

Team 10 – GNA (Grocery Navigation Assistant)

Ezra Kim, Micah Lee, Anjana Sainju, Matthew Sulka
Calvin University, Grand Rapids, Michigan

Introduction

GNA (Grocery Navigation Assistant) is a senior project designed to solve the problem of inefficient and disorganized grocery shopping by developing a system that maps out the most efficient route around a grocery store.

Our product locates the items in a customer's grocery list in a store to minimize unnecessary wandering and backtracking. Customers can generate a grocery list on our mobile application, which can then be transferred into the GNA to be sorted and displayed.

The interface also shows the layout image of the grocery store, with the location of the items highlighted for ease of navigation. The cart-mounted system is easily detachable for recharging and maintenance.

Data Transfer Process

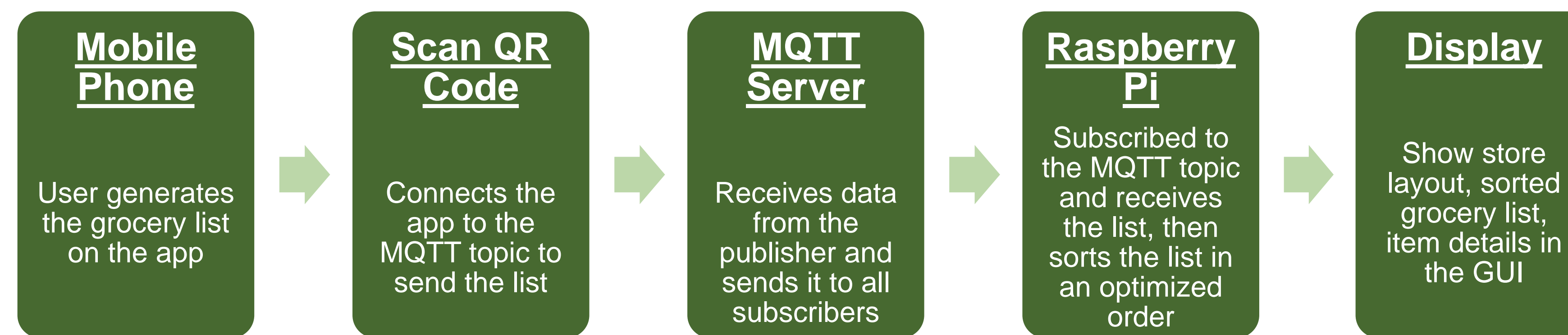


Figure 2: Flowchart describing the data transfer of the grocery list from a user's personal mobile device to the GNA device.

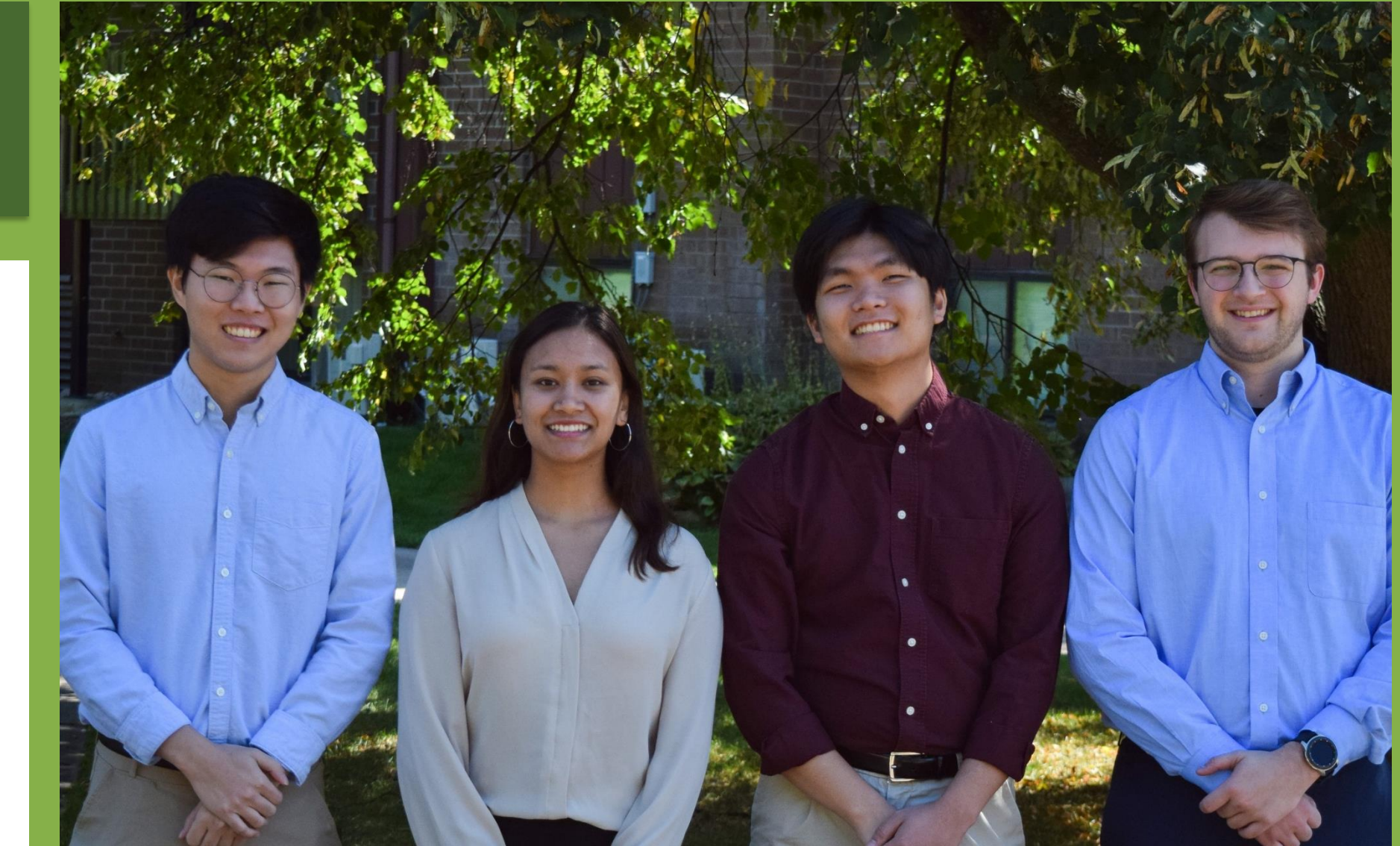


Figure 5: From left to right - Micah Lee (ME), Anjana Sainju (EE), Ezra Kim (EE), Matthew Sulka (EE)

Mobile Application & Data Transfer

We used React Native to build our application on Expo, and the app is compatible with iOS and Android devices.

We also utilized an application layer protocol called MQTT (Message Queuing Telemetry Transport) to establish communication between the GNA and the mobile application. Eclipse Mosquitto, which is a lightweight open-source implementation of the MQTT protocol, works well with our hardware and software components. The MQTT protocol works by "publishing" and "subscribing" to "topics." Thus, by scanning the QR code, the user can send their list to the same topic that the GNA is subscribed to and sends the list to the GNA for it to sort.

Housing & Mounting Mechanism

The mounting mechanism design was inspired by the vise grip commonly seen throughout workshops, where a screw and a guide rod allow for clamping between two vertical surfaces.

We applied silicon tape to reduce slippage along the handlebar and the main body of the shopping cart.

We designed the internal component housing with two primary pieces: the base and the back cover. The back cover is attached to the base with seven screws, where the base holds the internal components, keeping them safe from the outside environment.

Graphical User Interface

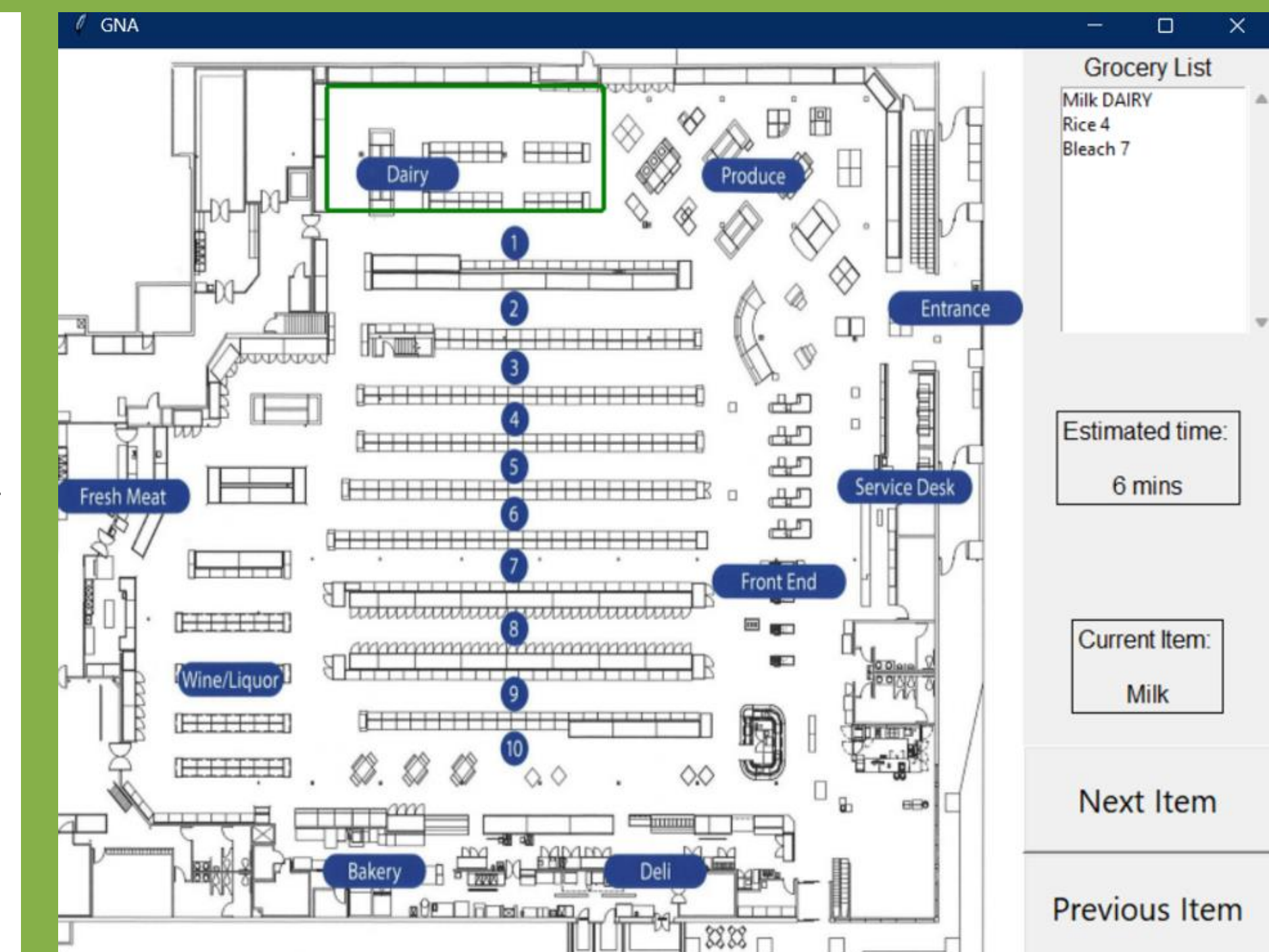


Figure 6: Final design of the GUI with the store layout, user's sorted grocery list, and navigation buttons.

The application was created using Python's built-in 'guizero' library to keep it simple and lightweight. D&W had already made a handout with the store's layout, as well as some common items and their corresponding locations. This information was used for the GUI and to build the database of the items into a CSV file format.

The user will see the layout of the store, with the current item's location highlighted in a green box. The estimated time is calculated given the assumption that finding each item will take two minutes on average. Using the two buttons located in the bottom right corner, the user can navigate through their sorted list.

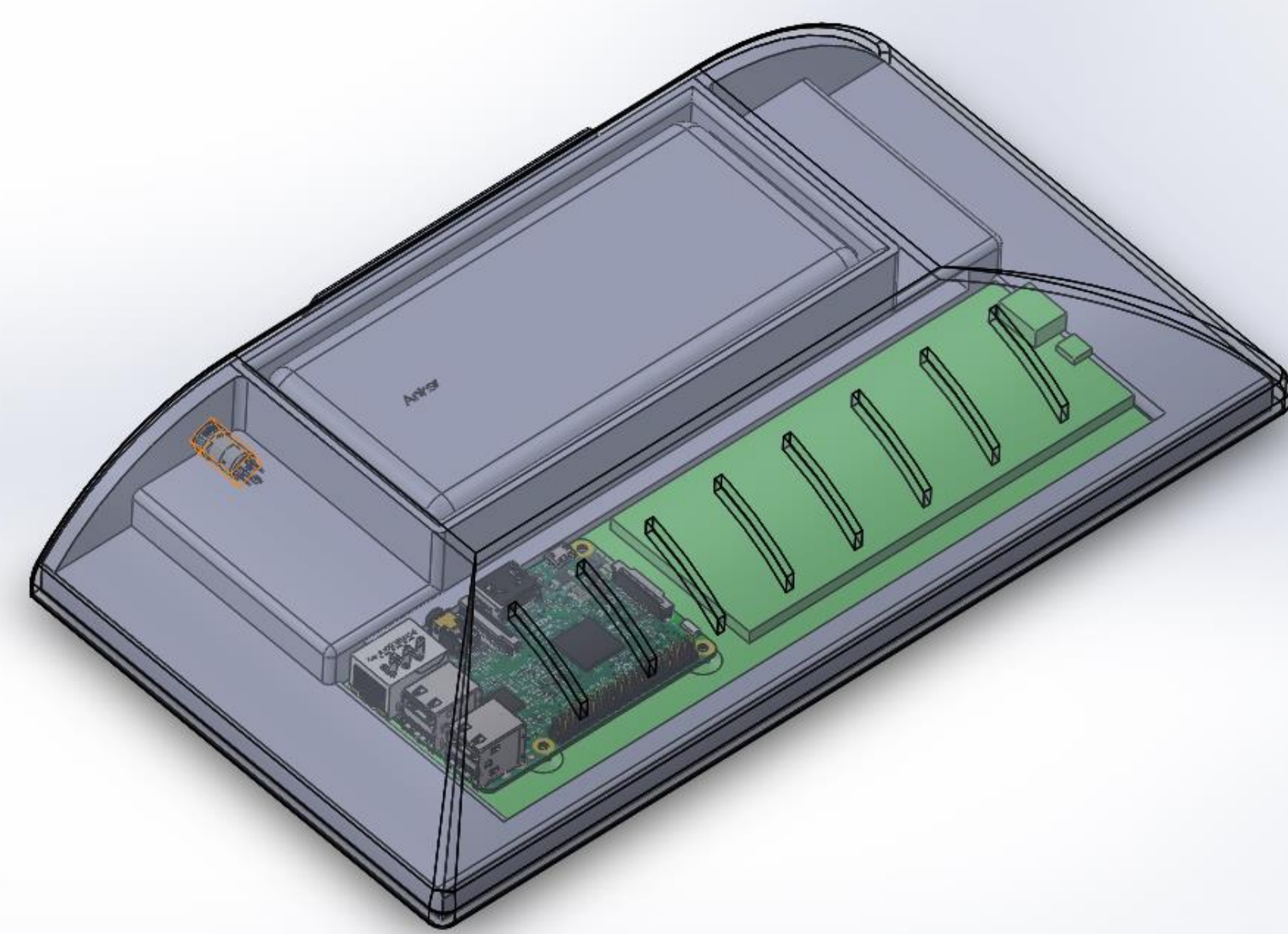


Figure 1: Internal component layout seen from the backside of the base housing.

Hardware Components

- Raspberry Pi 3 Model B
- HMTECH 10.1-inch Touchscreen Display
- Anker 20000mAh Portable Charger
- HB15CK Power Button
- 3D-Printed Mounting Bracket (PLA)

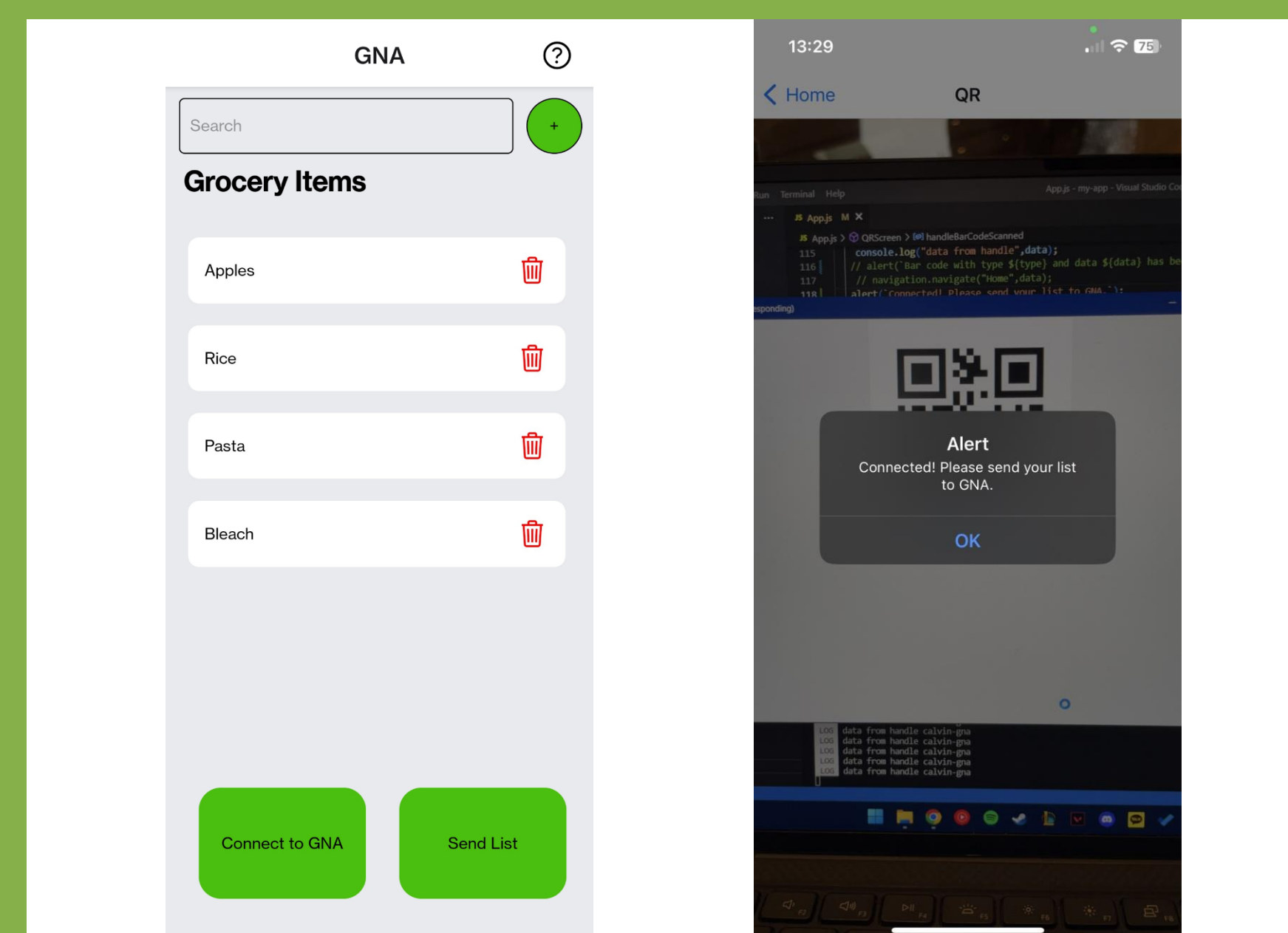


Figure 3: The mobile application UI for the user's grocery list and the QR code reader.

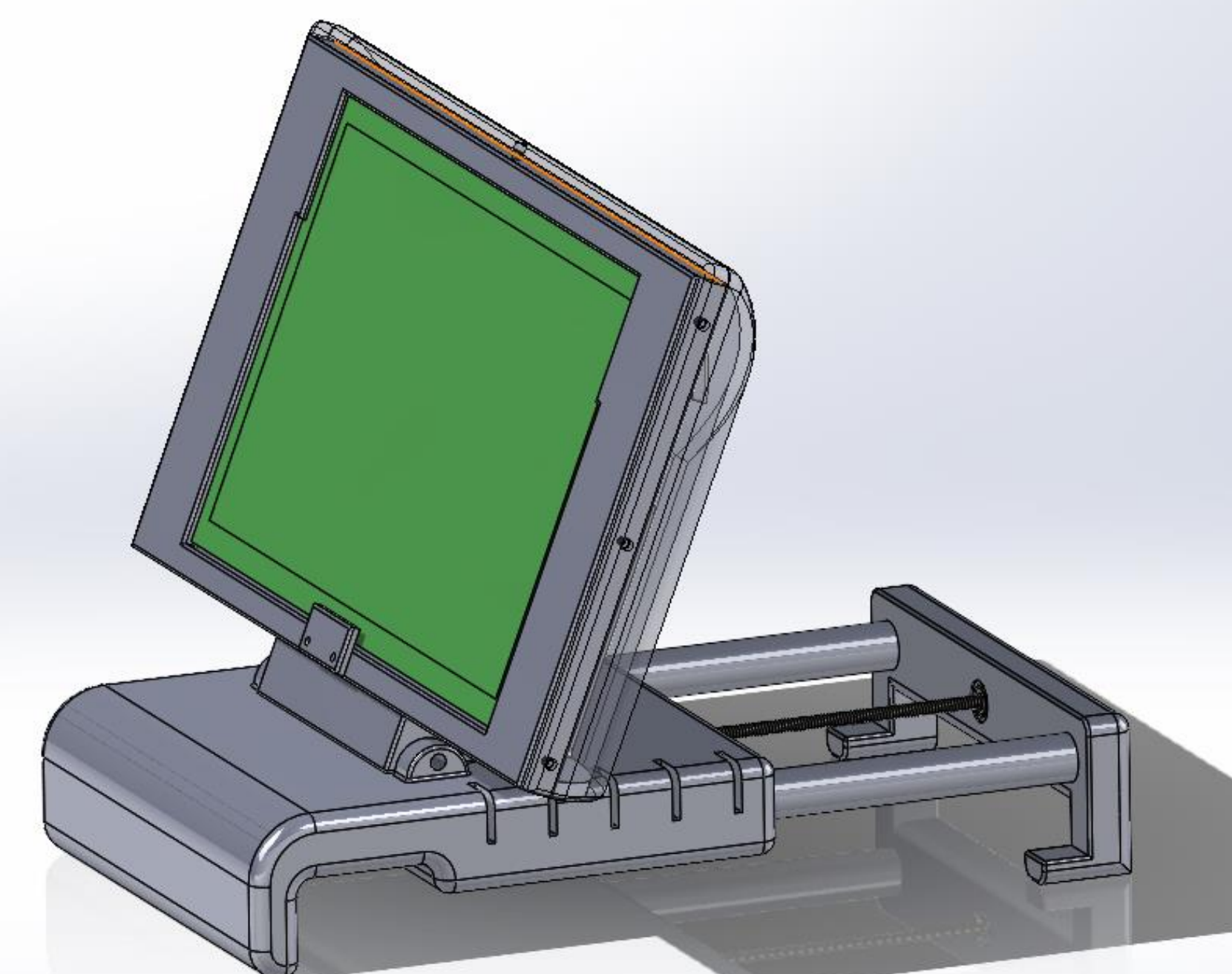


Figure 4: Fully assembled Solidworks model of the GNA device.