Following The Food

Developing a Data Collection Tool to Monitor Community Fridge Usage

Advisor

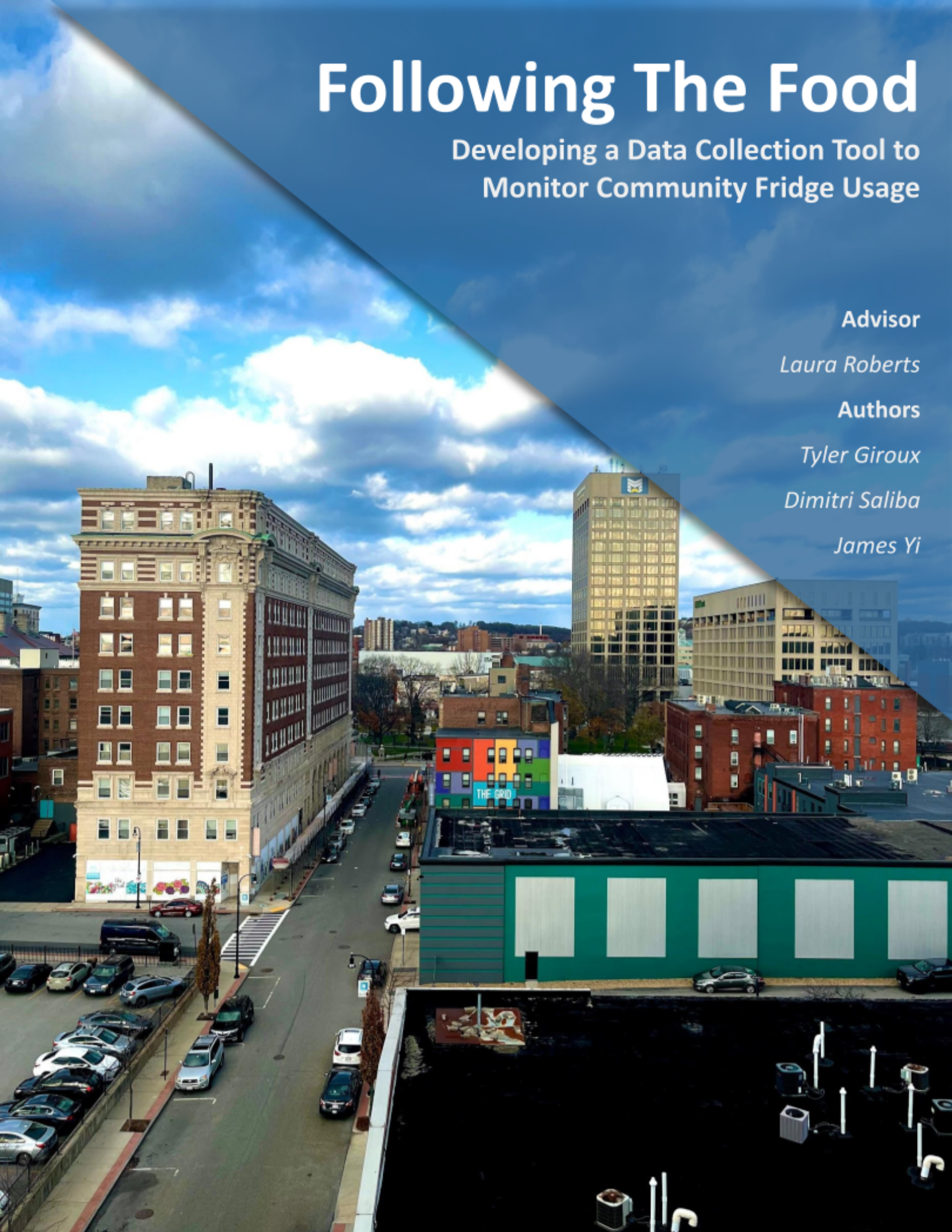
Laura Roberts

Authors

Tyler Giroux

Dimitri Saliba

James Yi



Following The Food:

Developing a Data Collection Tool to Monitor Community Fridge Usage

---

An Interactive Qualifying Project
Submitted to the Faculty of
WORCESTER POLYTECHNIC INSTITUTE
In partial fulfillment of the requirements for the
degree of Bachelor of Science

Date: December 16th, 2022

Submitted by
Tyler Giroux
Dimitri Saliba
James Yi

Project Advisor
Prof. Laura Roberts

Sponsor
Worcester Community Fridges

Abstract

This project aimed to better understand the usage of the Worcester Community Fridges by developing data collection tools for the organization. The main constraint was maintaining the hands-off, self-service mission of the fridges while still gathering a significant amount of data. We interviewed volunteers as well as researched similar projects done by other community fridge organizations. We evaluated many different data collection, aggregation, and visualization strategies. Our solution involves a combination of qualitative data from volunteers, a system of surveys for self-reported data on fridge conditions, and a hardware device that monitors the fridge door. All of this information is aggregated and displayed in a live updating data visualization portal available to the community.

Executive Summary

In 2021, the United States Department of Agriculture (USDA) calculated that 10.2% of the United States population were food insecure, which is slightly higher than the global average of 9.8% calculated by the UN. Massachusetts has a lower food insecurity rate compared to both the national and global average, but the city of Worcester has a greater rate than all of the above.

This is where community fridges step in to help close the gap in food assistance. Community fridges require no application, no documentation, are open twenty four hours a day, seven days a week, and are run by the community around the fridge. While studying the social dynamics at play in community driven service initiatives, Esther Carmen (2021) noted that one of the primary benefits of community-led action is social relationship building. This is exactly what the organization Worcester Fridges set out to fix in 2021. In the midst of the COVID 19 pandemic, Worcester Fridges opened its first community fridge, a public refrigerator which anyone in the community is free to use, either by donating extra food to prevent waste, or taking food to alleviate food insecurity. Unlike government programs which have no direct contact with the community, Worcester Fridges is a grassroots organization which sees itself as more of a mutual aid program than charity, relying on active participation from many different parts of the Worcester community.

Worcester Community Fridges takes a predominantly hands-off approach to mitigating food insecurity. The general concept behind community fridges is to provide a physical spot and the necessary infrastructure (refrigerator, weather proofing, etc.) in a location that is both proximate to food insecure individuals, as well as to businesses that may frequently have surplus food. Rather than wasting surplus food, businesses, individuals, or organizations can donate to the community fridge. Anyone from the community is free to take what they need from the fridges with none of the overhead that may be involved in other assistance programs such as paperwork or an application process. This lack of overhead is a key differentiator between community fridges and other government assistance programs. Because of this volunteer-centric approach, one of the most important factors for the success of the community fridges is community opinion. In their study of a community fridge in Scotland, Carmen (2021) found that organization of this type is prone to stigma. Specifically they found that business owners initially viewed the community fridge project with apprehension due to preconceived notions of the type of people who would use the fridge's assistance as "undesirable". This type of stigma is incredibly detrimental to grassroots organizations which rely on their community standing to drive engagement. In the case of a community fridge, stigmatization of its users, or as Worcester Fridges

describes it: “Fridge Myths”, dissuades people in need from seeking assistance and dissuades businesses and donors from contributing. It is for this reason that all the policies and practices of the Worcester Fridges, and by extension us, must be constructed with maintaining good community relations at the forefront. As this is a community-run initiative, to maintain good community relations, we had to construct an ethical plan that would allow us to collect data on these community fridges. This data collection would assist the Worcester Community Fridges in reinforcing their methodologies and potentially securing grant funding.

The overall goal of this project was to help Worcester Community Fridges implement a sustainable data-gathering system which would monitor fridge usage in order to measure community impact. As such, we made the primary deliverable a data collection tool that the Worcester Community Fridges organization could use to monitor the usage of multiple different community fridges. The primary objectives to help us accomplish this goal is:

- Iteratively develop sustainable and ethical data collection tools
- Get qualitative testimonials to contextualize our quantitative data
- Develop user guides to train volunteers
- Network with other fridge organizers

The first objective was to develop sustainable and ethical data collection tools alongside a data visualization portal that would effectively display the outputs. Our sponsor informed us that they wanted some type of survey for data collection. We modeled the questions seen in Appendix B based on a similar approach used by the LA Community Fridges organization. We added an option to submit an image of the fridge with the survey to show more accurate data on the content of the fridge as well as how clean the fridge was. An additional data collection tool we designed was a mechanism that would detect when a fridge was opened and for how long. We would call it the Fridge Opening Detection Apparatus or F.O.D.A. for short.

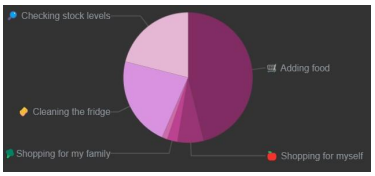
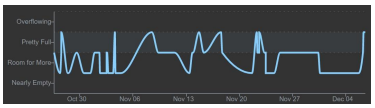
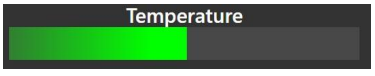
For our second objective, we wanted something that would contextualize all the data that we would collect. We brainstormed how to approach this solution and recalled that the volunteers on Discord would share heartwarming stories with one another about their fridge experiences. With this in mind, we decided that a focus group with the established volunteers on Discord would be the best approach since they have been informed about our project by our sponsor.

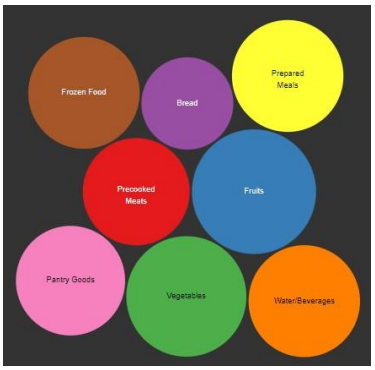
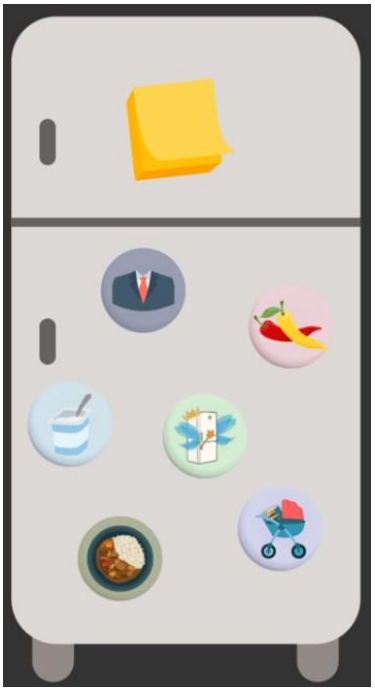
Once we ran through our idea with our sponsor, we created an outline of questions to ask the focus group as outlined in Appendix D. After the focus group, we transcribed them and conducted content analysis on which stories presented during the meeting had the most impact on people’s lives. After we have our stories, we display them in our data visualization website with our data from our data collection tools to help contextualize the numbers and provide meaning on why these numbers are so important.

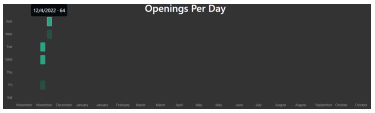
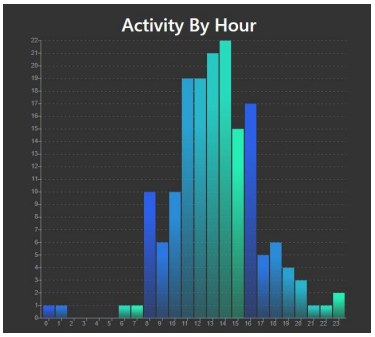
The next step in our plan was to develop user manuals to leave with our sponsor. These user manuals would help troubleshoot any problems that could potentially arise and also provide a step-by-step guide if our sponsor wanted to extend our project. Adequate user manuals are incredibly important as we plan on leaving our project in the hands of our sponsor. We had to consider who and how our user manuals would be used. It is expected that our sponsor would be the main people using our manuals, and to cater to them we had to use simple, non-technical language and provide detailed descriptions of each step as our sponsor does not have a lot of technical background. We observed our sponsor completing the tasks in the user manual. Any questions our sponsor asked during this process, allowed us to refine the user manual to be more specific and detailed. Once our sponsor was satisfied with the user manuals, we were confident they had the capabilities to be able to run our system themselves and potentially train other volunteers as well.

Our last objective was to reach out to other community fridge organizers to see if our project was something that interested them. We looked into the community fridges around the Boston area to see if they have any system in place to track data. We found that most, if not all of the fridges had no data collection system in place.

Our results are shown in the table below,

Data Collected	How it's Collected	How it's Displayed	Example
Submissions per Fridge	Survey	Web Page - Radial Gauge	
Reason for Shopping	Survey	Web Page - Pie Chart	
How Full	Survey	Web Page - Line Graph Web Page - Timeline Discord Embed	
How Clean	Survey	Web Page - Line Graph Web Page - Timeline Discord Embed	
How Cold	Survey	Web Page - Timeline Web Page - Temperature Gauge Discord Embed	

Requested Items	Survey	Web Page - Bubble Chart Web Page - Hive Plot	
Notes	Survey	Discord Embed	**Additional Notes:** Fridge & freezer not cold. Frozen food was defrosted.
Images	Survey	Web Page - Timeline Discord Embed	
Name of Survey Taker	Survey	Discord Embed	**Submitted By:** Anonymous
Testimonials	Focus Group	Web Page - Fridge Art	

Timestamp	Survey, F.O.D.A.	Web Page - Slider Web Page - Timeline Web Page - Bar Chart Web Page - Calendar Heat Map Discord Embed	
Openings per Day	F.O.D.A.	Web Page - Calendar Heat Map	
Duration of Openings	F.O.D.A.	Web Page - F.O.D.A. Blurb	
Activity by Hour	F.O.D.A.	Web Page - Bar Chart	

The Worcester Community Fridges pride themselves on their status as a mutual aid organization. The heart of mutual aid is that rather than one group giving charity to another, everyone involved in the community is both giving and receiving in their own way. When we embarked on our project our goal was to align our deliverables with this mission. As such our tools allow everyone in the community to help collect and view data on fridge usage. Our deliverables are as strong as the community that uses them, we have already experienced overwhelming support from the Worcester Fridges community, and other fridge organizations are already showing interest in collaborating on data collection. Written on the front of community fridges everywhere is the quote:

"Take what you need, leave what you can."

In our seven week trial period, the community has left over 150 manual submissions containing data that will help Worcester Fridges do everything from optimize donation distribution, to prove community impact and secure grant funding.

Acknowledgments

To our sponsors at the Worcester Community fridges Julia Rose and Maria Ravelli thank you for your help along the way, and for giving us the creative freedom to fully explore all aspects of this project. Your academic and personal support was instrumental in completing this project, and your commitment to learning with us has been inspirational.

To the Worcester Community Fridges community as a whole, thank you for accepting our group with enthusiasm. Whether it be showing up to the project center on a saturday evening for a focus group, or submitting our fridge checkup forms, your participation has been the backbone of this project.

To our advisor, Laura Roberts, thank you for all your guidance throughout this semester. We are truly grateful for all the time and effort you put into helping our group. Not only did you help us to deliver as great a project as possible, but you also tried hard to make sure that our experience working on our IQP was pleasant and fun.

Table of Contents

Table of Figures

1.0 INTRODUCTION

In 2021, the United States Department of Agriculture (USDA) calculated that 10.2% of the United States population were food insecure, which is slightly higher than the global average of 9.8% calculated by the UN. These statistics show that one of the largest issues plaguing the world today is hunger and starvation. It is a problem that has been present for many years now, which makes it all the more shocking to find that another large global issue is food waste. According to Feeding America, the US alone wastes 108 billion pounds of food a year. Food insecurity is the state of being without reliable access to a sufficient quantity of affordable, nutritious food. This can stem from many issues like food waste, food availability, and food access to name a few. While food insecurity is an issue all over the world, food insecurity is an issue that can be looked at on a global, national, and local level. For example, Massachusetts has a lower food insecurity rate compared to the national average, but Worcester has a higher food insecurity rate then its neighboring counties throughout Massachusetts. While Government food assistance like SNAP or free school lunch help, the existence of locally driven food aid programs suggests it does not do enough. This can be seen in Worcester Massachusetts, where community fridges have been implemented to help alleviate the high food insecurity rate.

Worcester Community Fridges is a nonprofit organization that organizes a network of community fridges throughout Worcester, Massachusetts. They believe in having daily access to fresh food as it is a human right. Here in Worcester, there are currently four fridges run by the Worcester Community Fridges located throughout the city. Community fridges are located in public spaces where food can be shared within an area. Being a completely community run mutual aid initiative, there are no systems in place to track the utilization of the fridges in terms of food intake and output. Lack of usage data and

Worcester Fridges Mission Statement

"Woo Fridge believes having daily access to fresh food is a human right. In Worcester, 15% of families have identified as living with food insecurity. While navigating the Covid-19 pandemic, these numbers have risen significantly within our city. Community fridges are open 24/7, leaving limited barriers in the way of someone accessing fresh, healthy food of their choosing."

unaddressed ‘fridge myths’ about how they are used plagues these fridges. We are given the opportunity to develop a system that tracks this data to potentially build upon the Worcester Community Fridges project.

One of the key factors in the success of the Worcester Fridges is their community engagement. However due to the self service nature of community fridges, it is difficult to track how active a fridge is in an empirical manner. The goal of this project was to help Woo Fridges implement a sustainable data gathering system which monitors fridge usage in order to measure community impact. We envisioned an easy to use tool for tracking data on how often the fridges are used. We first iteratively developed sustainable and ethical data collection tools, then collected qualitative testimonials to contextualize the data. Once those two are done, we began working on user manuals to educate our sponsor and their volunteers on how our system works. Finally, we networked with other fridge organizations to see if our system would benefit other communities as well.

In the next chapters, we will discuss background information on food insecurity on various levels, including specifics on the Worcester community and how these fridges aid the community. We will then propose a comprehensive methodology for how we developed effective data gathering tools, gathered testimonials, built user manuals, and networked with other fridges. Our results will show what we are leaving behind to our sponsor, and finally we will discuss some recommendations for what to do with our deliverables.

2.0 BACKGROUND

To understand the importance of community food assistance, an understanding of the root causes is essential. There are many issues that affect food security such as food access, food waste, food cost, climate change, and many more. When a person's food security is low, it is referred to as food insecurity. This could be a result of either not being able to get enough nutritious food or even skipping meals. In this chapter we will discuss the growing food insecurity rate in Worcester and how community fridges aim to combat this rise. We will also highlight how community fridges provide greater local hunger relief through mutual assistance.

2.1 Food Insecurity is on the rise in Worcester

Food insecurity remains to be a problem at a local level, with Worcester displaying it at an even more extreme level than the rest of the nation. According to the USDA, the US' food insecurity rates continue to be a problem with the national average of about 10% remaining unchanged from 2020 to 2021 (USDA, 2021). As stated by Feeding America (2018), households being unable to afford sufficient food is directly correlated with unemployment and poverty rates. This stands true with the US poverty rates hovering around 11.6% (US Census, 2021).

The State of Massachusetts on the other hand, has a much lower food insecurity rate in comparison to the rest of the nation. Massachusetts food insecurity hovers around 7% with the poverty rate being 9.4% (Feeding America, 2020; US Census, 2021). While Massachusetts is lower than the national average, Worcester on the other hand is not. The poverty rate of Worcester is at 19.7%, over double the state average with Worcester County's food insecurity rate being at 9.1% (Feeding America, 2020; US Census, 2021). Since food

Risks of Food Insecurity

Gundersen (2015) found that food insecurity is associated with increased risks of:

- Some birth defects
- Anemia
- Lower nutrient intakes
- Cognitive problems
- Aggression and anxiety
- Higher risks of being hospitalized
- Poorer general health
- Asthma
- Behavioral problems
- Depression
- Suicide ideation

insecurity and poverty are correlated, it is safe to assume the Worcester County food insecurity rate does not accurately reflect food insecurity in the City of Worcester where it is likely to be higher.

This is further supported by a recent report created by the Worcester Regional Research Bureau (WRRB). In 2018 Feeding America projected an estimate of 10% increase in food insecurity across most of Worcester for 2020. According to this estimate, all of Worcester would have over 10% food insecurity rate with some areas even reaching over 30% (WRRB, 2022). This estimate does not factor in the unforeseen COVID-19 pandemic which could have potentially increased these percentages.

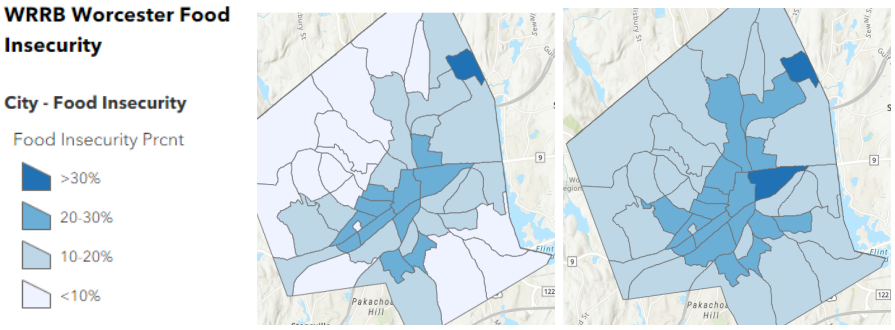


Figure 2 2018 vs 2020 (Estimate) Food Insecurity Percent in Worcester (WRRB Worcester Food)

According to Project Bread, the percentage of food insecure households in Massachusetts took a drastic increase at the start of the pandemic from 9.2% to 19.6%. As of September 2022, that percentage remains double of what it was pre-pandemic at 16.6% with no signs of improvement (Project Bread, 2022). This may be due to inflation driving up the cost of food. Inflation has hit a 40-year high, leading to a 12% increase in groceries since May of 2021 (Szaniszlo, 2022). An escalating inflation rate alongside salaries not being able to keep up with the cost of living, there is no surprise that the food insecurity rate sees no signs of improvement (Szaniszlo, 2022).

Figure 1.1
Poverty Rate of Worcester vs. Massachusetts

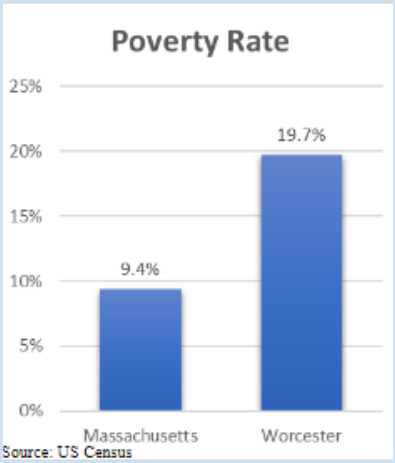
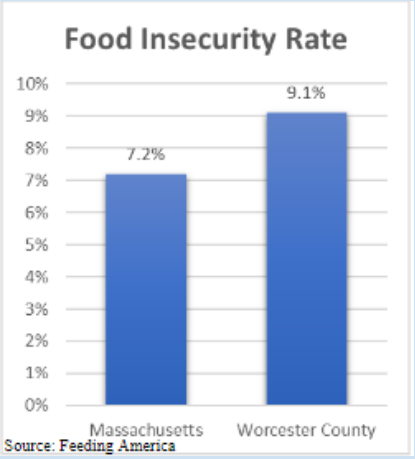


Figure 1.2
Food Insecurity Rate of Worcester County vs. Massachusetts



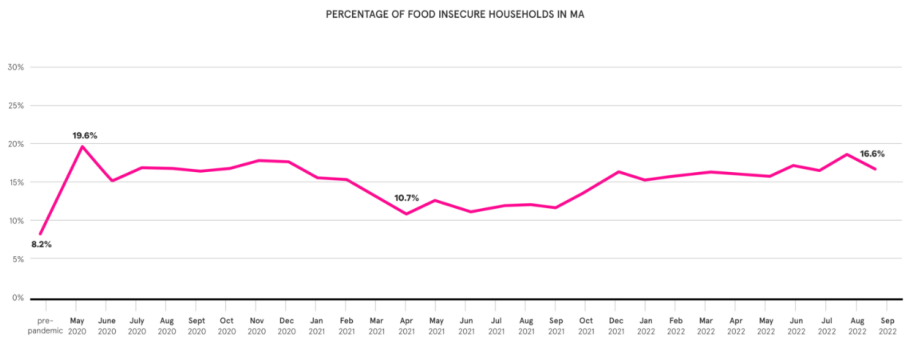


Figure 3 Percentage of Food Insecure Households Post-Pandemic in Massachusetts

2.2 Worcester Community Fridges

This is where community fridges step in to help close the gap in food assistance. Community fridges require no application, no documentation, are open twenty four hours a day, seven days a week, and are run by the community around the fridge. While studying the social dynamics at play in community driven service initiatives, Esther Carmen (2021) noted that one of the primary benefits of community led action is social relationship building. This is exactly what the organization Worcester Fridges set out to fix in 2021. In the midst of the COVID 19 pandemic, Worcester Fridges opened its first community fridge, a public refrigerator which anyone in the community is free to use, either donating extra food to prevent waste, or taking food to alleviate food insecurity. Unlike government programs which have no direct contact with the community, Worcester Fridges is a grassroots organization which sees itself as more of a mutual aid program than charity, relying on active participation from many different parts of the Worcester community.

Worcester Fridges takes a predominantly hands off approach to mitigating food insecurity. The general concept behind community fridges is to provide a physical spot and the necessary infrastructure (refrigerator, weather proofing, etc.) in a location that is both proximate to food insecure individuals, as well as to businesses that may

frequently have surplus food. Rather than wasting surplus food, businesses, individuals, or organizations can instead donate to the community fridge, and anyone from the community is free to take what they need from the fridges with none of the overhead that may be involved in other assistance programs such as paperwork or an application process. This lack of overhead is a key differentiator between community fridges and other government assistance programs. Comprehensive interviews have shown that programs such as SNAP and WIC have "learning costs" associated, that provide a barrier for entry even though the programs are free financially (Barnes 2022). Worcester Fridges currently has four community fridges, one of which is pictured in Fig. 4. As a result the primary role of the Worcester Fridges organization is the coordination of volunteers for maintaining and cleaning the fridges, as well as delivering any food that other institutions wish to donate.

Because of this hands off approach, one of the most important factors for the success of the community fridges is community opinion. In their study of a community fridge in Scotland Carmen (2021) found that organization of this type is prone to stigma. Specifically Carmen's (2021) study found that business owners initially viewed the project with apprehension due to preconceived notions of the type of people who would use the fridge's assistance as "undesirable". This type of stigma is incredibly detrimental to grassroots organizations which rely on their social credit to drive engagement. In the case of a community fridge, stigmatization of its users, or as Worcester Fridges describes it: "Fridge Myths", dissuades people in need from seeking assistance and dissuades businesses and donors from contributing. It is for this reason that all the methodology of the Worcester Fridges, and by extension us, must be constructed with maintaining good community relations at the forefront.

Figure 4
Main Street Fridge

Common Fridge Myths

Myth: One person regularly takes all the food in the fridge for themselves.
Fact: Shoppers tend to take what they need, someone may be gathering food for many different people.

Myth: Only the homeless can take food from the fridges.
Fact: The fridges exist for everyone in the community who may be hungry.

Myth: The fridges are a form of charity with division between volunteers and shoppers
Fact: The fridges are a mutual aid program, many people both shop and donate to the fridges.

As this is a community run initiative, to maintain good community relations, we had to construct an ethical plan that would allow us to collect data on these community fridges. This data collection would assist the Worcester Community Fridges in reinforcing their methodologies and potentially secure grant funding.

3.0 METHODOLOGY

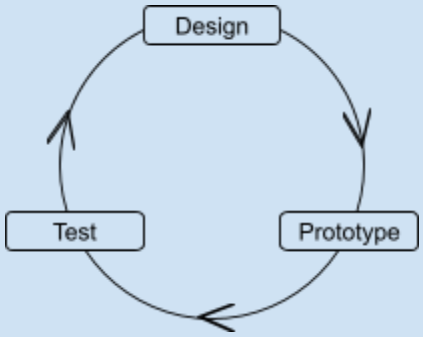
The overall goal of this project was to help Worcester Community Fridges implement a sustainable data gathering system which would monitor fridge usage in order to measure community impact. As such, we made the primary deliverable a data collection tool that the Worcester Fridges organization could use to monitor the usage of multiple community fridges. The primary objectives to help us accomplish this goal were:

- Iteratively develop sustainable and ethical data collection tools
- Get qualitative testimonials to contextualize our quantitative data
- Develop user guides to train volunteers
- Network with other fridge organizers

3.1 Objective 1: Iteratively develop sustainable and ethical data collection tools

The first objective was to develop sustainable and ethical data collection tools alongside a data visualization portal that would effectively display the outputs. Our sponsor informed us that they wanted some type of survey for data collection. Using this information, we developed a pilot survey on Google Forms. We modeled the questions seen in Appendix B based on a similar approach used by the LA Community Fridges organization. We added an option to submit an image of the fridge with the survey to show more accurate data on the content of the fridge as well as how clean the fridge was. We made all the questions on the survey optional to keep privacy protected and to avoid people not wanting to fill out the full survey or avoid submitting it all together.

Iterative Design



Iterative Design is a design methodology that uses a cyclic process of **designing, prototyping, and then testing** in order to improve a deliverable. The information gained from each testing cycle is used to inform the designing stage of the next cycle.

During our initial tests, we found that when using Google Forms for image submissions, the user would have to sign into their google account. We thought that this would be restrictive in certain cases. For example, if the survey taker did not have a google account, did not want to use their account for privacy reasons, or were discouraged from filling out the survey because they did not want to sign in. After we met and considered other options, we decided to use Airtable for our survey base. Airtable required no sign in and also could export answers to Google Sheets which made it ideal for our survey base. The primary issue with Airtable was that it would require a paid subscription to store over 1000 entries. We found that by deleting the row from Airtable after submission, we would never go over the 1000 submission limit. After we compiled the survey on Airtable, we met with our sponsor to discuss a way to notify them when there was a submission. Our sponsor told us that their primary method of communication with other volunteers was through Discord.

We then proposed a Discord bot that would display the survey results in each fridge's respective channel. We found that using Pipedream, a free integration software, allowed us to connect multiple APIs together to create an automated cross-platform workflow. With the backend of how our survey data gets processed, we then worked with our sponsor to determine the formatting of our Discord bot's displays. It was concluded that not every detail in the survey needs to be announced as the Discord is mainly a communication tool for volunteers.

An additional data gathering tool we designed was an apparatus that would detect when a fridge door was opened. It would record when the fridge was opened and for how long it was open. We brainstormed what equipment would be best for our needs, the environment our device would be housed in, as well as maintaining fridge user's privacy. We decided on using an Arduino Nano

Discord is a chat application used to organize large groups of people. Groups can create a **Server** with different text and voice **channels**.

The **Worcester Fridges** discord has a dedicated text channel for each fridge.

A **Discord Bot** is an automated user that allows for messages to be sent from code rather than manually by a person.

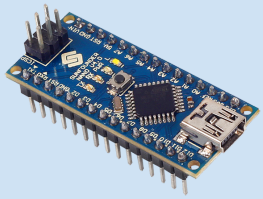
API

Application Programming Interfaces are how different programs communicate with each other. In the case of our project many sites we use, such as Google Sheets, Airtable, and Imgur provide APIs that we call over the internet programmatically in order to automate tasks

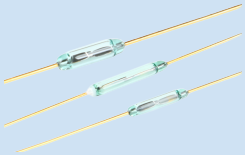
microcontroller which had all the control options we wanted and was very compact. For sensors, we decided that a magnetic reed switch would be most optimal for detecting when a fridge was open or closed while maintaining the user's privacy, and a low profile due to its silent activation. Lastly, we determined that an output in the form of a CSV file stored on a micro SD card would be easy to use and maintain.

We wanted to create a data visualization tool in addition to the discord embed. We started to look at different software to evaluate their strengths and weaknesses. We decided to make our own data portal in the form of a web page using React and the Reaviz data visualization package. We started from scratch and began by importing the data from our surveys to the portal. We tried different graphs and charts to best convey our data in a visually appealing format and met with our sponsor to go over what types of data visualization they wanted on the web page.

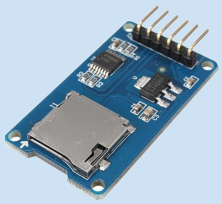
Hardware



Arduino Nano: A very small microprocessor that can run C++ code



Magnetic Reed Switch: Small switches that silently detect the presence of magnets nearby



SD Card Writer: A chip that connects to microprocessors and allows them to read and write information to micro SD Cards.

	Looker Studio	Tableau	Code From Scratch
Customizable	✔	✗	✔
Fast	✗	✔	✔
Good Looking	✔	✗	✔
Sheets Integration	✔	✔	✔

Figure 5 Rubric of data portal options

Data Portal Criteria

Customizability: Support for coding custom visualizations from the ground up *easily*

Fast: Good performance while working with large datasets

Good Looking: Graphs and general layout are easy to make visually appealing

Sheets Integration: Easily pull data from our Google Sheets database

3.2 Objective 2: Get qualitative testimonials to contextualize our quantitative data

For our second objective, we wanted something that would contextualize all the data that we would collect. We were brainstorming on how we should approach this solution and recalled that the volunteers on Discord would share heartwarming stories with one another about their fridge experiences. With this in mind, we decided that a focus group with the established volunteers on Discord would be the best approach since our project has been advertised the most on there out of all their social medias.

Once we ran through our idea with our sponsor, we created an outline of questions to ask the focus group as outlined in Appendix D. These questions were crafted as a team after consideration of what we thought would provide the best stories for our contextualization. With the questions made, we also had to create a poster to advertise our focus group meeting as shown in Appendix C.

After the focus group, we transcribed them and conducted

content analysis on which stories presented during the meeting had the most impact on people's lives. After we have our stories, we display them in our data visualization website with our data from our data collection tools to help contextualize the numbers and provide meaning on why these numbers are so important.

3.3 Objective 3: Develop user manuals to train volunteers

The next step in our plan was to develop user manuals to leave with our sponsor. These user manuals would help troubleshoot any problems that could potentially arise and also provide a step-by-step guide if our sponsor wanted to extend our project.

Adequate user manuals are incredibly important as we plan on leaving our project in the hands of our sponsor. We had to consider who and how our user manuals would be used. It is expected that our sponsor would be the main people using our manuals, and to cater to them we had to provide a minimal amount of leeway as our sponsor does not have a lot of technical background. Since the Worcester Community Fridges plan on opening more fridges, our user manual had to provide the necessary steps to creating our data collection tools from scratch.

We then tested our user manuals with our sponsor to make sure they understand how our data collection tools are created. Watching over our sponsor test the user manuals allowed us to answer any questions that arose and made sure that our sponsor had sufficient understanding of our process. Once our sponsor was satisfied with the user manuals, we were confident they had the capabilities to be able to run our system themselves and potentially train other volunteers as well.

3.4 Objective 4: Network with other fridge organizers

Our last objective was to reach out to other community fridge organizers to see if our project was something that interested them. We looked into the community fridges around the Boston area to see if they have any system in place to track data. We found that most, if not all of the fridges had no data collection system in place. We then created a list of 7 community fridges in the Boston area that are currently active and are easily reachable via Instagram. We sent this list out to Julia Karpicz, Co-Organizer of the Worcester Community Fridges, to get her to set up the initial contact with these organizations with the official Woo Fridges Instagram account.

As community fridges are mainly run by the community, we concluded that sharing our project with the community would yield the best outcome. Our user manuals were shared with the other fridge organizations that were interested in hopes that they would start to share the data collected with all the other organizers.

4.0 Results

For this project, we developed five deliverables consisting of two data collection tools, a database, and two data visualization tools. One data collection tool was a collection of surveys developed in Airtable. The second data collection tool was the Fridge Opening Detection Apparatus or F.O.D.A. for short. The database was a google sheet that hosted all of the survey results. One of the data visualization tools was a discord bot, and the other was a web page that displayed the data from our surveys.

4.1 Data Collection Tools

4.1.1 Airtable Survey

A survey was made for each individual fridge and all the surveys asked the same questions. This was so that data could be collected for each individual fridge but still have consistent responses. We made QR codes for each survey and attached them to the corresponding fridge so that the surveys were accessible to every person who uses the fridges at any time.

Figure 6
Survey QR Code

Alongside our data collection tool, we also provided a user manual on how to develop, operate, and maintain the tool for any potential future community fridge organizations.

The amount of data we received was more than what we had estimated for our project duration. We expected that our total form submissions would fall within the 100 submissions that Airtable allows its users without buying a subscription. We surpassed our expectations which forced us to meet with our sponsor and discuss purchasing a membership to Airtable. The membership would allow room for future growth and retention of data. Our data found that certain fridges had

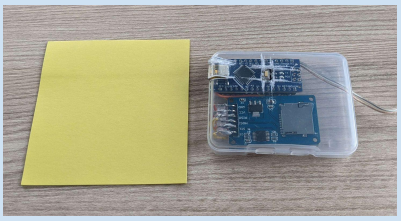
more foot traffic than others. Portland had the most foot traffic and because of that, it had the most submissions. We predicted that the majority of submissions would be made by people donating food and cleaning the fridge. According to the data we gathered this prediction held true as the majority of submissions were submitted by donors and volunteers who clean the fridges.

4.1.2 Fridge Opening Detection Apparatus

In addition to the survey, we developed another data collection tool that we call the Fridge Opening Detection Apparatus or F.O.D.A. for short. This device uses a magnetic reed switch to constantly poll whether the door is open or closed. After debouncing this reading the device logs the time since the board was powered on, as well as the duration of each door opening as a row in a file on a micro SD card.

Operators simply download the data from the SD card, and log what time they reset the device. This data can then be put into our F.O.D.A data entry portal, which will automatically calculate the real world time of each door opening and upload all the information to our database for future use.

Figure 7
Fridge Opening Detection Apparatus



Debouncing

Debouncing is the act of removing sporadic data caused by mechanical switches making a series of short electrical contacts before settling in their new state. We do this by looking for consistently occurring repetitions of a given switch state rather than just one

4.2 Database

For our database we settled with Google Sheets. In our Google Sheets we have different tabs pertaining to each individual fridge and their data, with our user manuals explaining the process and formatting. The sheet was formatted in a way for our sponsor to easily read and decipher the data in a quick and easy manner, with the headers of each column being the questions from the surveys.

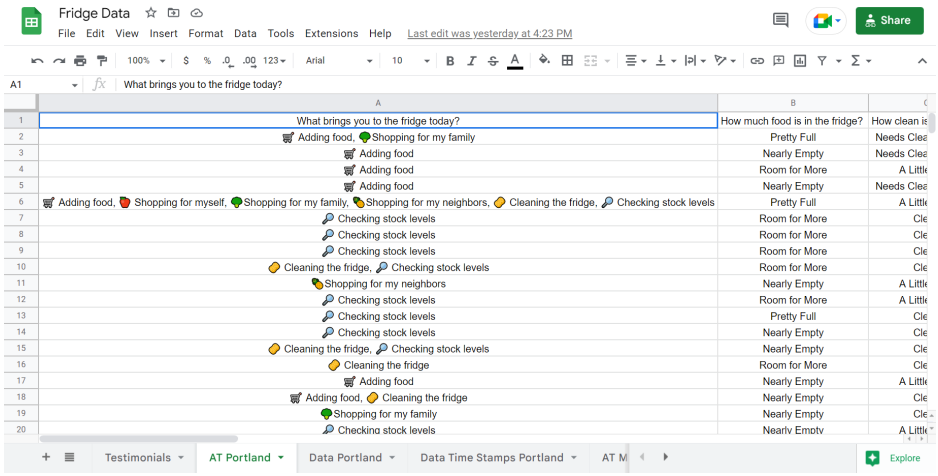


Figure 8 Google Sheets database

Being a popular web service and being formatted into rows and columns, it allowed for easy integration into our data gathering system. We were able to import all our data into the database and easily export that information into our other tools such as our Discord Bot and data portal due to Google Sheets' easy to use API.

Importing the data from our Airtable surveys was very simple. Airtable has a built in system that allows automatic exporting to Google Sheets. With that data now in Google Sheets, our Pipedream software would then automatically run and go through the necessary steps in updating that data and exporting it into Discord.

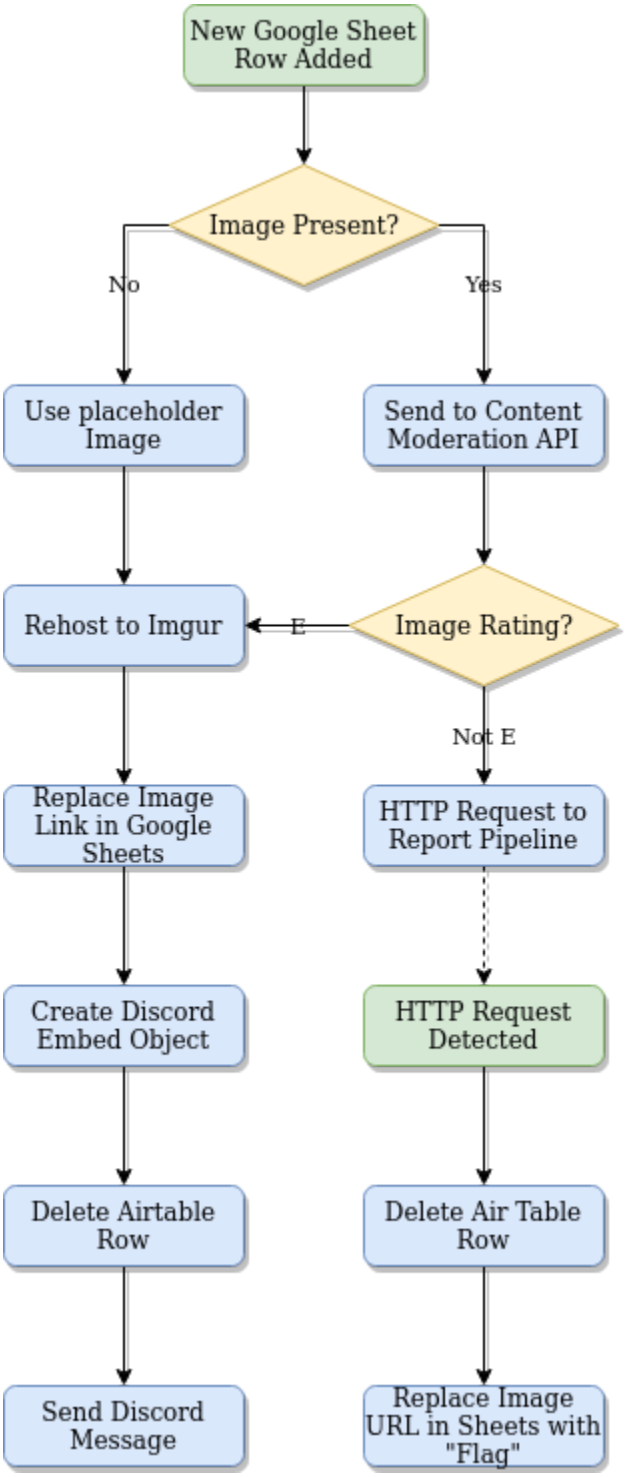


Figure 9 Flowchart of our Pipedream setup

4.3 Data Visualization Tools

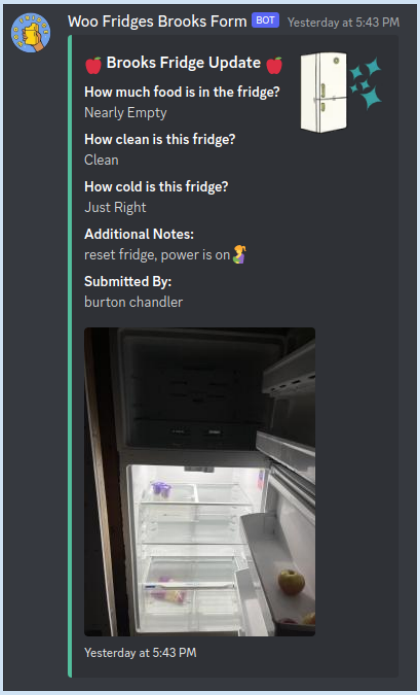
4.3.1 Discord Bot

Our Discord bot data visualization tool was used to notify volunteers on the status of the fridges with the most pertinent information from the survey. Volunteers would be informed about the fridge's stock level, cleanliness, temperature, and any notes left by the survey taker. In addition to the data on the status of the fridge, an image is displayed for more clarity. If an image was not submitted with the survey, then a generic stock image is displayed. In the top right of the discord embed there is a small image of a fridge that shows if the fridge is clean or dirty based on the survey results. Volunteers used this to quickly and efficiently see if a fridge needed cleaning.

Upon the initial release of the survey, we did not receive many submissions. We found that volunteers were open to using the survey to submit a checkup on the fridge, but they were used to submitting through Discord themselves. We, as well as our sponsor, sent some messages in Discord promoting the survey. This led to a noticeable increase in the survey submissions we received.

Our data showed most submissions were from volunteers, so in the future we hope with some more exposure and more promotion, shoppers will submit more surveys as well.

Figure 10
Discord Embed



4.3.2 Data Portal Web Page

Spanning the top of the web page is a slider that configures the date range of all of the data displays on every page seen in Fig. 11.1. The slider also displays each form submission color coded by fridge, in order to help the user choose useful date ranges.

Figure 11.1 Web page date slider

The overview tab of the web page is where our general data points will be presented alongside our qualitative testimonials. Here we contextualize our data with the fridge art that contains testimonials from our focus group as seen in Fig. 11.2. The magnets on the fridge represent a story from the volunteer's time with the Worcester Community Fridges. If a viewer puts their mouse on a magnet, the corresponding story will be displayed to read. The sticky note magnet will hold additional stories that can be cycled through by clicking on the magnet. With this art in the overview page we hope that it gives some context on why these fridges are so important to the community before viewing the data points.

Figure 11.2 Testimonial visualizer

We then compare the amount of submissions each fridge obtains in the form of a radial gauge as seen in Fig. 11.3. This allows an easy view on which fridge obtains the most survey submission, and in the figure below, we can see that Portland currently obtains the most.

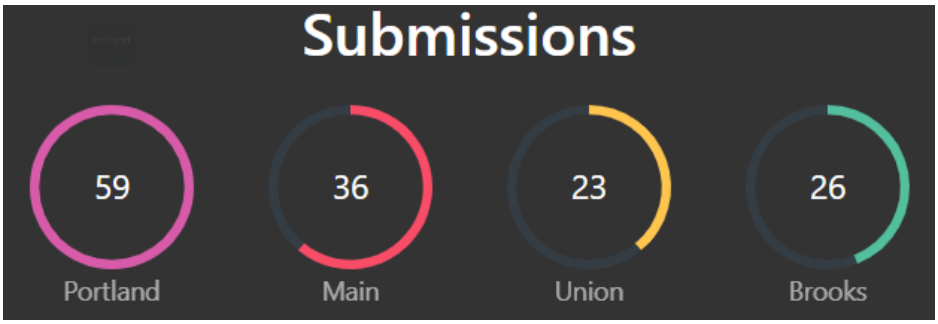


Figure 11.3 Submission count gauges

The final visualization on the Overview tab is a hive plot as seen in Fig. 11.4. This plot provides quick information on which fridges are requesting certain foods. Any dip in the plot means a lack of interest in that food group.

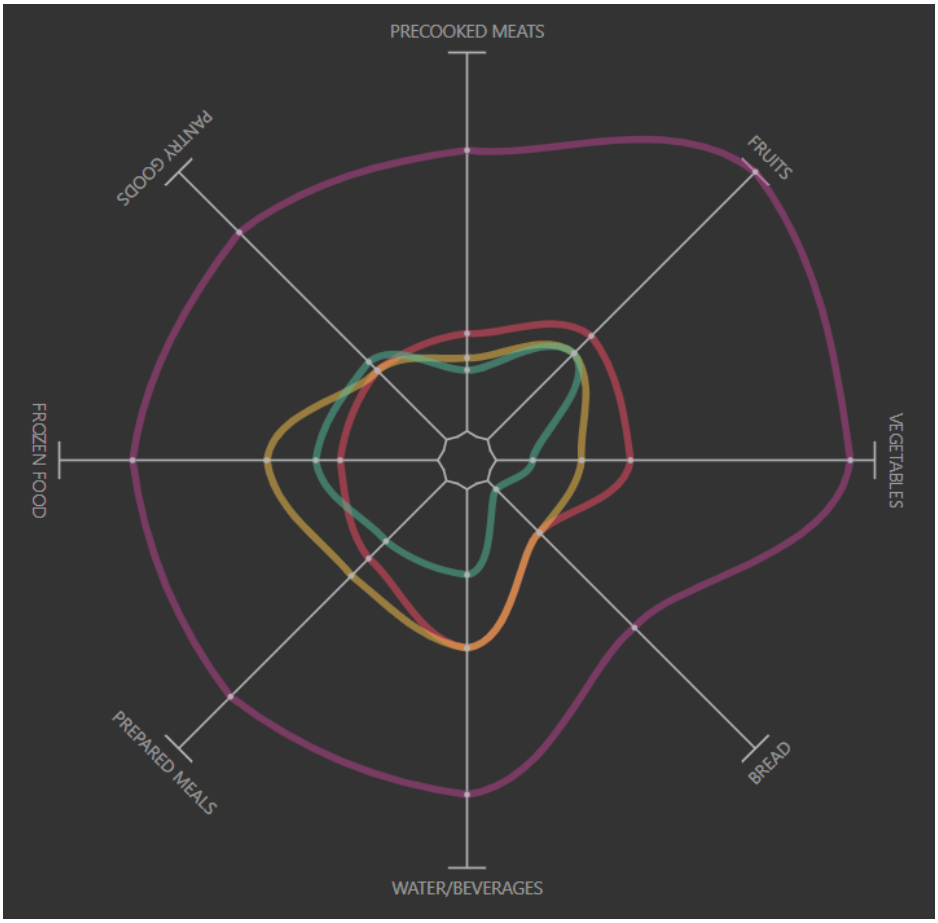


Figure 11.4 Food request hive plot

There were four fridges active during our time with the Worcester Community Fridges. On our web page, we made a tab with data for each fridge. All the tabs follow the same design format but were colored differently. At the top of each fridge's individual tab, there is a brief summary of the history of that fridge and an image of the fridge accompanying it. This was done to give some character to each of the fridge's tabs as well as inform viewers on the history of the Worcester Community Fridges. An example of this can be seen below in Fig. 11.5.

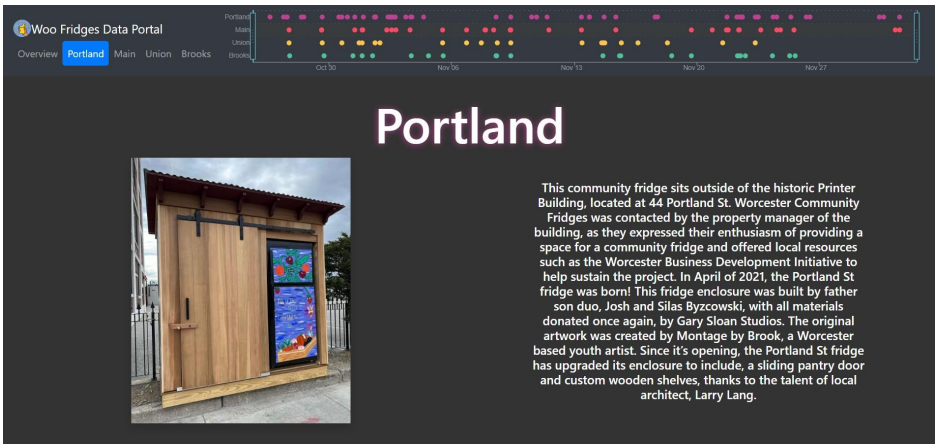


Figure 11.5 Top of Portland fridge tab

The first graph on each tab is a timeline shown in Fig. 11.6 with many interesting features. This timeline takes data from the surveys and creates a dot for each submission. The X-axis represents time. The Y-axis represents the cleanliness of the fridge. The size of the dot corresponds to the stock level of the fridge. The more full the fridge was when recorded, the larger the dot. Finally hovering the mouse over any data point shows a tooltip with the corresponding image submission. This figure allows a lot of data to be conveyed at once and primarily serves as a way to generally keep track of how each fridge is doing.

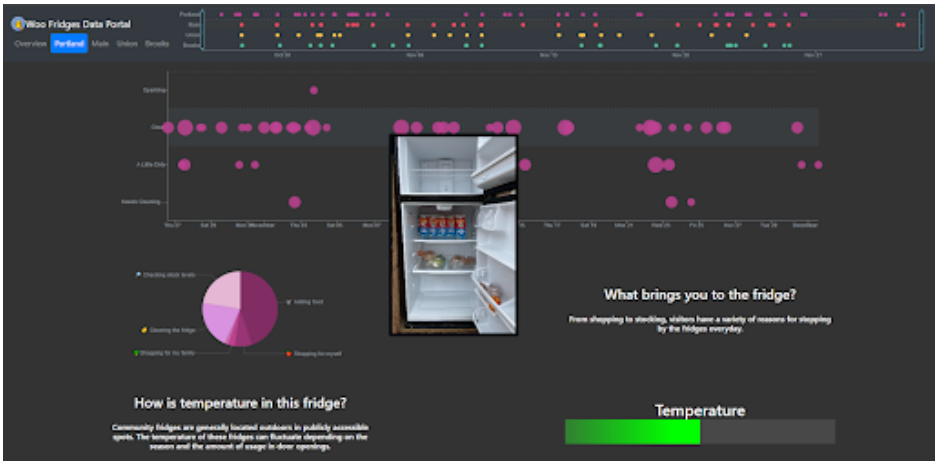


Figure 11.6 Timeline graph with tooltip

The next graph on each tab is a pie chart. The pie chart contains the data from the survey question "What brings you to the fridge today?". This information is particularly useful in contextualizing the rest of the graphs. For example if the data is predominantly submitted by people who are shopping, data regarding what food is needed in the fridges may hold more weight. An example of this chart can be seen below in Fig. 11.7.

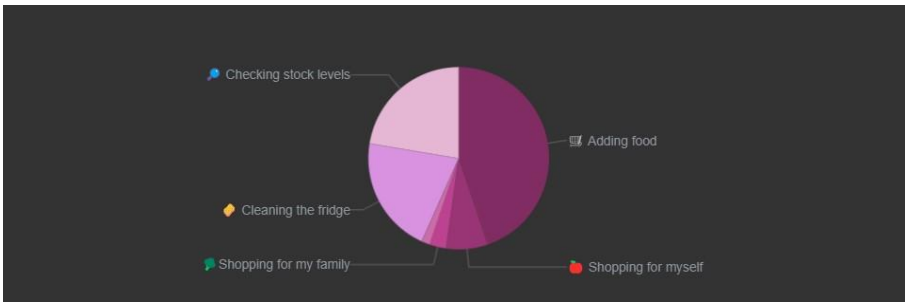


Figure 11.7 Submission purpose pie chart

After the pie chart, there is a temperature gauge. This gauge shows a general temperature of the fridge from the responses gathered from the survey. The responses to the survey question were given a numeric value and averaged to obtain a bar that shows the general temperature of the fridge. Our survey questions asif the fridge is “too cold”, “too hot”, or “just right”. The gauge will increase or decrease corresponding to the survey results. When the average gets a lot of high readings, the gauge will become red. Additionally, the bar will turn blue if there are too many low readings. This allows volunteers to see when a fridge is having temperature issues and respond quickly to fix and potential issues the fridge may have. An example of this gauge can be seen below in Fig. 11.8.

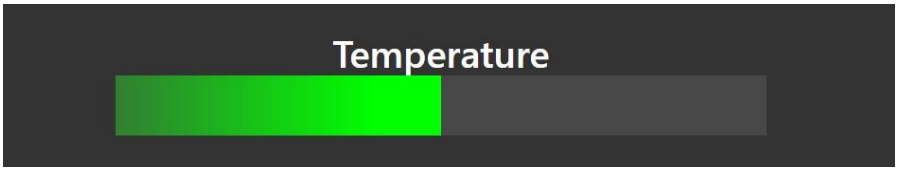


Figure 11.8 Temperature gauge

Two stacked line graphs show the cleanliness and stock level of the fridge over time. Unlike the aforementioned timeline, Fig. 11.9 presents the data as continuous lines, allowing for intuitive recognition of time based trends in the data, such as cycles or oscillating behavior.

Figure 11.9 Transient cleanliness and stock graphs

The last chart on each of the fridge tabs is a bubble chart. The bubble chart shows what food people would like

to see more of in the fridges based on the survey results. The size of the bubble corresponds to how many times that food was requested. This chart shows viewers what foods are more requested at each fridge. This data also helps volunteers know how they should distribute donations and what they should get when they shop for the fridges. An example of this chart can be seen below in Fig. 11.10.

Figure 11.10 Requested food bubble graph

While all the different fridge tabs have the graphs and charts shown above, the Union tab has additional charts and graphs due to the deployment of the F.O.D.A. on the fridge. The first graph shown in Fig. 11.11 shows the activity by hour of the fridge opening. From the information gathered, we saw that the fridge is virtually inactive from 2:00 am to 5:00 am, and peak hours are from 11:00 am to 2:00 pm.

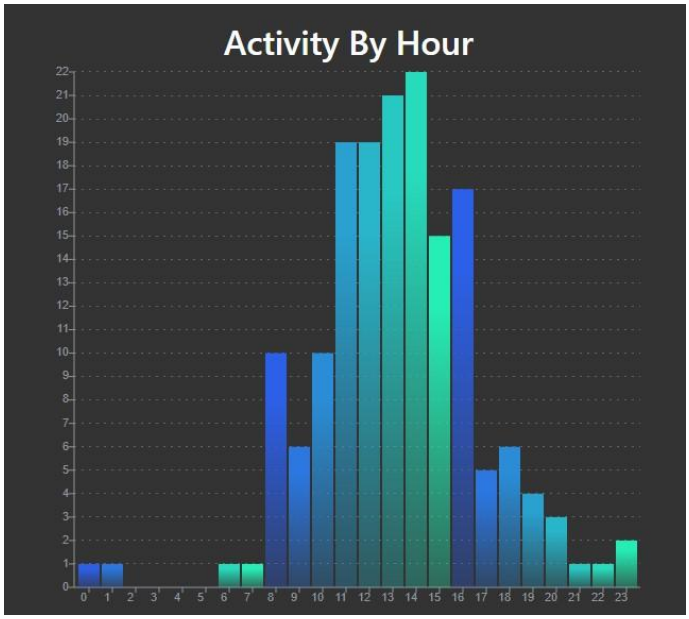


Figure 11.11 Door opening activity by hour

In addition to the graph for activity by hour, we have another chart, shown below in Fig. 11.12, that shows the

number of openings for any given day. The more openings recorded, the brighter the color on that day. The chart is configured like a calendar and says the number of openings when a viewer puts their cursor on one of the days.

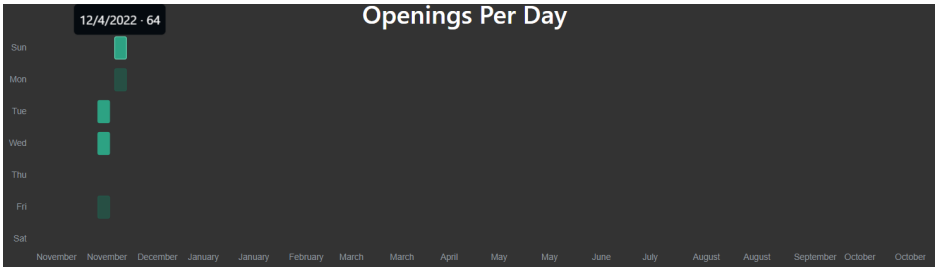


Figure 11.12 Door opening count by day

Fig. 11.11 and Fig. 11.12 helps viewers see which days get the most traffic as well as what the busiest hours are. Our sponsor can use this data in combination with the rest of the data from the web page to correlate spikes in activity with donations or certain events.

5.0 Recommendations and Conclusion

During our time working with the Worcester Community Fridge organization, we were able to design and create a system for them to use after we are gone. Our recommendations will mainly pertain to analyzing the data that will be collected throughout the time our system remains in their hands.

Recommendation	**Reasoning**
Monitor Data Portal for requested foods	The Data Portal serves as a direct line of communication between members of the Woo Fridges community. Regularly checking what fridges are requesting which food items will help optimize the effect of donations.
Share data with other community fridges	In the spirit of mutual aid, open sourcing tools and sharing data with other community fridge groups is a great way to gather multiples times as much data while also building relationships with other community fridges.
Promote use of fridge survey on social media	The effectiveness of these tools depends on frequent survey submissions. Promoting the survey and corresponding data portal on social media is a great way to get the community more engaged in this data collection process.
Empower shoppers to use fridge survey	A diversity of voices is essential for well rounded data. Many community members, especially frequent shoppers may not frequently check social media, explaining the survey in person is a great way to help these community members' voices be heard.
Cross reference FODA data with major events	One of the main benefits of the FODA is that it can be used to reliably see changes in the communities engagement with the fridges. This is useful feedback, for example a spike in usage after an Instagram post would indicate that Instagram is an effective way to reach community members.
Host more events focused on community building	Our focus group revealed that one of the biggest strengths of the fridges is the strong community they cultivate. Continuing to foster this community will help the organization build stronger bonds with the community as well as keep members actively engaged.

The Worcester Community Fridges pride themselves on their status as a mutual aid organization. The heart of

mutual aid is that rather than one group giving charity to another, everyone involved in the community is both giving and receiving in their own way. When we embarked on our project our goal was to align our deliverables with this mission. As such our tools allow everyone in the community to help collect and view data on fridge usage. Our deliverables are as strong as the community that uses them, we have already experienced overwhelming support from the Worcester Fridges community, and other fridge organizations are already showing interest in collaborating on data collection. Written on the front of community fridges everywhere is the quote:

"Take what you need, leave what you can."

In our seven week trial period, the community has left over 150 manual submissions containing data that will help Worcester Fridges do everything from optimize donation distribution, to prove community impact and secure grant funding.

References

Abouzahra, R., & Pianka, R. (2010). Hunger Relief Software: An Information Management Solution for Food Pantries. Worcester: Worcester Polytechnic Institute.

Barnes, & Riel, V. (2022). “I don’t know nothing about that:” How “learning costs” undermine COVID-related efforts to make SNAP and WIC more accessible. Administration & Society, 9539972110739–. https://doi.org/10.1177/00953997211073948

Carmen, Fazey, I., Caniglia, G., Anthony, J., & Penny, L. (2021). The social dynamics in establishing complex community climate change initiatives: the case of a community fridge in Scotland. Sustainability Science, 17(1), 259–273. https://doi.org/10.1007/s11625-021-01075-x

Feeding America. (2018). Food insecurity and poverty in the US - feeding america - hunger and health. https://hungerandhealth.feedingamerica.org/wp-content/uploads/2018/10/Food-Insecurity-Poverty-Brief_2018.pdf

Feeding America. (2020). Map the meal gap. Overall (all ages) Hunger & Poverty in the United States. https://map.feedingamerica.org/county/2020/overall/

Feeding America. (n.d.). Hunger in America. Feeding America. Retrieved September 12, 2022, from https://www.feedingamerica.org/hunger-in-america

Greater Worcester Community Foundation. (2022). Worcester County Food Bank Fund to End Hunger. Greater Worcester Community Foundation. https://www.greaterworcester.org/Grants/Grant-Opportunities/Worcester-County-Food-Bank-Fund-to-End-Hunger

Gundersen, C., & Ziliak, J. P. (2015). Food Insecurity And Health Outcomes. Health Affairs, 34(11). https://doi.org/10.1377/hlthaff.2015.0645

Hunger & Food Insecurity in Massachusetts: Project bread. Hunger & Food Insecurity in Massachusetts | Project Bread. (n.d.). Retrieved November 2022, from https://www.projectbread.org/hunger-by-the-numbers

Szaniszlo, M. (2022, August 3). Nearly 2 million Massachusetts residents have skipped meals due to inflation. Boston Herald. Retrieved from https://www.bostonherald.com/2022/08/02/nearly-2-million-massachusetts-residents-have-skipped-meals-due-to-inflation/

Telegram & Gazette. (2016, September 23). Gr. Worcester Foundation Awards $60K for hunger relief. The Worcester Telegram & Gazette. https://www.telegram.com/story/news/local/worcester/2016/10/02/gr-worcester-foundation-awards-60k-for-hunger-relief/25278641007/

The Research Bureau. (2022, November 15). Is Worcester County Food Insecure? it depends on where. Worcester Regional Research Bureau. Retrieved from https://www.wrrb.org/reports/2022/11/is-worcester-county-food-insecure/

United States Department of Agriculture. (2002, July). Community Food Security Assessment Toolkit. https://www.ers.usda.gov/webdocs/publications/43164/15824_efan02013_1_.pdf?v=4360.7

United States Department of Agriculture. (2021). Snap eligibility. Food and Nutrition Service U.S. Department of Agriculture. https://www.fns.usda.gov/snap/recipient/eligibility

United States Department of Agriculture. (2021). The prevalence of food insecurity in 2020 is unchanged from 2019. USDA ERS - Chart Detail. https://www.ers.usda.gov/data-products/chart-gallery/gallery/chart-detail/?chartId=58378

United States Department of Agriculture. (2022). Applicant/recipient. Food and Nutrition Service U.S. Department of Agriculture. https://www.fns.usda.gov/wic/applicant-recipient

USAGov. (2022, June). Food assistance. USAGov. https://www.usa.gov/food-help

U.S Census Bureau. (2021). U.S. Census Bureau quickfacts: United States. https://www.census.gov/quickfacts/US

Worcester County Food Bank. (2020, March 3). About. Worcester County Food Bank. https://foodbank.org/about/

Appendices

Appendix A: Oral Consent Form

We are the Woo Fridges team from Worcester Polytechnic Institute in Massachusetts. We are conducting a focus group of community fridge volunteers in Worcester to collect information about how these fridges made an impact in people's lives. This research will be used to gather testimonials to provide context to our quantitative data.

*Your participation in this study is completely voluntary and you may withdraw at any time. Please remember that your answer*s can *remain anonymous if requested. No names or identifying details will appear on the questionnaires or in any of the project reports or publications if requested.*

This is a collaborative project between the Worcester Community Fridges and Worcester Polytechnic Institute, and your participation is greatly appreciated. If interested, a copy of our results will be provided via email.

If you have any questions regarding our research, you can contact our team at gr-worcesterfridges-a22@wpi.edu. If you have any questions regarding your rights as a research subject, please contact Worcester Polytechnic Institute's Institutional Review Board ar irb@wpi.edu

Thank you for your help!

Appendix B: Survey Questions

- What brings you to the fridge today?
- How much food is in the fridge?
- How clean is this fridge?
- How cold is this fridge?
- Which items would you like to see in the fridge more?
- Any additional comments you would like to share with us?
- 📷 Share a photo of the inside of the fridge and/or pantry.
- Name

Appendix C: Focus Group Invitation

Appendix D: Focus Group Questions

- How have the fridges impacted you and the people around you?
- What led you to begin donating to the fridges?
- What is your favorite fridge story?
    - It can be funny, happy, meaningful
- How would you describe your experience with the fridges?
- How would you describe the interactions you have with users of the fridges?
    - Donors
    - Fellow volunteers
    - Shoppers
- Do you feel that your help makes a positive difference in people's lives?
- What is your favorite part of working with the Worcester Community Fridges group?
- If you could change one thing about the fridge system what would that be?
    - For example:
        - Better website
        - More group volunteering
        - Add another fridge
        - Expand social media presentations
        - Reach out to more organizations

Appendix E: Focus Group Testimonials

(26:50) - Pat's 3 peppers story

"*Do you want potatoes? [They shook their heads, no] They didn't speak english… 3 peppers, I held them up and their faces just lit up. Peppers! And you would have thought I was giving them gold… I haven't forgotten the expressions on their faces*"

(32:40) - Julia chaotic beautiful bean stroller/car radio

"*Finding something random like a stroller with beans in it. What makes the fridges wonderful, they are participatory. They are whatever the community makes of them, wants them to be, use them to be.*"

(45:35) - Noah, fridge shaped them to be who they are

"*Not to sound dramatic but i feel like my experience with the fridges and the people at the fridges kind of shaped me to be the person I am today*"

(44:45) - Andrew yogurt story

"*Picked up a donation from Saint Johns that was mostly yogurt. Brought it to Portland. There was a guy there shopping that really liked yogurt. He was very grateful.*"

(37:00) - Pat home cooked meal suicide story

"*A person came up to the fridge and said 'You know I was home the other day and I had nothing at my house to eat. I was thinking about ending it all. As I was walking around, I saw the fridge on the street. The church was moving around home cooked meals. There were individual service items in there [the fridge]. It was like someone made this really nice comfort food. I felt taken care of. Like someone cared.' Can't tell that story without feeling all emotional*"

(59:05) - Pat rich couple story taking from fridge

"*This couple in really nice clothes and driving a really nice car shopped at the fridge. I was wondering what they are doing here. Anything could have happened to them. They can look like they got it all together but. You can't tell. You couldn't tell. You know you can make general assumptions. But you really can't tell.*"

Appendix F: Arduino Nano Code

```
#include <SPI.h>
#include <SD.h>
File data;
const int chipSelect = 10;
const int reedPin = 2;
const int debMax = 20;
const int deltaMax = 3;

//long fallingDeb;
//long risingDeb;
long startTime;
bool reading= false;
bool last;
int opCount;
int clCount;

void setup()
{
  pinMode(reedPin, INPUT_PULLUP);
  //attachInterrupt(digitalPinToInterrupt(reedPin), ISR_REED, CHANGE);
  // Open serial communications and wait for port to open:
  Serial.begin(9600);
  while (!Serial) {
    ; // wait for serial port to connect. Needed for Leonardo only
  }


  Serial.print("Initializing SD card...");

  if (!SD.begin()) {
    Serial.println("initialization failed!");
    return;
  }
  Serial.println("initialization done.");
}

void loop(){
```

```
//Serial.println(String(clCount) + ", " + String(opCount));
if (digitalRead(reedPin)) {
  if (last) {
    clCount ++;
    if (clCount > debMax+5) {
      clCount = debMax+3;
    }
  }
  if (clCount > deltaMax) {
    opCount = 0;
  }
  last = true;
}else {
  if (!last) {
    opCount++;
    if (opCount >debMax+5) {
      opCount = debMax+3;
    }
  }
  if (opCount > deltaMax) {
    clCount = 0;
  }

  last = false;
}
if (opCount > debMax) {
  if (!reading) {
    reading = true;
    Serial.println("Opened");
    startTime = millis();
    clCount = 0;
    opCount = 0;
  }
}
if (clCount > debMax) {
  if (reading) {
    Serial.println("Closed");
    if (millis()-startTime > 1200000 || millis()-startTime < 1000) {
      Serial.println("Bad Data");
    }else {
```

```
        saveData("" + String(startTime) + "," + String(millis()-startTime));
      }

      reading = false;
      clCount = 0;
      opCount = 0;
    }
  }
  delay(10);

}

void saveData(String entry){
  Serial.println("Writing: " + entry);
    data = SD.open("data.csv", FILE_WRITE);
    if (data){
      data.println(entry);
      data.close(); // close the file
    }
```

Appendix G: Database Survey Submission Examples

A	B	C	D
What brings you to the fridge today?	How much food is in the fridge?	How clean is this fridge?	How cold is this fridge?
Adding food, Shopping for my family	Pretty Full	Needs Cleaning ASAP	Just Right
Adding food	Nearly Empty	Needs Cleaning ASAP	Too Cold
Adding food	Room for More	A Little Dirty	Too Cold
Adding food	Nearly Empty	Needs Cleaning ASAP	Too Cold
Adding food, Shopping for myself, Shopping for my family, Shopping for my neighbors, Cleaning the fridge, Checking stock levels	Pretty Full	A Little Dirty	Just Right
Checking stock levels	Room for More	Clean	Just Right
Checking stock levels	Room for More	Clean	Just Right
Checking stock levels	Room for More	Clean	Just Right
Cleaning the fridge, Checking stock levels	Room for More	Clean	Just Right
Shopping for my neighbors	Nearly Empty	A Little Dirty	Just Right
Checking stock levels	Room for More	A Little Dirty	Just Right
Checking stock levels	Pretty Full	Clean	Just Right
Checking stock levels	Nearly Empty	Clean	Just Right
Cleaning the fridge, Checking stock levels	Nearly Empty	Clean	Just Right

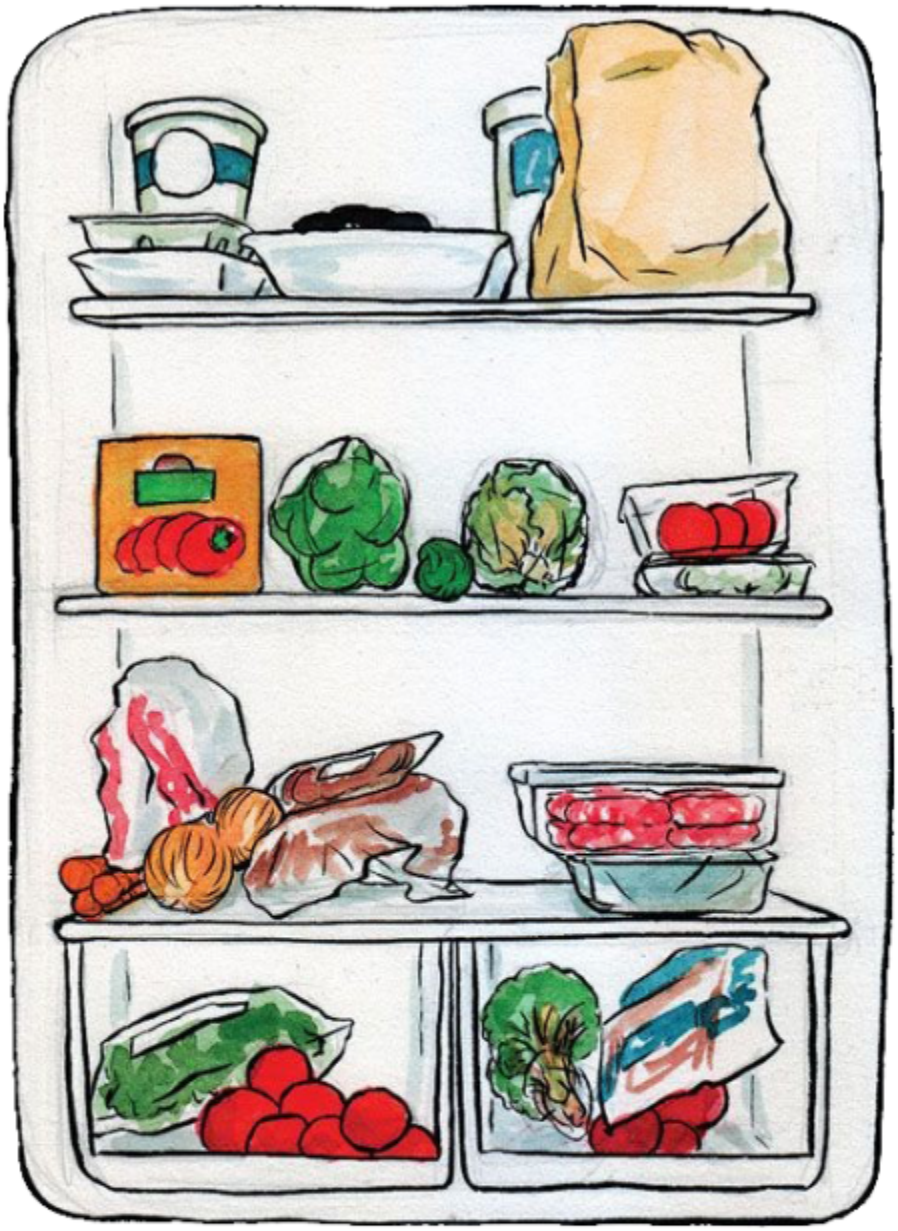
Which items would you like to see in the fridge more?	Any additional comments you would like to share with us?	Share a photo of the inside of the fridge and/or p
Precooked Meats, Bread, Frozen Food, Pantry Goods, Water/Beverages, Prepared Meals, Vegetables, Fruits	Meats and breads	https://i.imgur.com/lIUmeRV.jpg
Precooked Meats, Fruits, Vegetables, Bread, Water/Beverages, Prepared Meals, Frozen Food, Pantry Goods		https://i.imgur.com/jP4WRe8.jpg
Fruits, Vegetables, Water/Beverages, Prepared Meals, Pantry Goods, Frozen Food		https://i.imgur.com/brn61gJ.jpg
Precooked Meats, Fruits		https://i.imgur.com/ZnbX15s.png
		https://i.imgur.com/WzzfILF.jpg
Water/Beverages, Pantry Goods, Frozen Food, Fruits, Vegetables, Bread, Prepared Meals, Precooked Meats	Kiwis, banana's, pineapples, grape's, lamb	https://i.imgur.com/ctSMZ0l.png
Fruits, Vegetables, Water/Beverages, Prepared Meals, Frozen Food		https://i.imgur.com/ctSMZ0l.png
	This is a test for the new comments section on the fridge surveys	https://i.imgur.com/fAjJ5fi.jpg
Bread, Vegetables, Fruits, Precooked Meats, Pantry Goods, Frozen Food		https://i.imgur.com/ASYv2nR.png
Precooked Meats, Vegetables, Bread, Water/Beverages, Prepared Meals, Frozen Food, Pantry Goods		https://i.imgur.com/KPS6vkc.png
Precooked Meats, Pantry Goods, Bread, Prepared Meals, Vegetables, Fruits, Water/Beverages, Frozen Food	One track stop missing from sliding door track. Should fix asap	https://i.imgur.com/IFoH9Cr.jpg
	Fridge is plugged back in, will need a few hours to come to temp. It's current	https://i.imgur.com/JZYz81r.png
Fruits, Vegetables, Bread, Water/Beverages, Prepared Meals, Frozen Food, Pantry Goods, Precooked Meats		https://i.imgur.com/S9DWHdC.jpg
Vegetables, Fruits, Prepared Meals		https://i.imgur.com/dTTxFKB.jpg
		https://i.imgur.com/tNnNnyh.jpg
Water/Beverages		https://i.imgur.com/yJniM70.jpg
		https://i.imgur.com/4jrPfGn.jpg

H	I	J
Name	Timestamp	RecordID
	2022-10-26T14:49:29.000Z	
	2022-10-26T18:13:43.000Z	recFvpJXxYT1ehkFq
	2022-10-26T18:17:00.000Z	recSESVsXbOFvdHD9
	2022-10-26T18:21:17.000Z	rec5kODcux1CWLy2C
	2022-10-26T18:23:34.000Z	rectEjRV2EUGfaPzt
	2022-10-26T18:41:29.000Z	recPgdQse4XJJwArV
	2022-10-26T18:54:57.000Z	recWsxvNNjQ2BvB2I
	2022-10-26T19:03:50.000Z	recTpnevxLP2FQJRK
	2022-10-27T13:14:57.000Z	reclCwijgcqx3XgL3
	2022-10-27T13:37:39.000Z	receKLdG4FclmrOwS
Tyler	2022-10-27T17:13:04.000Z	recdDOjMXV4sX5uxu
	2022-10-27T18:06:58.000Z	rec5wamH5kTQi8Z1r
WPI Team	2022-10-28T13:31:04.000Z	recWOpiM5jOEqzDK7
WPI Team	2022-10-28T17:01:57.000Z	recHfVscDTY4dbZts

Appendix H: Database F.O.D.A

	A	B
1	Relitive Timestamp	Duration
2	2022-11-30T16:34:30.303Z	2.973
3	2022-11-30T16:44:47.054Z	55.6
4	2022-11-30T16:54:40.625Z	11.142
5	2022-11-30T16:55:20.307Z	63.649
6	2022-11-30T16:58:50.781Z	7.739
7	2022-11-30T17:14:06.193Z	49.364
8	2022-11-30T17:17:08.468Z	9.159
9	2022-11-30T17:32:10.285Z	15.877
10	2022-11-30T17:55:02.182Z	75.501
11	2022-11-30T17:56:57.686Z	31.914
12	2022-11-30T18:09:42.809Z	19.27
13	2022-11-30T18:34:50.319Z	12.564
14	2022-11-30T18:35:03.333Z	268.732
15	2022-11-30T18:39:32.315Z	27.029
16	2022-11-30T18:50:19.755Z	30.102
17	2022-11-30T18:51:30.670Z	23.495
18	2022-11-30T18:51:54.405Z	207.895
19	2022-11-30T19:03:56.676Z	36.41
20	2022-11-30T19:23:25.488Z	7.218
21	2022-11-30T19:41:33.345Z	30.223
22	2022-11-30T19:42:05.239Z	75.202
23	2022-11-30T19:47:04.488Z	5.577
24	2022-11-30T19:47:54.321Z	14.936
25	2022-11-30T19:52:58.704Z	122.623

Appendix I: F.O.D.A Data Submission Portal



Choose a fridge: Union Hill

1. Set the time you reset the arduino

2. Drag DATA.CSV into the Fridge.

3. Data should automatically be transferred to the database in ~1min

4. Delete DATA.csv from the SD card

11/30/2022 04:00 PM

Appendix J: F.O.D.A Data Submission Portal Code

```
<body>
<center>
	<div
	  id="drop_zone"
	  ondrop="dropHandler(event);"
	  ondragover="dragOverHandler(event);">

	</div>
	<div>
	 <label for="fridges">Choose a fridge:</label>

<select name="fridges" id="fridges">
<option value = "">--</option>
  <option value="portland">Portland</option>
  <option value="main">Main</option>
  <option value="brooks">Brooks</option>
  <option value="union">Union Hill</option>
</select>
	</div>
	<div>
	<p>1. Set the time you reset the arduino</p>
	<p>2. Drag DATA.CSV into the Fridge.</p>
	<p>3. Data should automatically be transferred to the database in ~1min</p>
	<p>4. Delete DATA.csv from the SD card </p>
	<input type="datetime-local" id="meeting-time"
	       name="start-time"
	       </div>
	</center>

</body>



<style>
	#drop_zone {
```

```
        width: 50%;
        height: 640px;
        background: url('https://woofridge.org/wp-content/uploads/2021/04/fridge-png.png')
no-repeat;
        background-size: 100%;
      }

</style>

<script>
      function dropHandler(ev) {
        console.log('File(s) dropped');

        // Prevent default behavior (Prevent file from being opened)
        ev.preventDefault();

        if (ev.dataTransfer.items) {
          // Use DataTransferItemList interface to access the file(s)
          [...ev.dataTransfer.items].forEach((item, i) => {
            // If dropped items aren't files, reject them
            if (item.kind === 'file') {
              const file = item.getAsFile();
              console.log(`... file[${i}].name = ${file.name}`);
              console.log(file);
              if (document.getElementsByName("start-time")[0].value === ""){
                   alert("Please select the time you reset the arduino first");
                   return;
              }
              let fridge = document.getElementsByName("fridges")[0].value

              let endpoint = fridge==="portland"?"https://eoxkiloqh9is4ke.m.pipedream.net":
                        fridge ==="brooks"?"https://eo8jyeg4v2s23g2.m.pipedream.net":
                              fridge === "main"?"https://eont250ifzfgtgx.m.pipedream.net":
                                    fridge ===
"union"?"https://eo9ebonnnhua2c1.m.pipedream.net":
                                          "";

                   if (endpoint === "") {
```

```
                    alert("Please select a fridge first");
                    return;
                }

            const reader = new FileReader();
              reader.addEventListener('load', (event) => {
                var arr = [];
                event.target.result.split("\n").forEach((line) => {
                if (line !== "") {
                    arr.push(line.split(","));
                }
                });
                d = new Date(document.getElementsByName("start-time")[0].value);
                    const headers = new Headers()
                    headers.append("Content-Type", "application/json")

                    const body = {
                      "data": arr,
                      "start": d.getTime()
                    }

                    const options = {
                      method: "POST",
                      headers,
                      mode: "cors",
                      body: JSON.stringify(body),
                    }

                    fetch("https://eoxkiloqh9is4ke.m.pipedream.net", options)
                    alert("Data transfer initiated, check the sheet in about one
minute");

              });
              reader.readAsText(file, "UTF-8");

              //console.log("done");
            }
          });
```

```
    } else {
      // Use DataTransfer interface to access the file(s)
      [...ev.dataTransfer.files].forEach((file, i) => {
        console.log(`… file[${i}].name = ${file.name}`);
        console.log(file);
        console.log(file);
        var reader = new FileReader();
        console.log(reader.readAsText(file));
      });
    }
  }

  function dragOverHandler(ev) {
    console.log('File(s) in drop zone');

    // Prevent default behavior (Prevent file from being opened)
    ev.preventDefault();
  }

</script>
```