the location of the mobile on which the app is stored. Smartphones already have a GPS chip which uses satellite data to determine the position of the phone. Maps such as Google Maps then identify that location. Another common method with phones is through mobile repeater triangulation. The location of the device is determined by the relative distance to various cell phone towers. This method works fast in urban areas but it is not as common because it is expensive. Combining the built in GPS with the app will require writing a unique code for our specific purpose.

The app will be effective due to its live feedback and notification system. The notification system includes reminding consumers their groceries about to expire and also making them aware about how much money is lost if food is wasted. We believe a crucial part to our method involves understanding human relationship to money. People tend to be more upset when they lose a dollar versus the happiness from gaining a dollar. This loss aversion psychology is important in understanding which features our app should have.

Outcomes:

One of our objectives is saving food waste by saving money for consumers. The app has an overall goal to decrease food waste produced by consumers. Consumers usually irrationally buy excess food. People tend not to care about food waste even if they are aware of the problem. However, people care about how much money they are wasting. Our concept is to convert the amount of food consumers are wasting into the amount of money they are wasting, as it is a very powerful tool to influence consumers' habits. We want to inform consumers on how much money they waste, rather than how much they saved. In our research we found that people's psychology is set such that they are more greatly affected by losing money than by saving money. The way we can determine whether the objective is successful is in following the data produced by consumers and determining if over a set period of time the app shows a decrease in the amount of money wasted. This is going to illustrate that consumers either are buying less food, started developing better food usage habits, or both. We can create a database and store all the money waste data from users of our app. We will thusly be able to easily track whether our app is influencing change.

Anticipated Problems:

The initial problem that our group will run into is how to develop the app. Currently, no one in our group has the skillset to design a well-functioning app. Thus, we will either have to outsource to a company that will develop apps for pay or add a new member to our group who is capable of creating an app. Also, because the novelty of our app comes from the convenience and user-friendly interface, our group feels it is necessary to be directly involved in the design and functionality of our app. Thus, we would have to find someone who is completely willing to work with us until we can make an app that satisfies our demands. Adding someone new to our app development also poses potential problems, though, because the cost to afford this extra help

(especially if we outsource to a company) coupled with protecting our intellectual property rights could be deterrents to the success of our app. The issue of money and development will continue to be a problem throughout the existence of our app because the app will constantly need to be maintained and updated.

Once the app is developed, our group will face the issue of getting our app into the Google Play and Apple stores and then marketing them to consumers. It shouldn't be too difficult to get our app into the Google Play store, but Apple has more restrictions as to which apps are allowed to be sold. We will also need to address how we will initially market to consumers. Marketing takes lots of time and money, and thus we will have to do a lot of research into our target demographic before we can begin to market our app. We will continue to face the challenge of marketing as long as our app is in existence. However, our marketing strategies will likely frequently be changing depending on the amount of consumers who actually download our app and the demographic that we want to continue to target.

After consumers have downloaded the app, we will face the question of: will it actually be convenient enough for the consumer, or is even taking the effort to scan a receipt too much for consumers to want to keep up with? It is also possible that consumers won't mind imputing their food into the app, but they won't want to take the time to record what has happened to their food once it expires – either eaten or wasted – even if they are reminded automatically by the app on the day of its expiration. If this is true, we will have difficulty determining how much food, and thus money, each individual consumer wastes. And since our solution is designed on the premise that consumers will be incentivized to use this app and reduce their food waste due to how much money they could be saving, consumers may be discouraged to use our app because it won't be able to accurately tell them their monetary loss. Also, we will have difficulty tracking data on overall average consumer behavior change if consumers are not consistent in recording their food waste data.

Overall, each of these anticipated problems are manageable, but they will require a lot of forethought, research, and adequate planning. And since there are many facets to making this app successful, we will have to tackle each of these problems in conjunction with one another because they are all interrelated and integral to the success of our app.

Project Team:

Press Head: Handle external communications and relations. In charge of social media and press releases as well as interviews and other representation of the team. They should be knowledgeable about every part of the project and will need to be able to to answer to specific questions about our project, our goals, and the technologies we're using to develop our app.

Quality Assurance: Make sure that the content of our work is functional and the best that we can produce. They will need to revise and edit the written work of their teammates, work on debugging, application testing, and edge case testing. They will have to work closely with all

members of the team. With the press head,. Their role is to be critical towards their teammates and their drafted products and to be helpful towards the refinement of those drafts.

Design Head: Create electronic resources for the application interface, press releases, team/project website, and social media. This includes visual resources such as backgrounds, icons, logos, font choices, audible resources like notification noises, and media release videos. They will work closely with the press head and interface development. Their role is to make our media visually pleasing, understand color theory and design principles, and to make sure that our image is consistent across platforms.

Application Development: Primarily responsible for the backend application development. They will be responsible for creating the algorithms that each feature of the app will use. Base app functionality such as OCR and receipt interpretation, food item inventorying and modification, and notification triggers will precede advanced features such as GPS-based notifications, recipe database implementation, food product image recognition, and partner account management and security. This role will require a lot of cooperation with database development and interface development.

Interface Development: Applies the design and media to the application. They are responsible for making each feature of the app accessible and attractive, and will need to work closely with the design and media and application development. They will need to match the algorithms to places on the app and arrange them in a way that is user-friendly and they will do a lot of the work on the testing and debugging process since they know the interface best, and they will need to analyze the user feedback in order to make adjustments to the user-end.

Database Development: Primarily responsible for the development, updating, optimizing, maintenance, and implementation of the databases foremost for the food products, costs, and expiration dates. After the implementation of this, they will be responsible for future developments such as the user account databases, a recipe database, or partner organization database. They will need to keep a database of all the money wasted by each consumer, which will be kept anonymous, so we can track if overall consumer behavior has changed. They will also be responsible for ensuring the security of network communications, between the app, the databases, and the web.

Three Potential Advisers:

1. Lelia Virji: Sodexo's Sustainability Support Specialist for Universities. We interviewed with her during the beginning of this semester concerning food waste in universities. She is very interested in our group and our project and wanted to keep up with our progress.
2. Ryan Chiang: A rising fourth year CS major here at Georgia Tech. He is close with one of our team members.
3. Dr. Robert Waters: A CS professor here at Georgia Tech who is known to be very helpful towards students.

Timeline:

Summer 2016: We will be performing primary research within our own households regarding our food-wasting habits. For the first month we will simply keep track of receipts from groceries purchased, and we will document what is thrown away. For the second and third months we will keep a detailed log of all groceries purchased, and from this develop a chart of expiration dates with each perishable product. We will then document what food is wasted having taken note of these expiration factors. This data will serve as a primary example of how our app may benefit the consumer, and whether it is feasible for us to continue with the development of our project. We may also make a point to familiarize ourselves with the technologies we need to be using to progress with our app.

Autumn 2016: Manufacture all the parts we need to build an inventory app. This includes a wireframe for the app, visual elements for each function, audio samples for functions and notifications, algorithms for the backend of the application such as user inputs, notification triggers, camera implementation, and an understanding of OCR interpretation technologies.

	Press	Design	Interface	Application	Database
Sep	Identify early adopters and target audience. Prepare presentations for the class.	Learn how to use electronic design tools. Identify colors, fonts, etc. that correspond to the vision of our application.	Wireframe the application and identify target screen sizes.	Learn how to use the language. Begin work on item input and sorting, both manual and external sources.	Begin compiling the data on food, common food items, and expiration dates.
Oct	Research about and write an App Store profile. Prepare presentations for the class.	Research file formats and the uses/drawbacks of each. Identify different elements and plan out what formats need to be used.	Translate item input algorithms to onscreen actions.	Design notification triggers such as expiration timing and GPS location.	Organize the data and learn how to set up and manage a database.

Nov	Prepare a press release for our project and application.	Begin the design of elements needed for use on the application.	Assign design elements to functions of the application as per the wireframe	Implement the device camera and learn the “what” and “how” of OCR.	Create the food expiration database and make it accessible only to the application.
Dec	Prepare documents on our mission, contact, projected release, etc. for web use.	Complete the application design elements.	Translate the latest developments into onscreen actions.	Merge the OCR, camera, and input algorithms to create a full system.	Access OCR input to obtain database output.

Spring 2017: Put together the components of the app and employ ourselves in alpha testing and then employ others in beta testing the product and providing feedback on features and usability. We will then reevaluate the application and work to improve both the structure and interface of our project.

	Press	Design	Interface	Application	Database
Jan	Prepare outreach to beta test, research access points to reach target audience.	Begin website design elements and research HTML5.	Create sidebar menu and sub-elements.	Build algorithm to find common items between recipe database inputs and current food inventory items.	Build recipe database and have it “share” information with inventory.

Feb	Release beta test, prepare to act as IT, prepare follow-up surveys and group interviews.	Build a website for our app/project, utilizing press documents.	Alpha testing, debugging, refining, etc.	Develop algorithm to record, for our own database, how much money each consumer wastes. Alpha testing, debugging, refining, etc.	Build a database that stores how much money is wasted by each consumer in order to track consumer behavior change. Alpha testing, debugging, refining, etc.
Mar	Host interviews, release surveys, interpret information we gain from testing.	Research effective social media profiles, strategies, etc.	Deal with beta testers, mark all areas of code that complaints pertain to, research how to optimize current algorithms, networks.		
Apr	Thank you letters to testers, prepare a social media profiles.	Clean up the app interface as per the feedback from beta testing phase.		Work to optimize algorithms, networks.	

Summer 2017: Move through another Feb-Mar-Apr iteration of beta tests over May-Jun-Jul with hopefully only minor changes and fewer commitments to major features.

Autumn 2017: This is the release time for our applications and the point at which we should be seeking partnership with companies. We will need as much media presence as possible.

<table>
<tr><td></td><td>Press</td><td>Design</td><td colspan="3">Interface</td><td>Application</td><td>Database</td></tr>
<tr><td>Sep</td><td>Release the app for Apple. Reach out to potential partners, plan meetings, etc.</td><td>Build social media resources, create profiles and raise awareness.</td><td colspan="4" rowspan="2">Make the entire application work for Android and add Google’s recommended and required features and restrictions.

Alpha test and make sure it works as intended.</td></tr>
<tr><td>Oct</td><td rowspan="2">Meet with potential partners. Figure all that business out. Plan to look good, talk sharp, and plan to make a press release.</td><td>Get a small beta test group for Android together.</td></tr>
<tr><td>Nov</td><td>Make design elements specific for Android and the many Android devices on the market.</td><td colspan="3">Release the beta test, release surveys two weeks in. Deal with beta test bugs.</td><td>Plan to use potential partner databases, make sure that network communication for internetwork portions of the app is plausible.</td></tr>
<tr><td>Dec</td><td colspan="7">Finalize partner plans, press releases, etc.
Implement the partner organization into our project.
This portion of our future is mostly unseen.</td></tr>
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Budget:

Material & Supplies: For simplistic office supplies such as white boards, post-its, whiteboard markers, etc we foresee requiring no more than $200. In order to develop the app ourselves, our current sources indicate that we will be able to develop on entirely open-source software. If this is not the case, we may need to purchase subscriptions for development software, which may contribute $400 to the budget. Once the app is developed, Apple’s App Store requires $100 annually to make the product available on the market. For this we have allocated $200 in the budget.

Equipment: Between personal laptops, mobile devices, desktops, and Georgia Tech’s rentable equipment, we do not foresee any budget requirements arising in the development process.

Services: Hiring an app developer could cost anywhere between $100k and $500k from commencement to completion of the app. This is obviously an amount much larger than we

consider affordable, and thus plan on making best efforts to develop the app ourselves, pulling assistance from resources on-campus and the local area.

Travel: Once we have developed our app and filed for intellectual property rights, we may consider showcasing our product which would require travel. For the time being, travel costs are to be determined.

Expected Outcomes & Future Directions

When our project is completed, we hope to achieve a significant decrease in consumer food waste. Once our app goes on the market, we would collect data from our users and create data on how the amount of food waste has changed and the amount of money that has been saved since we began this project. Eventually, once the app gets running, we would most likely start adding and improving the features, like adding a database of recipes, so that consumers know what to do with the food they have that is almost expiring. By continually improving our application, we would be able to adapt to an ever-changing consumer market, and to consistently improve the ease of use of the virtual pantry as technology continues to evolve.

In order to continue making our app easier and less of a hassle, we would partner with grocery stores in order to expand our food databases. By expanding our databases, our receipt-scanner portion of the app would continually improve to be able to read all food items on the receipt, including those that are specific to certain grocery stores. For funding, we could take initiative and get funding from local governments in order to incentivize their citizens to use this app. As the earth becomes more and more populated, food waste will only become more and more of a problem, and by creating this app, we hope to help see a major decrease in the food that is wasted.

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