Final Presentation:
To-Go Bot

SPRING 2024 PNM CLASS

OVERVIEW

01 Our Product

02 Teams

03 Cost Breakdown

04 Improvements

01 OUR PRODUCT

PROBLEM

"I'M SO HUNGRY, BUT I DON'T HAVE TIME TO GRAB FOOD!"

As students we have to balance:

- Attending classes
- Studying
- Commuting
- Jobs

SOLUTION

Autonomous Delivery Robot

30% of students **felt safer** because the of contactless delivery robots

64% of students **didn't skip meals** because they didn't have to wait in long lines for food

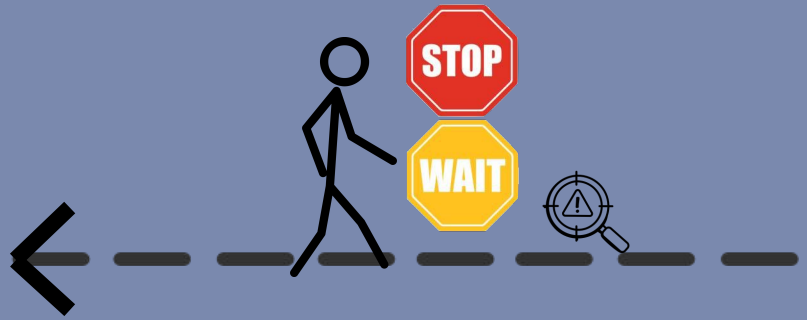
25% of students have **improved mental health** due to robot usage

60% of students **could study more** because the robots delivered goods when needed

HOW THE TO-GO BOT WORKS

1. Request robot to Point B

tailscale



2. Send the location of Point B to the robot

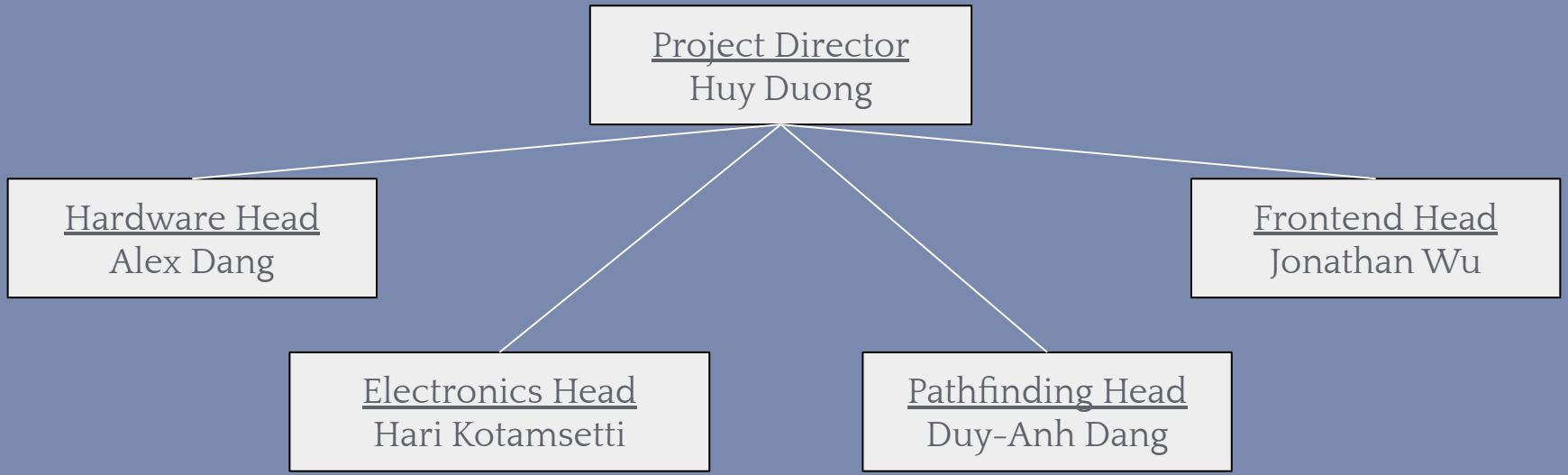
3. Continue on route. Use ultrasonic sensor to detect obstacles (people). Stop and wait for obstacle to pass.

4. Continuously send location of robot to website. Stop robot once it reaches the location.

MVP + DEMONSTRATION

02 TEAMS

HEADS


Project Director
Huy Duong
Hardware Head
Alex Dang
Electronics Head
Hari Kotamsetti
Pathfinding Head
Duy-Anh Dang
Frontend Head
Jonathan Wu

TEAMS

Hardware

- **Alex**
- Kylie
- Helena
- Luke

Electronics

- **Hari**
- Huy
- Sachi
- Spandan
- Noah

Pathfinder

- **Duy**
- Albert
- Athish
- Timmy
- Michael

Frontend

- **Jonathan**
- Natalie
- Joshua
- Mahek

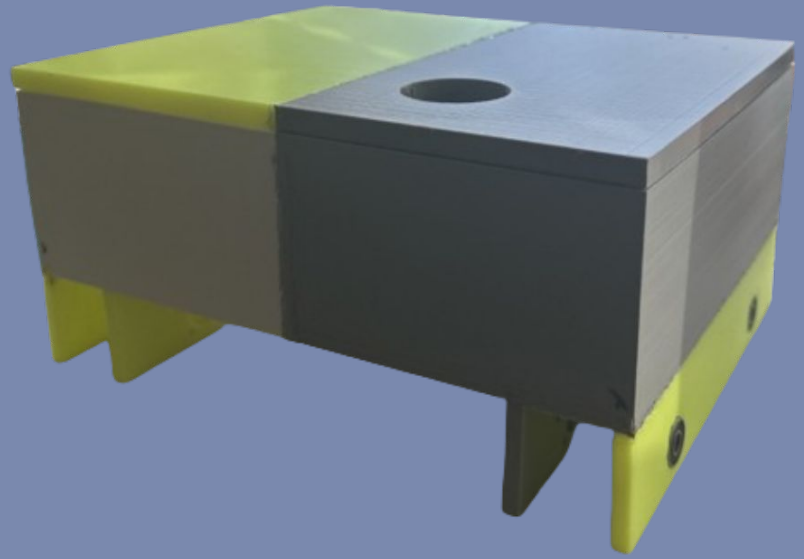
2.1 HARDWARE COMMITTEE

HARDWARE OBJECTIVES

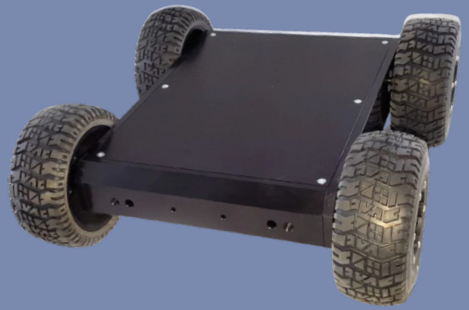
1. Create a chassis for our robot that will house the electronics.
2. Create a carrier box that will be able to carry food and hold our ultrasonic sensors.
3. Choose a drive train design that will support wheel and motor.

CHASSIS

- PLA and 20% infill
- Fusion welding using a solder iron
- Motor & Bearing Walls for more clearance
- Holes for Ultrasonic Sensors' Wires



Why?:
Inspiration from



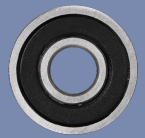
In terms of the Main Chassis verse the Wheels

DRIVE-TRAIN/WHEELS

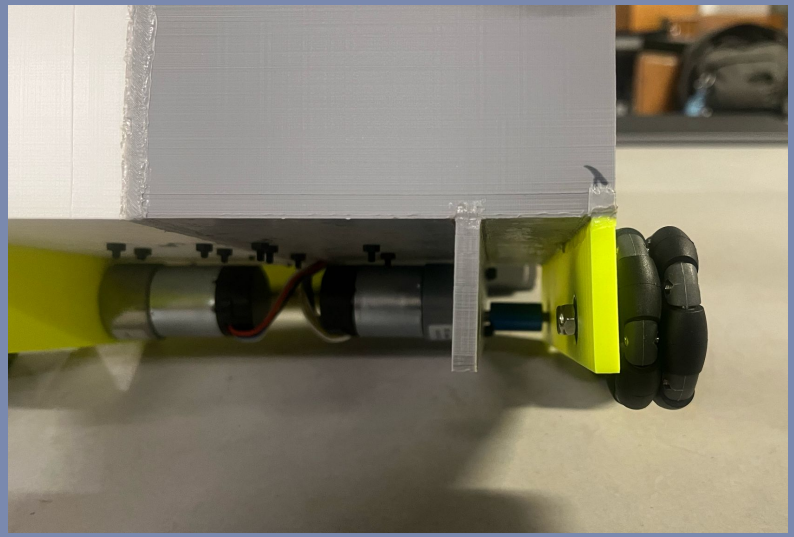
4 Wheel Drive → 2 Wheel Drive

Materials:

- Omni Wheels (58mm)
  - Came with Screws (60mm & 45mm)
- Shaft Extenders
- Bearing (17mm; 6mm)



Set-Up with Motor & Bearing Walls:



CARRIER BOX

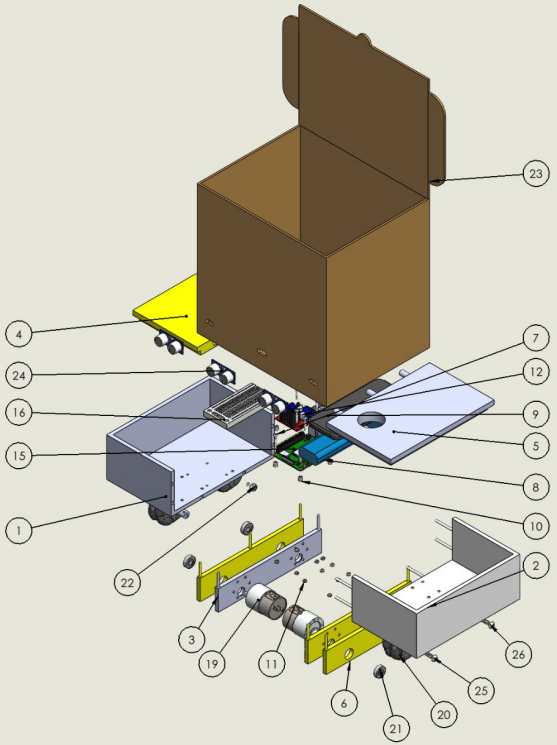
2 Components:

- Carrier
- Platform insert for electronics

Material:

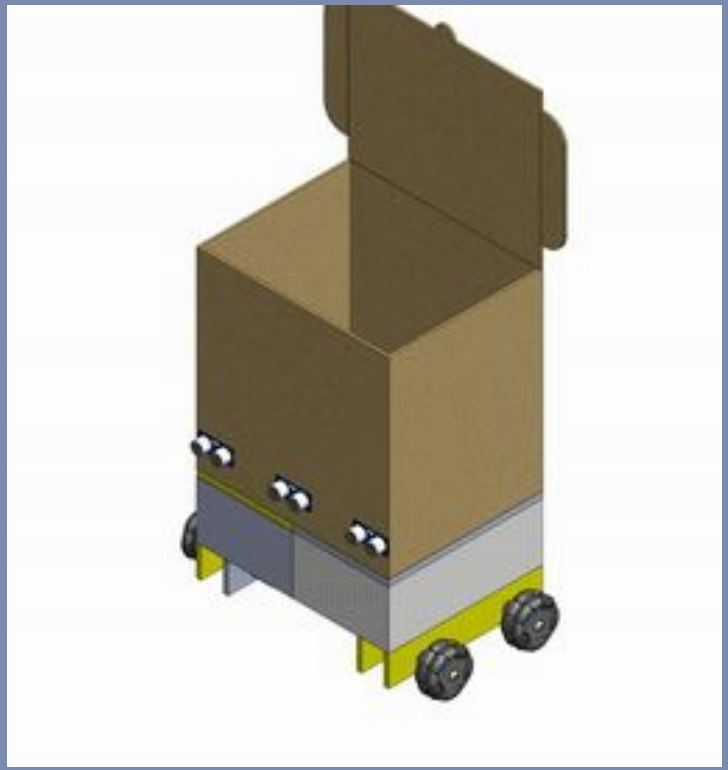
- B- Flute : 3.2 mm
- Double sided tape

BILL OF MATERIALS

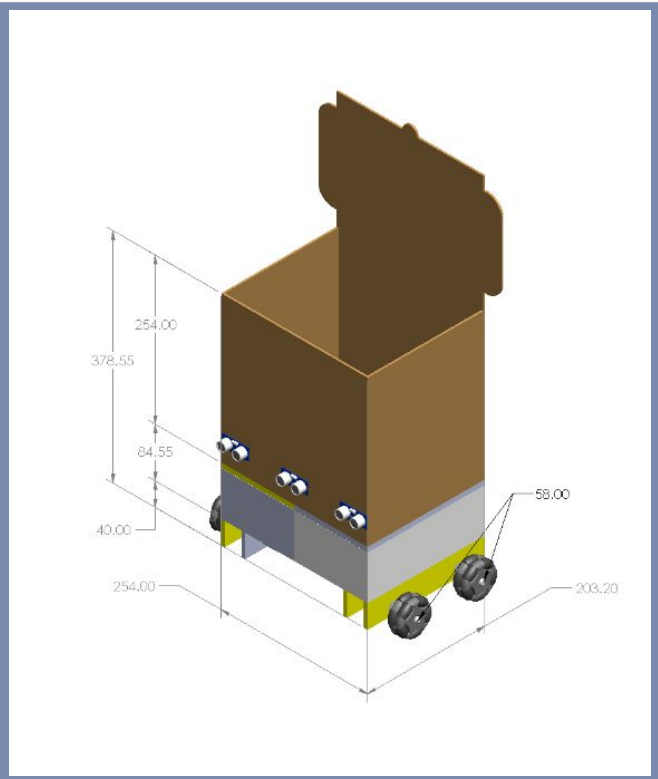


ITEM NO.	DESCRIPTION	QTY.
1	Chassis with Holes	1
2	Chassis with Dowel Pins	1
3	Motor Wall	2
4	Lid with Holes	1
5	Lid with Dowel Pins	1
6	Bearing Wall	2
7	M3*20 Screw	13
8	Lipo Battery	2
9	Battery Bank	1
10	M3*6 Spacer	13
11	M3 Nut	13
12	Motor Controller	1
13	GPS	1
14	Berry IMU	1
15	Rasberry Pi 3B	1
16	Bread Board	1
17	Antennae	1
18	Shaft Extender	2
19	DC Motors	2
20	Omni Wheels	4
21	Ball Bearing for 6mm Shaft	4
22	M6 Locknut	2
23	Carrier Box	1
24	Ultrasonic Sensor	3
25	60MM M6 Screw	2
26	45MM M6 Screw	2

ASSEMBLY & DRAWING



Dimensions: (mm)

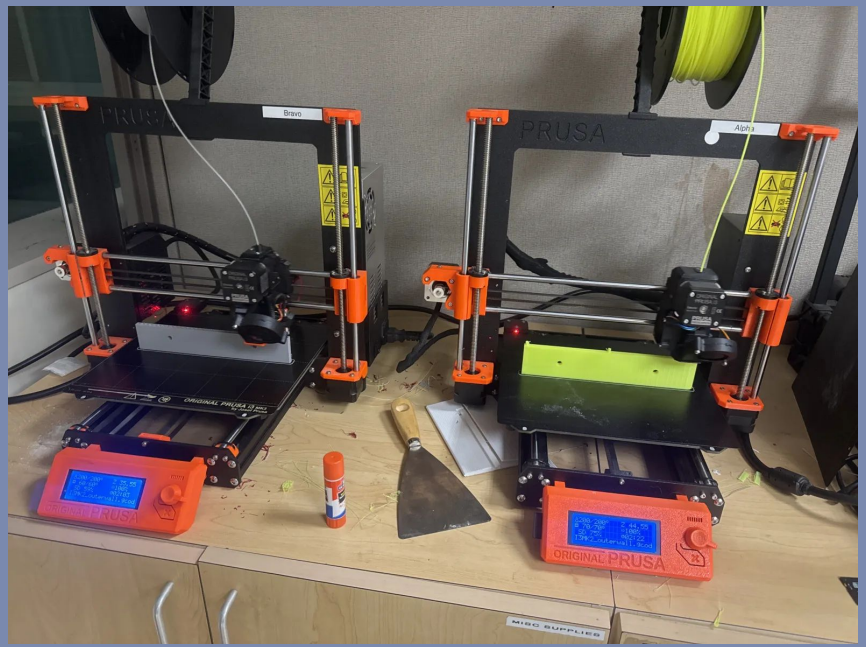


FINAL PRODUCT

Dimensions (mm): 254(w) x 203.2(l) x 378.55(h)

HARDWARE COMPLICATIONS

- 3D Printer Issues and Delays
  - 3 different 3D printers
- Chassis Assembly Technique
  - Dowel and hole system
  - Weak and snapped off → fusion together
- Motor and Wheel Placement
  - Electronics VERY low to ground
  - Added bearing and motor walls
  - Extra space in chassis



HARDWARE GANTT CHART

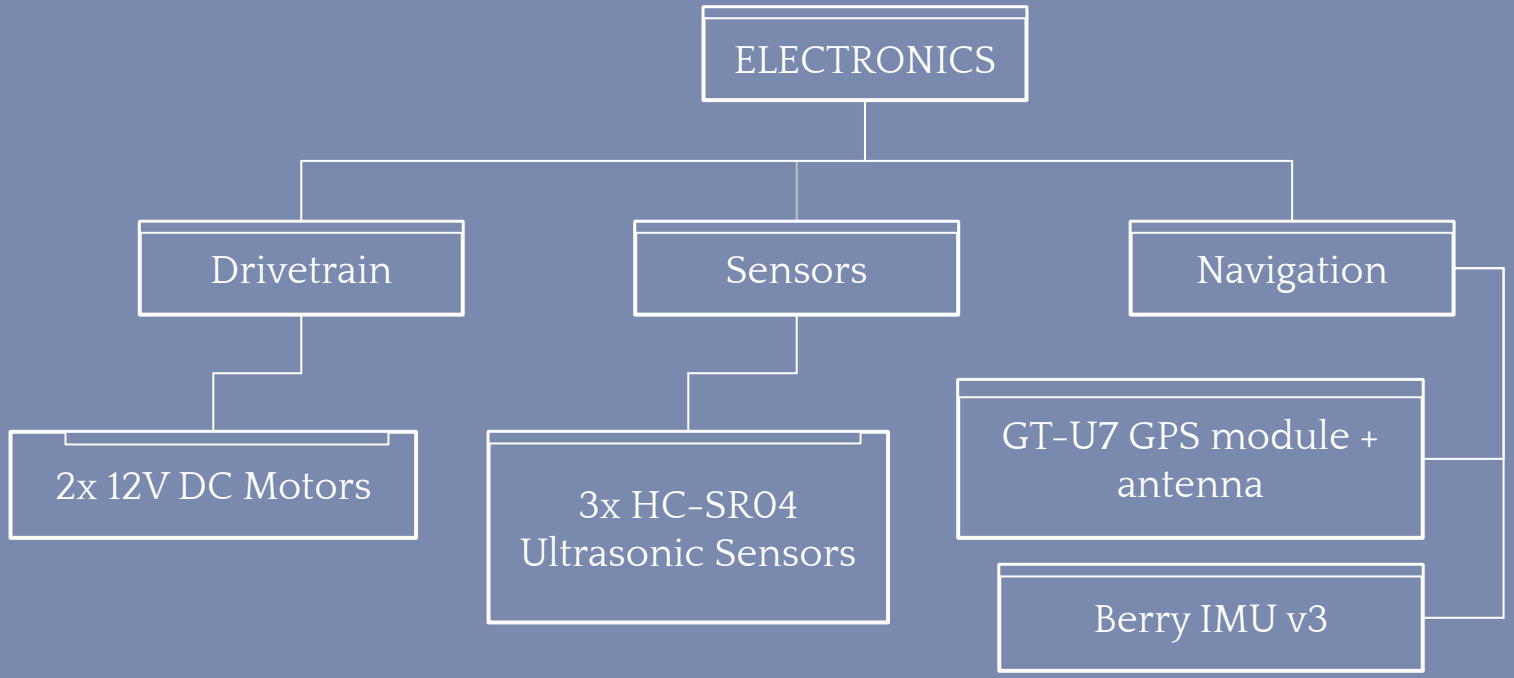
	TASK NAME	TASK OWNERS	WEEK 5					WEEK 6					WEEK 7					WEEK 8					WEEK 9				
			3/19	3/20	3/21	3/22	3/23	3/25	3/26	3/27	3/28	3/29	4/8	4/9	4/10	4/11	4/12	4/15	4/16	4/17	4/18	4/19	4/22	4/23	4/24	4/25	4/26
1	**Chassis**																										
1.1	Research/Design Chassis	Alex, Helena																									
1.2	CAD Design	Luke, Helena																									
1.3	Materials Research / Testing	Alex, Kylie																									
1.4	3D Print and Test	Hardware Committee																									
1.5	CAD Adjustments	Kylie, Luke																									
1.6	CAD Assembly	Helena, Luke																									
2	**Carrier Box**																										
2.1	Carrier Box CAD	Kylie																									
2.2	Carrier Box Assemble	Kylie																									
3	**Final Robot Assembly**																										
3.1	Robot Assembly	Helena, Alex																									
3.2	Wheel and Bearing Assembly	Alex, Helena																									
3.3	Final testing	Hardware Committee																									

2.2 ELECTRONICS COMMITTEE

ELECTRONICS OBJECTIVES

1. Design a drivetrain system for movement.
2. Design a navigation system for determining coordinate location and orientation.
3. Design a sensor system for object detection.

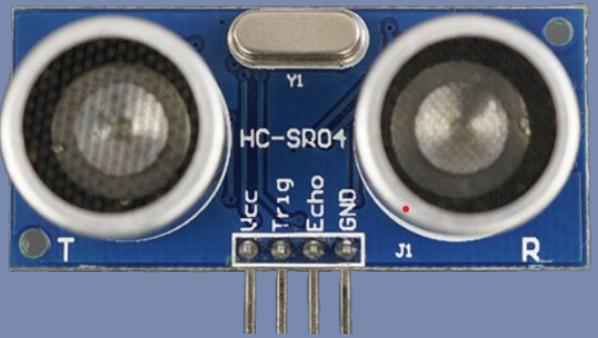
ELECTRONICS BREAKDOWN

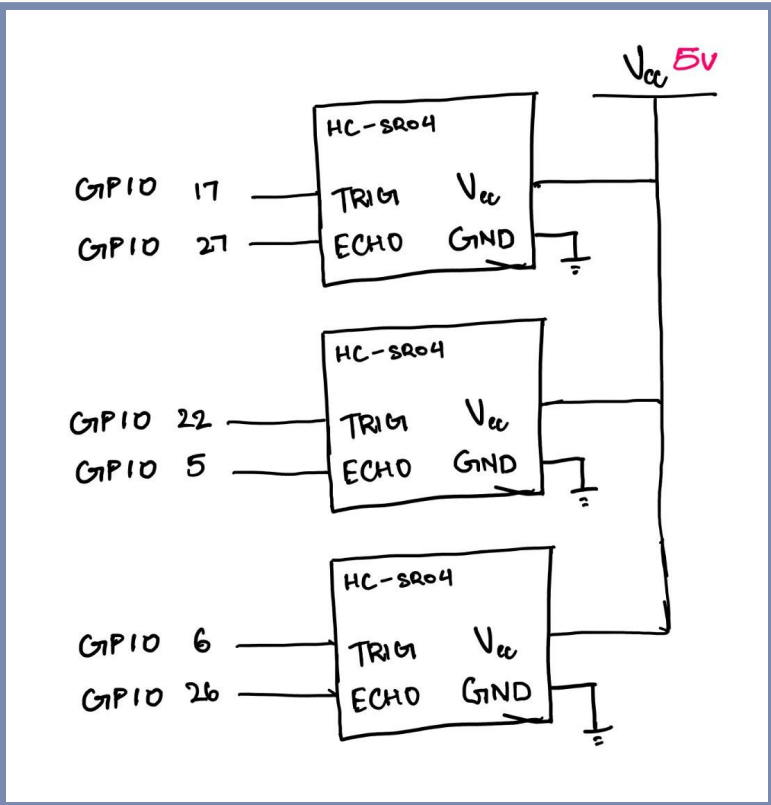


SENSORS SYSTEM

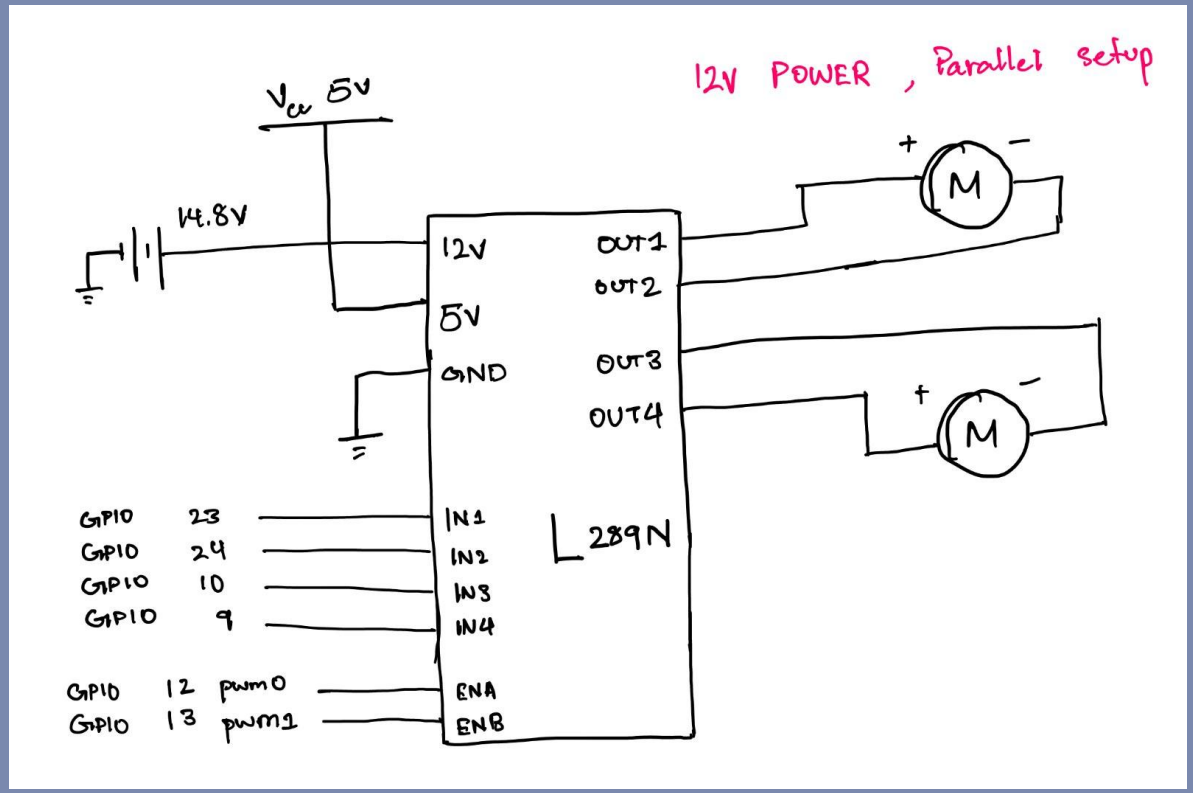
3x HC-SR04 Ultrasonic sensors:

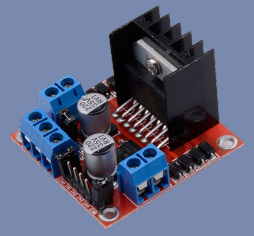
- Used for object detection
- Sensor Range: 2 cm to 400 cm





DRIVETRAIN ELECTRONICS





2x 7.4 V Batteries + L298N + 12V DC motors

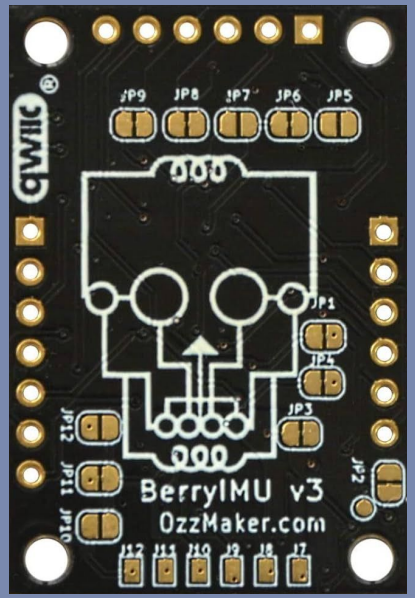
NAVIGATION SYSTEMS

Berry IMU v3:

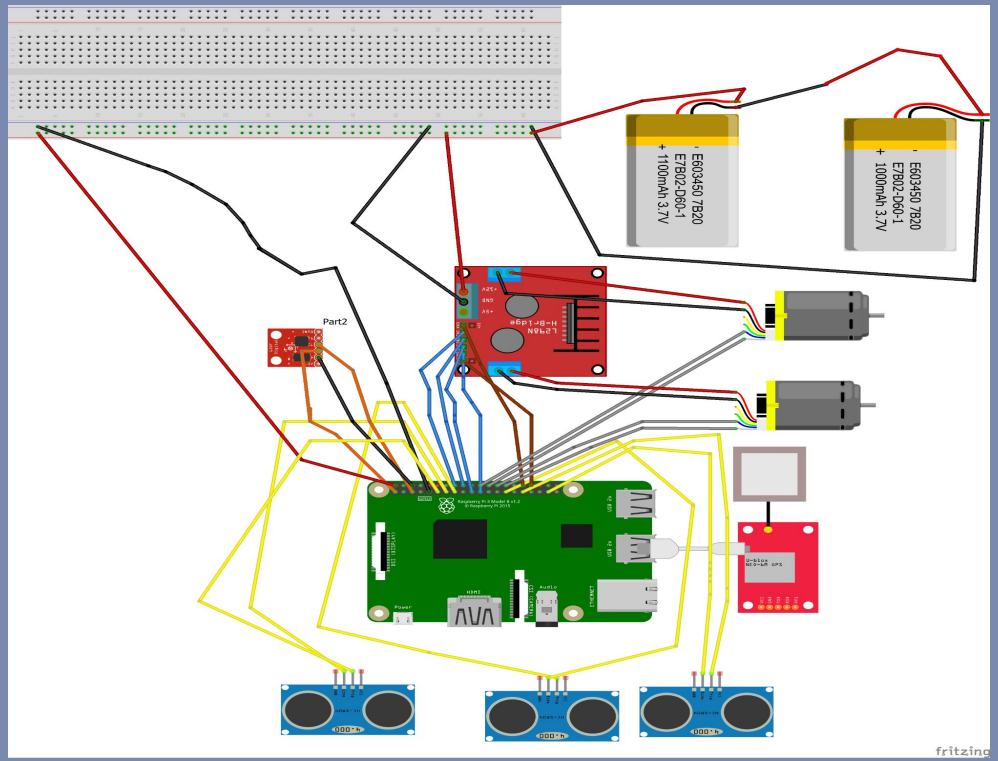
- Magnetometer + Gyroscope
- Uses I2C

GT-U7 GPS module:

- Ublox Neo6m IC
- Uses USB



ABSTRACTED SCHEMATIC DESIGN

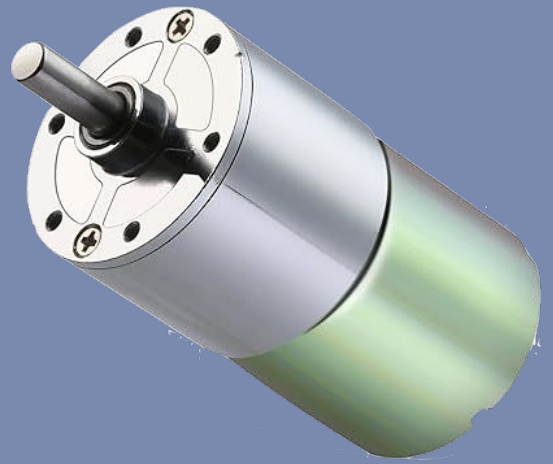


WIRE COLOR

- Motor
- Voltage
- Ground
- Motor Controller
- IMU
- Ultrasonic Sensor

ELECTRICAL COMPLICATIONS

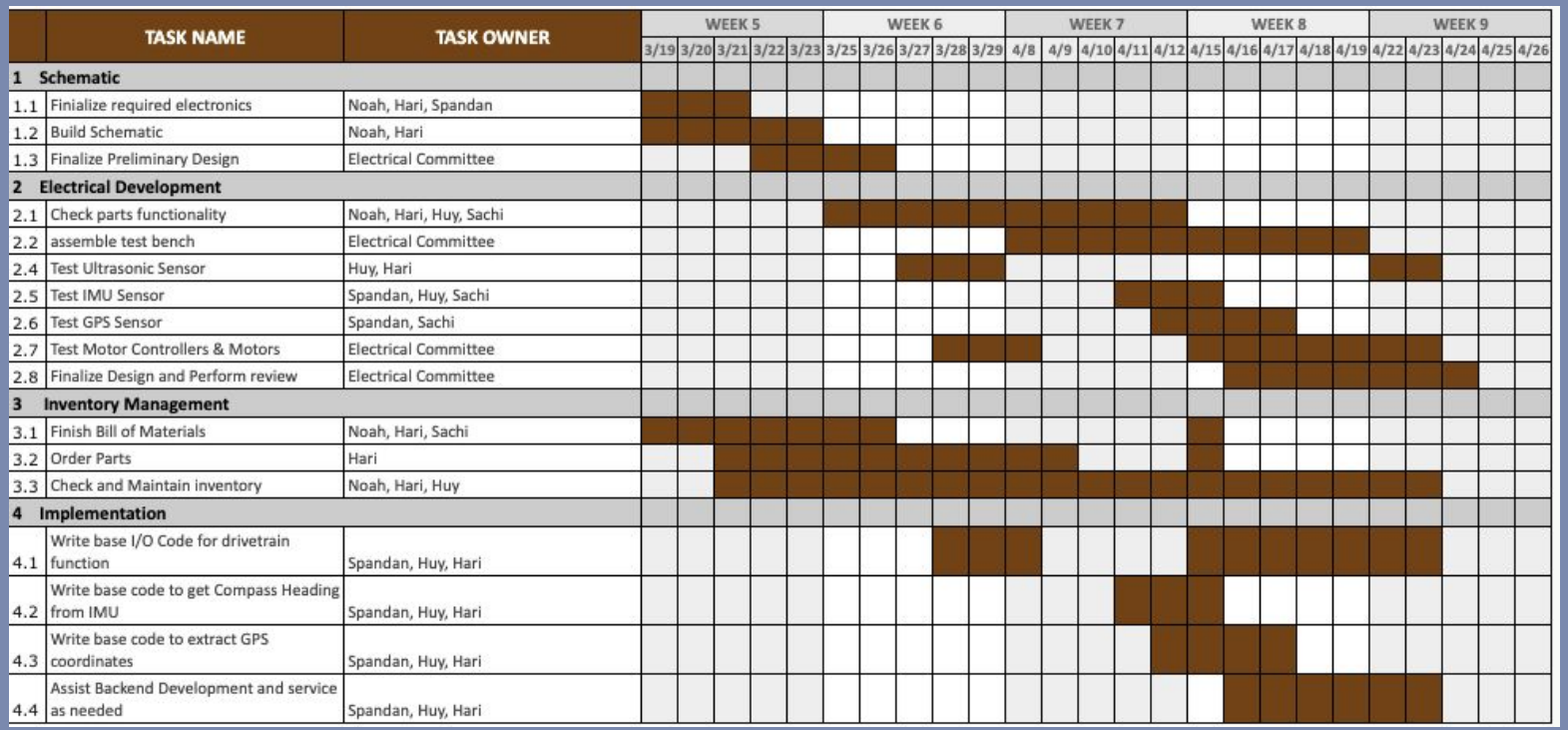
- **Required change in Drive motor configuration:**
  - Different Resistance → Different Speeds.
  - Lack of encoders → delay due to purchase decisions later.



- **Drive Train:**
  - Tank Drive system scrapped
    - Switched to rear-wheel drive

- **Raspberry Pi Failure**

ELECTRONICS GANTT CHART



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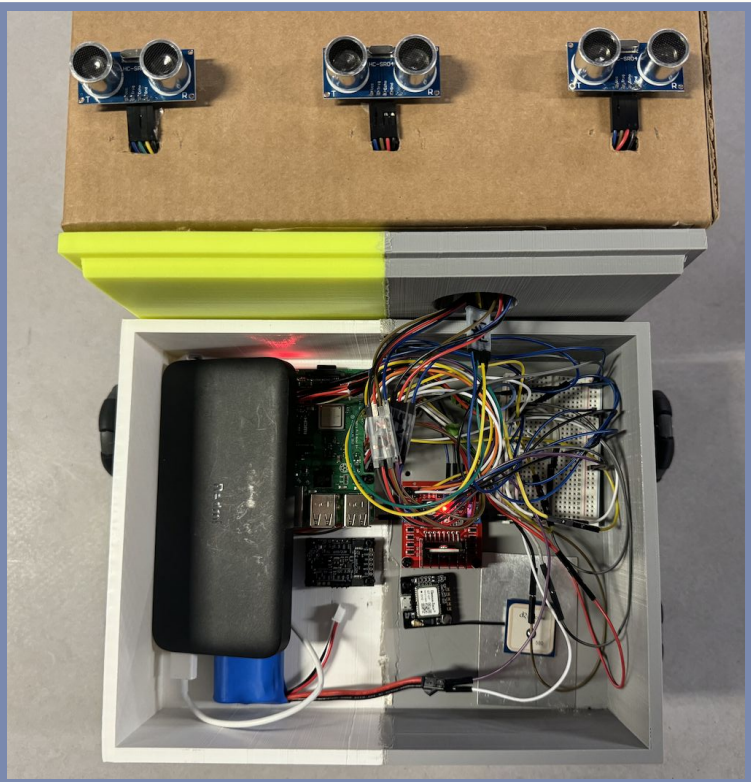
1	**Schematic**																										
1.1	Finialize required electronics	Noah, Hari, Spandan																									
1.2	Build Schematic	Noah, Hari																									
1.3	Finalize Preliminary Design	Electrical Committee																									
2	**Electrical Development**																										
2.1	Check parts functionality	Noah, Hari, Huy, Sachi																									
2.2	assemble test bench	Electrical Committee																									
2.4	Test Ultrasonic Sensor	Huy, Hari																									
2.5	Test IMU Sensor	Spandan, Huy, Sachi																									
2.6	Test GPS Sensor	Spandan, Sachi																									
2.7	Test Motor Controllers & Motors	Electrical Committee																									
2.8	Finalize Design and Perform review	Electrical Committee																									
3	**Inventory Management**																										
3.1	Finish Bill of Materials	Noah, Hari, Sachi																									
3.2	Order Parts	Hari																									
3.3	Check and Maintain inventory	Noah, Hari, Huy																									
4	**Implementation**																										
4.1	Write base I/O Code for drivetrain function	Spandan, Huy, Hari																									
4.2	Write base code to get Compass Heading from IMU	Spandan, Huy, Hari																									
4.3	Write base code to extract GPS coordinates	Spandan, Huy, Hari																									
4.4	Assist Backend Development and service as needed	Spandan, Huy, Hari																									

ELECTRONICS ASSEMBLY



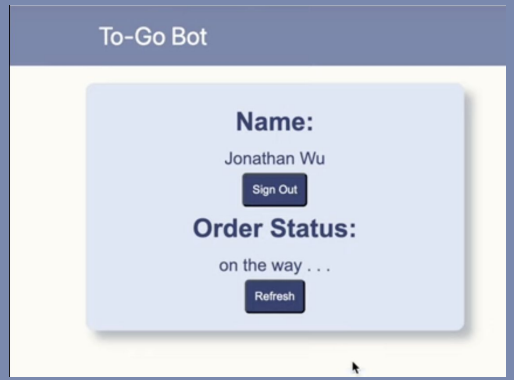
2.3 PATHFINDING COMMITTEE

PATHFINDING OBJECTIVES

1. Utilize ultrasonic sensors & program the robot to stop upon sensing an obstacle to stop -> go
2. Create Firebase to allow for sign in & out on website
3. Create a simulation of the Dijkstra's algorithm on 7th street




GOOGLE AUTHENTICATION FIREBASE



- Login button on website
- Order page prompts login before ordering
- Eases allocation of user data for orders
- Displays name for ordering

GOOGLE AUTHENTICATION FIREBASE

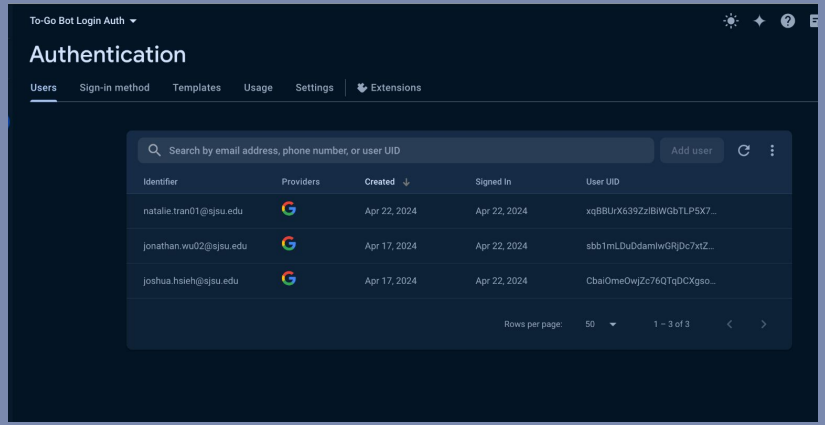
Firebase CLI

- User sign in recorded
- Extracted to JSON file and displayed in website


```
{"users": [
{
  "localId": "CbaiOmeOwjZc76QTqDCXgsozbnH2",
  "email": "joshua.hsieh@sjsu.edu",
  "emailVerified": true,
  "displayName": "Joshua Hsieh",
  "photoUrl": "https://lh3.googleusercontent.com/a/ACg8ocLg3U_ZtQpAslIpgj0XhPStBB6zef8vWgHtrsdAv8eCN9_lVg=s96-c",
  "lastSignedInAt": "1713854751231",
  "createdAt": "1713419948338",
  "providerUserInfo": [
    {
      "providerId": "google.com",
      "rawId": "101446557583461951178",
      "email": "joshua.hsieh@sjsu.edu",
      "displayName": "Joshua Hsieh",
      "photoUrl": "https://lh3.googleusercontent.com/a/ACg8ocLg3U_ZtQpAslIpgj0XhPStBB6zef8vWgHtrsdAv8eCN9_lVg=s96-c"
```

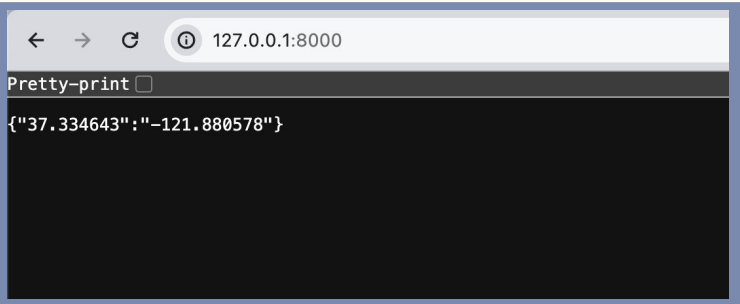

Firebase database

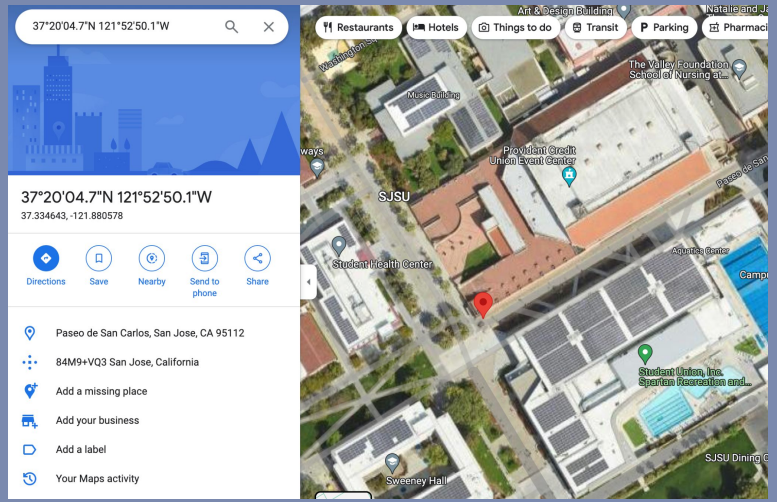
- Updates in real time
- Stores identifier, Provider, Created date, Signed in date, User UID



GPS LOCATION TRANSMITTER (FAST API)

- Extract from GPS signal into JSON file
  - Sends HTTP get request
- getLocation() method call returns coordinates in a list
- Use FASTAPI and Uvicorn to upload data onto HTTP file
- Updates coordinates in real time



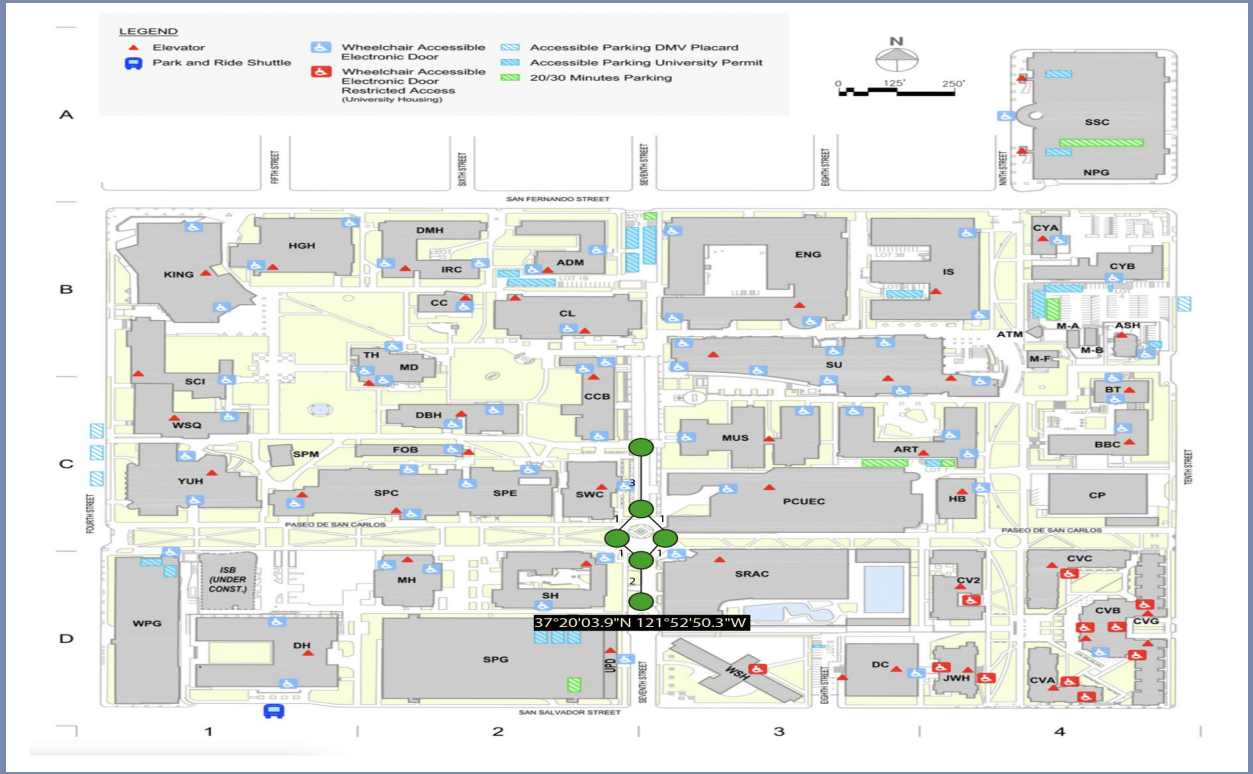


ULTRASONIC SENSOR

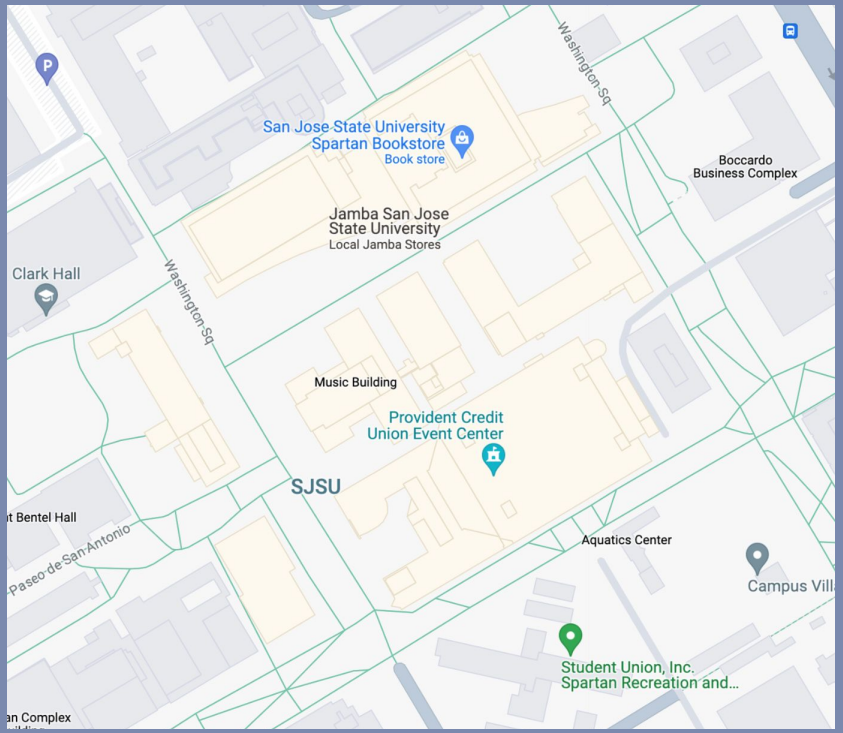
- Utilizes getDistance()
  - Detects distance and pauses robot
- Stops robot once obstacle < 1m is detected
  - Sending out pulse to get pulse duration

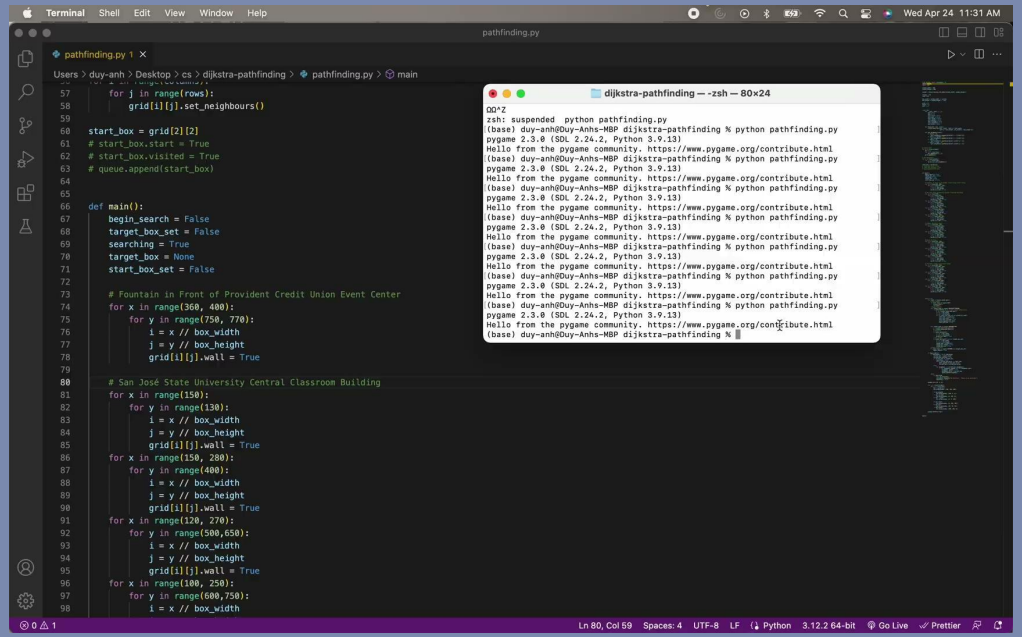
```
def getDistance(self):

    # Ensure trigger is low
    GPIO.output(self.TRIG, False)
    time.sleep(0.001)


    # Send a 10us pulse to trigger
    GPIO.output(self.TRIG, True)
    time.sleep(0.00001)
    GPIO.output(self.TRIG, False)


    # Measure the pulse length
    pulse_start = time.time()
    while GPIO.input(self.ECHO) == 0:
        pulse_start = time.time()
        time.sleep(0.0001)  # Add a small delay to prevent busy waiting

    pulse_end = time.time()
    while GPIO.input(self.ECHO) == 1:
        pulse_end = time.time()
        time.sleep(0.0001)  # Add a small delay to prevent busy waiting

    pulse_duration = pulse_end - pulse_start

    # Calculate distance (in cm)
    distance = pulse_duration * 17150
    return round(distance, 2)
```

MAP OF SAN JOSE STATE UNIVERSITY



SIMULATED MAP OF SJSU





PATHFINDING COMPLICATIONS

- Lack of ability to debug code due to dependency on the completion of the robot
- Improvised by developing an interactive map of Dijkstra's algorithm built into Pygames
- Could not use the GPS location transmitter due to original raspberry pi being fried

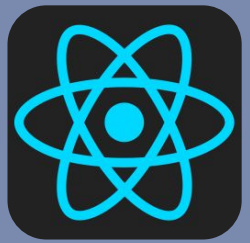
UPDATED PATHFINDING GANTT CHART

	TASK NAME	TASK OWNER	WEEK 5					WEEK 6					WEEK 7					WEEK 8					WEEK 9				
			3/18	3/19	3/20	3/21	3/22	3/25	3/26	3/27	3/28	3/29	4/8	4/9	4/10	4/11	4/12	4/15	4/16	4/17	4/18	4/19	4/22	4/23	4/24	4/25	4/26
1	**Research and Learning**	**Pathfinding Committee**																									
1.1	Research different processes/technologies	Pathfinding Committee																									
1.2	Firebase research	Albert, Athish																									
1.3	FastAPI research	Michael, Timmy, Athish, Albert																									
2	**Helping other committees**																										
2.1	Helped complete tasks with frontend	Pathfinding Committee																									
2.2	Helped electrical code motor movement	Pathfinding Committee																									
3	**Code implementation**																										
3.1	Develop psuedocode iterations for ultrasonic sensor	Athish, Albert																									
3.2	Establish/Build firebase for Frontend	Athish, Albert																									
4	**Upload Code to Rasberry Pi**																										
4.1	Firebase Implementation	Athish, Albert																									
4.2	Movement Script	Michael, Timmy																									
4.3	Djikstra's Simulation (Future Implementation)	Duy, Timmy																									
4.4	Python script for ultrasonic sensor	Michael, Timmy																									
4.5	GPS location transmitter using FastAPI	Athish, Albert																									
5	**Upload Code to Rasberry Pi/Test Product**																										
5.1	Upload and Test Movement	Pathfinding Committee																									

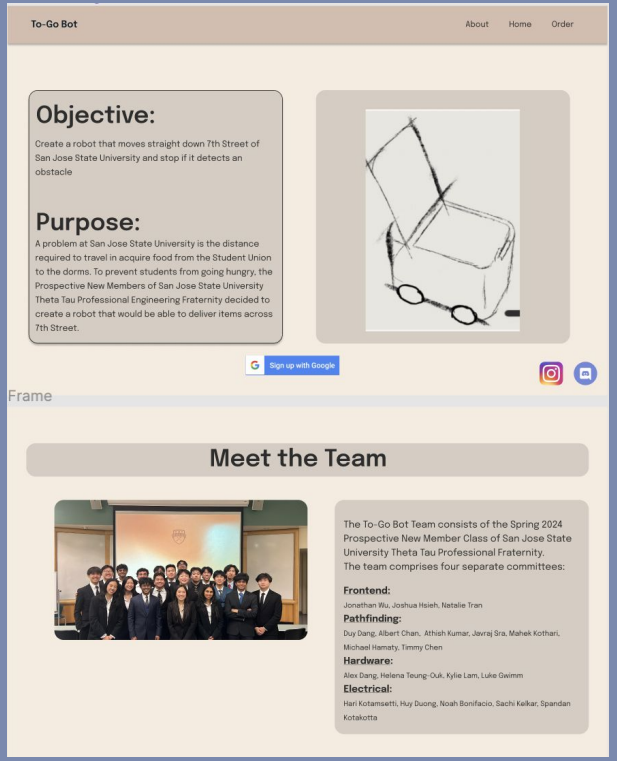
2.4 FRONTEND COMMITTEE

FRONTEND OBJECTIVES

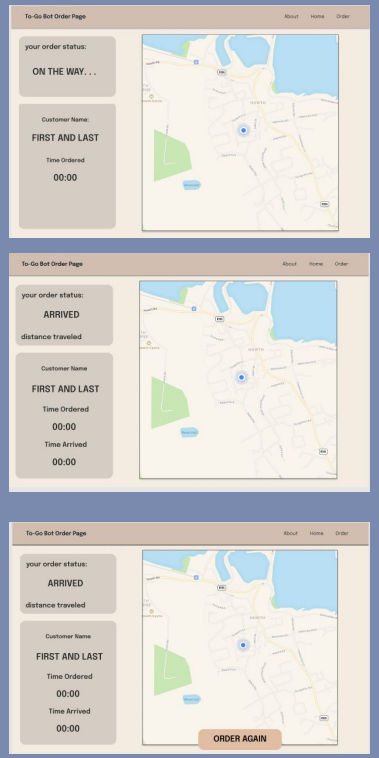
1. Create pages to display:
    a. Context of the Project
    b. Objective and Team Members
    c. Login with Google
    d. Location of the robot
2. Display using Google Maps API
3. Create a visually appealing website



FIGMA

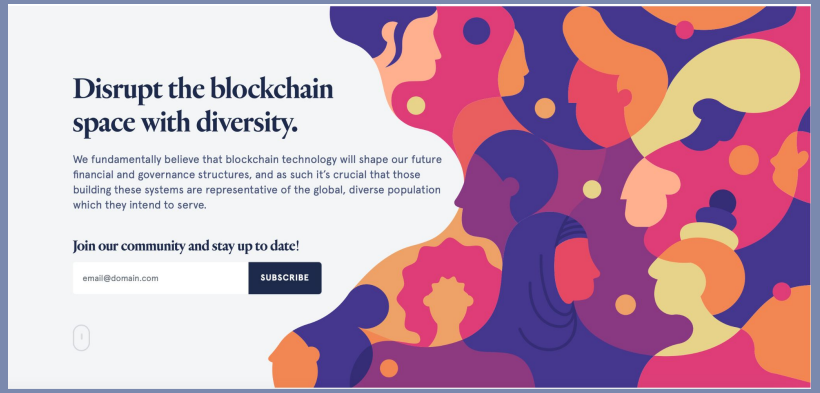

To-Go Bot
About
Home
Order
Objective:
Create a robot that moves straight down 7th Street of San Jose State University and stop if it detects an obstacle
Purpose:
A problem at San Jose State University is the distance required to travel in acquire food from the Student Union to the dorms. To prevent students from going hungry, the Prospective New Members of San Jose State University Theta Tau Professional Engineering Fraternity decided to create a robot that would be able to deliver items across 7th Street.
Sign up with Google
Frame
Meet the Team
The To-Go Bot Team consists of the Spring 2024 Prospective New Member Class of San Jose State University Theta Tau Professional Fraternity.
The team comprises four separate committees:
Frontend:
Jonathan Wu, Joshua Hsieh, Natalie Tran
Pathfinding:
Duy Dang, Albert Chan, Athish Kumar, Javraj Sra, Mahek Kothari, Michael Hamaty, Timmy Chen
Hardware:
Alex Dang, Helena Teung-Ouk, Kylie Lam, Luke Gwimm
Electrical:
Hari Kotamsetti, Huy Duong, Noah Bonifacio, Sachi Kelkar, Spandan Kotakotta


To-Go Bot Order Page
About
Home
Order
Order
At the press of this button, the autonomous robot will deliver the food to your location!


To-Go Bot Order Page
About
Home
Order
your order status:
ON THE WAY...
Customer Name:
FIRST AND LAST
Time Ordered
00:00
your order status:
ARRIVED
distance traveled
Customer Name
FIRST AND LAST
Time Ordered
00:00
Time Arrived
00:00
your order status:
ARRIVED
distance traveled
Customer Name
FIRST AND LAST
Time Ordered
00:00
Time Arrived
00:00
ORDER AGAIN

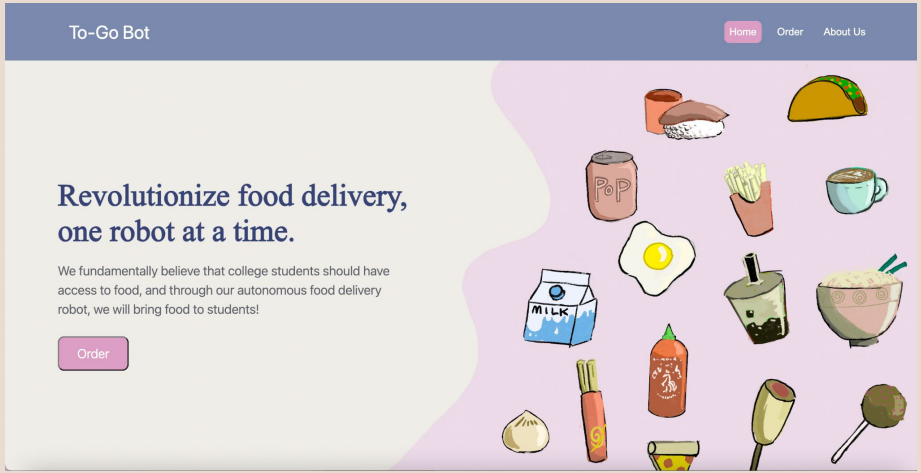
MOCKUP UPDATE

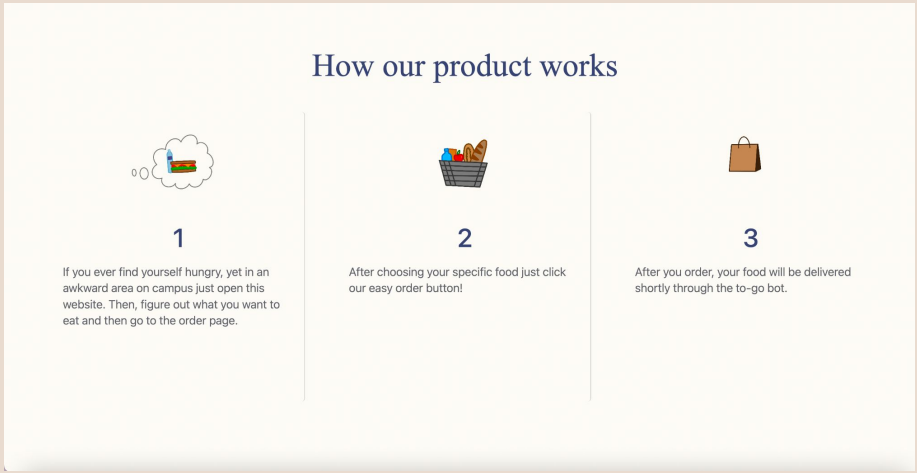
- **Home Page**
  - Helps users understand product easily
  - Easy user navigation
- **Color Scheme**
- **Visuals**
  - User engagement
  - User retention
- **References**
  - she256.org
    - Problem statement banner
    - Built around the consumer
    - Common theme



NAVIGATION BAR AND FOOTER

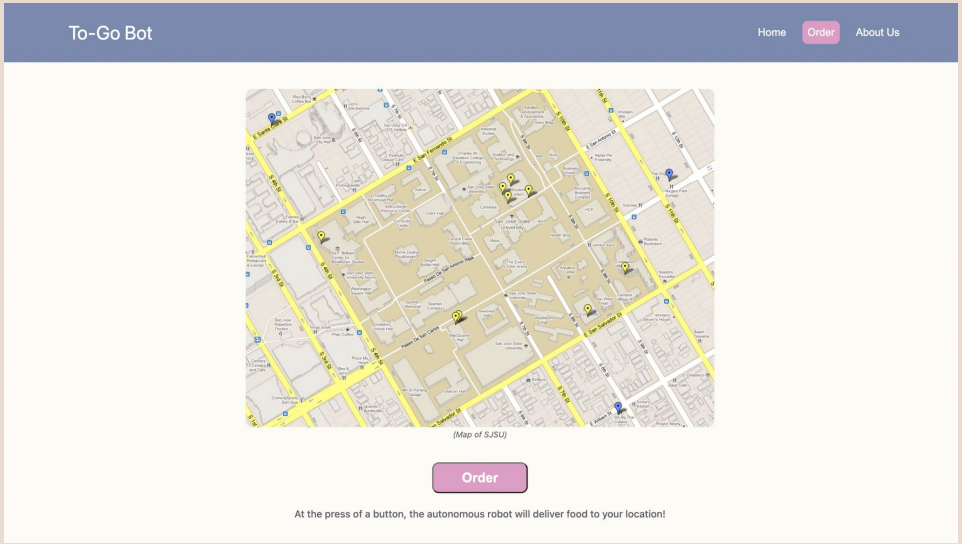
HOME PAGE


To-Go Bot
Home
Order
About Us
Revolutionize food delivery, one robot at a time.
We fundamentally believe that college students should have access to food, and through our autonomous food delivery robot, we will bring food to students!
Order
MILK
POP


How our product works
1
If you ever find yourself hungry, yet in an awkward area on campus just open this website. Then, figure out what you want to eat and then go to the order page.
2
After choosing your specific food just click our easy order button!
3
After you order, your food will be delivered shortly through the to-go bot.

ORDER PAGE

- For MVP:
  - Locate the robot's location
- Future Implementation:
  - Order calls the robot to user's location
  - Connect to third-party delivery service



ABOUT US PAGE

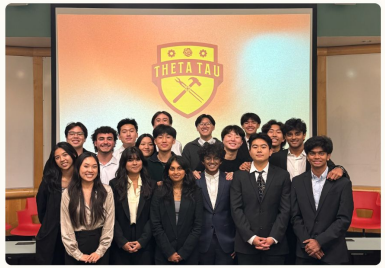
Our Mission

A problem at San Jose State University is the distance required to travel to acquire food from the Student Union to the dorms. To prevent students from going hungry, the Prospective New Members of San Jose State University Theta Tau Professional Engineering Fraternity decided to create a robot that would be able to deliver items across 7th Street.

(Our Product)

Powered by People

The To-Go Bot Team consists of the Spring 2024 Prospective New Member Class of San Jose State University Theta Tau Professional Fraternity.



Frontend:
Jonathan Wu, Joshua Hsieh, Natalie Tran, Mahek Kothari

Pathfinding:
Duy Dang, Albert Chan, Athish Kumar, Michael Hamaty, Timmy Chen

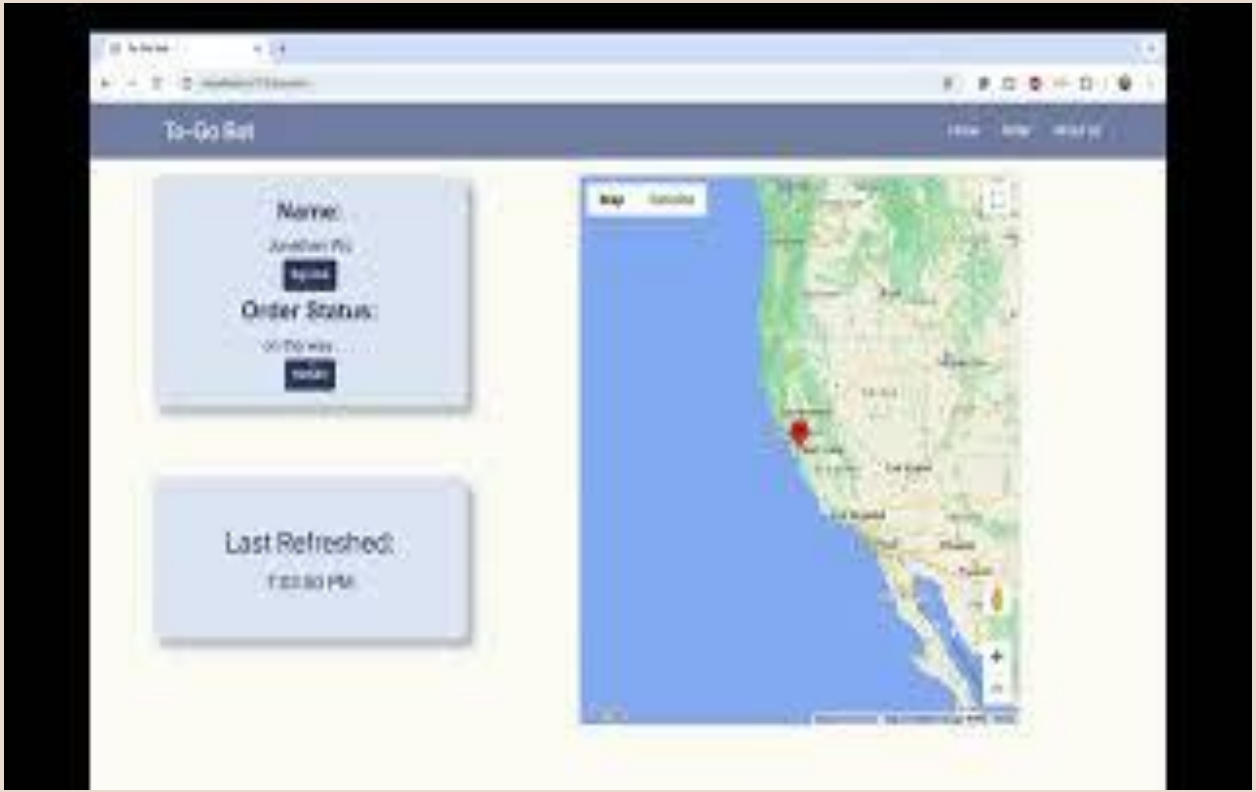
Hardware:
Alex Dang, Helena Teung-Ouk, Kylie Lam, Luke Gwimm

Electrical:
Hari Kotamsetti, Huy Duong, Noah Bonifacio, Sachi Kelkar, Spandan Kotakotta

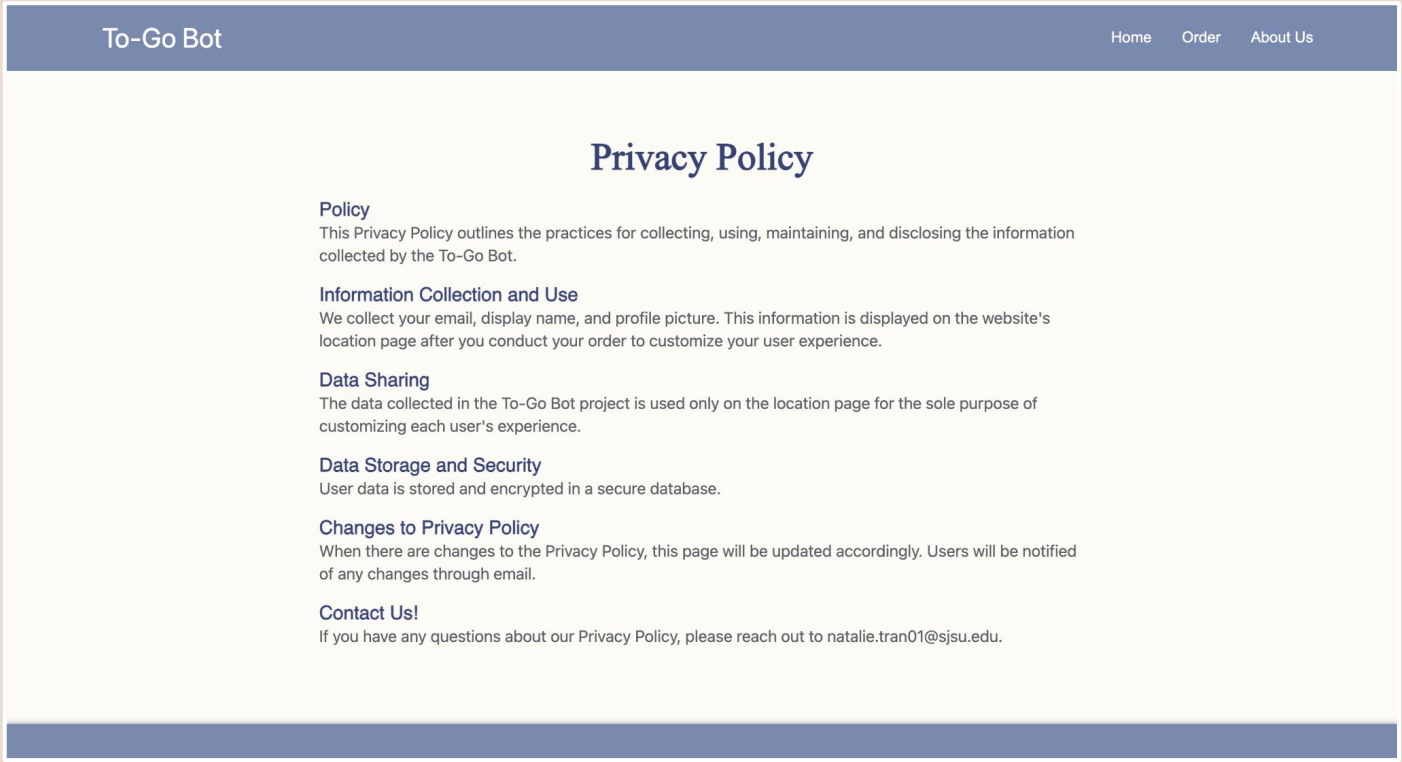
ABOUT US PAGE

Meet the Team

LOGIN AND LOCATION PAGE



PRIVACY PAGE



FRONTEND COMPLICATIONS

- GitHub branching and merge conflicts
- Adjusting padding and margins
- Trouble with Banner Styling
  - Creating a separate component
- Importing the correct files

FRONTEND GANTT CHART

	TASK NAME	TASK OWNERS	WEEK 5					WEEK 6					WEEK 7					WEEK 8					WEEK 9				
			3/19	3/20	3/21	3/22	3/23	3/25	3/26	3/27	3/28	3/29	4/8	4/9	4/10	4/11	4/12	4/15	4/16	4/17	4/18	4/19	4/22	4/23	4/24	4/25	4/26
1	**Code Implementation**																										
1.1	Finalize mockups on Figma	Jonathan, Joshua, Mahek, Natalie																									
1.2	Implement About Page	Mahek and Natalie																									
1.3	Implement Location Page	Jonathan																									
1.4	Implement "Order" Page	Jonathan and Natalie																									
1.5	Implement Login Page	Joshua and Jonathan																									
1.6	Implement Policy Page	Natalie																									
1.7	Polish consistency	Jonathan, Joshua, Mahek, Natalie																									
2	**Page Routing**																										
2.1	Routing the pages(header)	Joshua																									
2.2	Routing the pages(footer)	Joshua																									
3	**Testing with rest of team**																										
3.1	Connecting with backend	Jonathan																									
3.2	Debug	Jonathan, Josh, Mahek, Natalie																									
3.3	Final testing	Jonathan, Josh, Mahek, Natalie																									

03 COST BREAKDOWN

BILL OF MATERIALS

PARTS					
Materials	Cost	Quantity	Supplier	Already in possesion?	Total
electronics:					
Raspberry Pi 3B	$50.00	1	Amazon	Yes	$50.00
L298N Motor Controllers (4 pack)	$9.99	1	Amazon	Yes	$9.99
DC Motors with Encoders	$33.99	2	Amazon	Yes	$67.98
9g Servo SMRAZA	$0.00	1	Amazon	Yes	$0.00
HC-SR04 Ultrasonic Sensor (5 pack)	$8.99	1	Amazon	Yes	$8.99
Blomiky 2 Pack	$23.99	1	Amazon	Yes	$23.99
UBX-M10050-KB GNSS BE-180 GPS Module Beidou	$16.89	1	Amazon	Yes	$16.89
Berry IMU	$40.00	1	Amazon	Yes	$40.00
Antennea	$8.99	1		Yes	$8.99
GPS	$17.99	1	Amazon	Yes	$17.99
hardware:					
1 Kg 3D Printing Filament (PLA)	$13.99	2	Amazon	Yes	$27.98
58mm Omni Wheels	$25.58	2	Amazon	Yes	$51.16
M3 Screws and Standoffs (260pcs)	$7.99	1	Amazon	Yes	$7.99
BQLZR Blue 6mm Aluminum Shaft	$6.55	1	Amazon	Yes	$6.55
uxcell 606-2RS Deep Groove Ball Bearing	$8.09	1	Amazon	Yes	$8.09
				Total Cost	$346.59

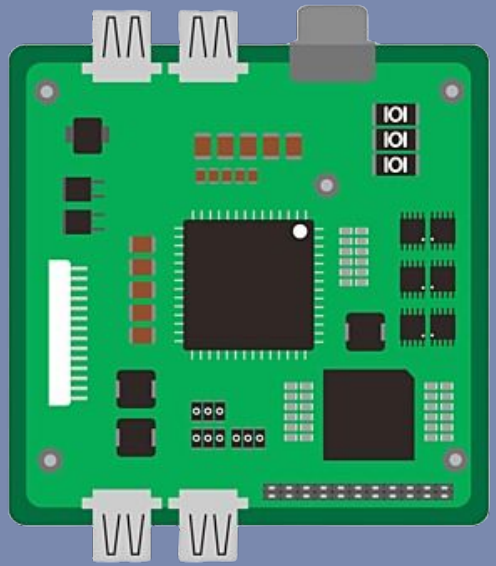
04 FUTURE IMPLEMENTATIONS

HARDWARE FUTURE IMPLEMENTATIONS

- Have a better material for the Carrier Box
- Latch Mechanism and Password Protected
- Metal Chassis and Bigger/Better Wheels

ELECTRICAL FUTURE IMPLEMENTATIONS

- All-Wheel Drive instead of Rear-Wheel Drive → Improve handling
- Output Filters to minimize voltage spikes
- Creating custom PCB
    - Streamlining power and logic lines without need of manual and complicated wiring.



PATHFINDING FUTURE IMPLEMENTATIONS

- Create an algorithm with an API node located at pick up/drop off locations
- Implement a more effective object detection system by using computer vision via camera through OpenCV
- Utilize a power train system to transmit power to all wheels

FRONTEND FUTURE IMPLEMENTATIONS

- Deploy on Vercel
- Having cloud base for the login and passwords
- Find collaborators for order transaction handling

SOURCES

National study of more than 7,000 college students shows delivery robots help students feel safer, skip fewer meals and improve their mental health - Starship Technologies: Autonomous robot delivery. (2022). Retrieved March 15, 2024, from Starship Technologies: Autonomous robot delivery website: https://www.starship.xyz/press_releases/national-study-of-more-than-7000-college-students-shows-delivery-robots-help-students-feel-safer-skip-fewer-meals-and-improve-their-mental-health/

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THANK YOU!

ANY QUESTIONS?