

2020-2021 MESA USA Design Brief:

School: Nex+Gen Academy

State: New Mexico

Division: Middle School **High School**

Team Members: Luke O'Donnell, Luke Fletcher, Ashton Brace

Problem Statement: Briefly describe the people who will benefit from the project and the challenges they face. Include any inequity that the project hopes to address. *(100 Words Maximum)*

In New Mexico (NM), one in five people and one in three children experience food insecurity, and with the pandemic, that number increased. Our user Roadrunner Food Bank (RRFB) is NM's largest food bank and serves more than half of the state's counties. RRFB is experiencing a volunteer shortage due to COVID-19, creating processing problems. They rely on volunteers to sort produce by hand, which is time-consuming. With fewer volunteers, food output decreases, limiting the distribution of nutritious food to families in need. Thus by creating a more efficient way of processing food, we can reduce food insecurity in NM.

User Research: Discuss key information about the users gathered through your research, interviews, and ongoing discussion with the users throughout the project. *(200 Words Maximum)*

We asked questions such as, "what are major equity issues in our community?" and "how have they been amplified during the pandemic?". We went on to find that the most prevalent issue was food insecurity. Our research was thorough and led to two interviews and a tour of one of RRFB's warehouses. The first person we interviewed was Sonya Warwick, Communications Officer at RRFB. According to her, a large population of New Mexicans are suffering from food insecurities and RRFB is struggling to keep up with the demand. Our second interview was with Meg Creaturo Anaya, Warehouse Production Manager at RRFB. She identified bottlenecks within the warehouse, one of these was more produce than the volunteers could handle, and some other volunteer shortages they have had due to the increased restrictions imposed by the COVID-19 response. The most mentioned subject matter was the quantity of vegetables and fruits they receive and the lack of volunteer capital to process it. To process this abundance of produce we decided to create a design which speeds up this process allowing our user to distribute more nutritious food to families in need.

User Insight: Discuss your team's understanding of the experiences, emotions, and motivations of the users. *(200 Words Maximum)*

During the pandemic, RRFB experienced reduced food supply; though a greater demand for it having to increase its output of food to 600 thousand pounds a week. Another problem we found was that RRFB is only able to have a third of the volunteers on duty that it did pre-pandemic. The demand and lack of volunteers to process the food have reduced the efficiency of the food banks which makes getting food out to food-insecure New Mexicans take longer. Having toured a warehouse, we saw how much produce the volunteers had to sort through. Volunteers have to manually sift through truckloads of produce, one item at a time to make sure that it is okay for it to be distributed, sometimes taking too long to make use of the highly perishable goods. The sorting process is slow and can be overwhelming especially if there is a volunteer shortage. While touring the facility our guide told us of the lack of modernized technology to sort through the masses of food and described how unpleasant it was to sift through produce to sort the healthy from the bruised or rotting.

User Needs: Provide a list of specific user needs produced from the user insight. *(100 Words Maximum)*

RRFB needs increased efficiency in the food handling/sorting process. An automated system would increase efficiency in sorting, and therefore, distribution. It should be:

- able to handle large quantities of fresh/rotten produce.
- accurate in its reading of bad produce.
- inexpensive and easily reproducible.
- able to protect the produce from becoming damaged (food bruises easily, can go rotten quickly.)
- versatile (prototype can be placed anywhere where space is available.)

Project Goals: List project goals and shows how they are linked to and will adequately meet the user's needs. *(100 Words Maximum)*

Our project goals are to create an automated system that sorts large quantities of produce that is

- easy to use
- efficient
- inexpensive
- adaptable

The system can quickly and accurately sense and process the pieces of produce based on whether they are fresh or rotten, allowing volunteers to focus on different essential tasks. The design will also be inexpensive and easy to reproduce to be affordably manufactured for food banks; furthermore, its assembly will allow the device to be utilized by the foodbank wherever it is needed. Lastly, it is easy to use, which will void the need for advanced training.

Key Features of Design: List key features of the design and show how they adequately meet project goals. *(200 Words Maximum)*

1. The wide Receiving Ramp: allows for an increased volume of produce to await scanning; this makes the design easy to use and lessens the need for user involvement. 2. The Bottleneck: assures accurate readings on produce by only permitting one item to be scanned at a time. This makes our design quick and efficient in how it scans produce. 3. The Scanner System uses an external light sensor connected to an Arduino board to detect each item's Red Green Blue (RGB) value. We used an Arduino board and an external light sensor to keep the design inexpensive. 4. The motorized Conveyor System: uses a DC motor powered by batteries that moves produce past the scanner at a regular pace (motor on underside of the prototype) and allows POD to be used anywhere in the warehouse, making it highly adaptable. 5. The Servo Sorting Arm: allows the produce to be sent to its respective chute, which allows the produce to be sorted. 6. The Chutes: allow for the produce to be sorted into two containers, one for rotten produce another for fresh produce. 7. The Speed Bumps: reduce velocity to prevent damages to the produce upon impact with the container.

Status of Project: Describe the current status of the project and discuss potential next steps. *(200 Words Maximum)*

The P.O.D. Must be budget-friendly, allowing for a comprehensive implementation of its features while also effectively transmitting results. The frame was upgraded to wood to make it more durable, and the added conveyor belt made of rubber offers high friction to transport produce. The high torque D.C. motor and belt will eliminate most dependency on gravity within our design, allowing produce to be processed faster. Our team decided to use an Arduino board and an inexpensive external light sensor to detect rotten fruit based on the overall color, precisely, the RGB value. We switched to an Arduino board because our team felt it to be more versatile, furthering the usability of our prototype.

Additionally, integrating the servo, external light sensor, and motor made Arduino seem like the better fit for the resources it offers. Our next steps include integrating a stepper motor into our design which would create a sequence in which the produce is accurately processed. Additionally, we wish to increase the wide receiving ramp's capacity and add a color-based scanner system to facilitate greater processing speed. We also wish to expand the scanning range to potatoes, bananas, and lettuce lessening need for user involvement.

Impact: Discuss how design may improve inequity and/or remove barriers for the user. *(200 Words Maximum)*

The P.O.D. allows RRFB, which serves over 33 counties in N.M., and other food banks, to distribute food more efficiently and quickly. During the pandemic, the number of volunteers allowed in a given warehouse within New Mexico were reduced, meaning every volunteer and where they are allocated mattered significantly. This situation creates a need for labor-intensive processes to be reduced, such as sorting produce. Thus far, we have created a design that can sort food while still being highly versatile in where it can be implemented and placed within the warehouse. This design will then free up volunteers, enabling them to do more essential tasks within the warehouse, which makes our design efficient. This, in turn, increases warehouse output, enabling more nutritious food to be distributed to more families in need throughout New

Mexico with our design in use. When the pandemic does fade away into the past, our design will still be easy to use and adaptable to what job they may see fit. Lastly, our design is easy to use for volunteers which will eliminate additional time needed to train them.

Reflection: Discusses personal growth and insights about designing for others and helping them overcome challenges. Also, include discussion of any increased understanding of Human Centered Design. *(200 Words Maximum)*

The pandemic has changed many people's lives in significant ways. Many more now suffer from food insecurity which reduces their quality of life and impacts their overall health and wellbeing. As engineers, COVID-19 has changed how we can imagine solutions as well as empathize and interact with others while offering a massive challenge. We discovered that defining a single equity issue was difficult, as New Mexico faces several problems, of which food insecurity is the most alarming. As we came to understand the role food banks play in addressing this issue, we struggled to ideate and formulate a solution to our user's challenges. We settled on a design that streamlines a tedious process, and alleviates the stresses of having a reduced number of warehouse volunteers. We learned how to get involved with our community during hard times and how some organizations will never cease to serve their community and find solutions for modern day problems. Through research, interviews, and touring RRFB, we saw volunteers working hard to benefit countless others. While not entirely perfect, our design will enable our users to continue serving their community more efficiently and consistently, with or without a pandemic affecting that process.

Prototype Graphic: Graphic is easy to understand and adequately labels key features.



