

RE-SPACE

Re-thinking your space

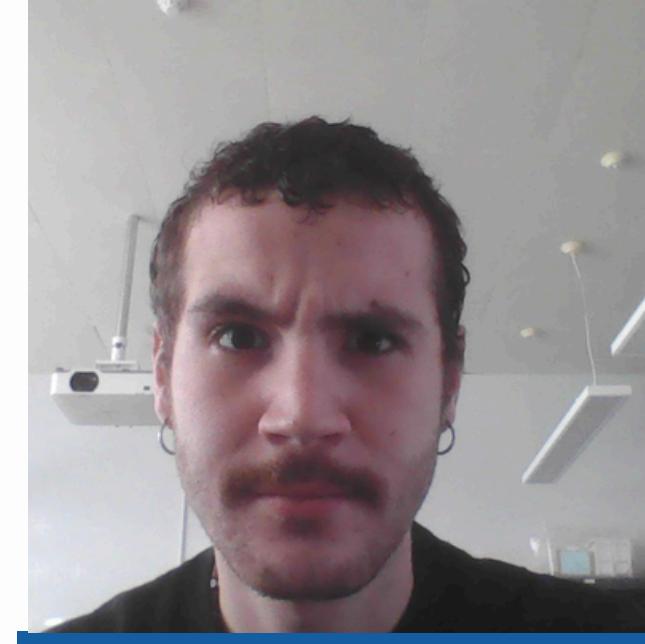
Our Team



Josh Beckett
Robotics Engineer



Daniel Arruda
Robotics Engineer



Ronny Ben Yehuda
Robotics Engineer



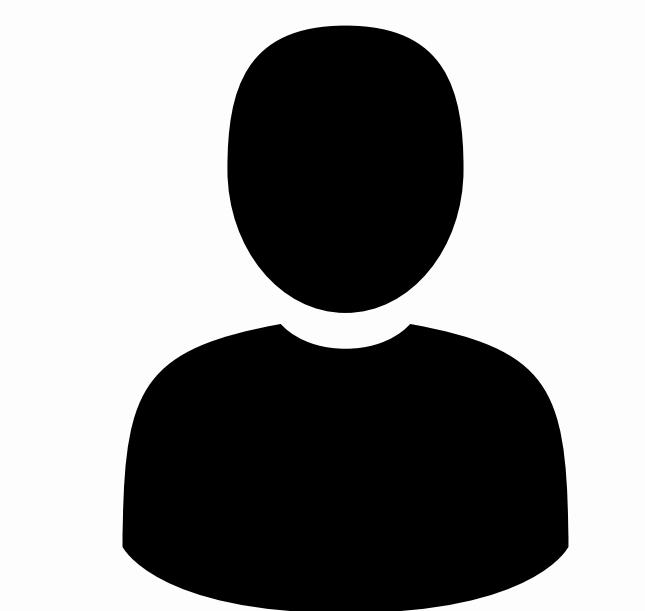
Maya Rogers
Robotics Engineer



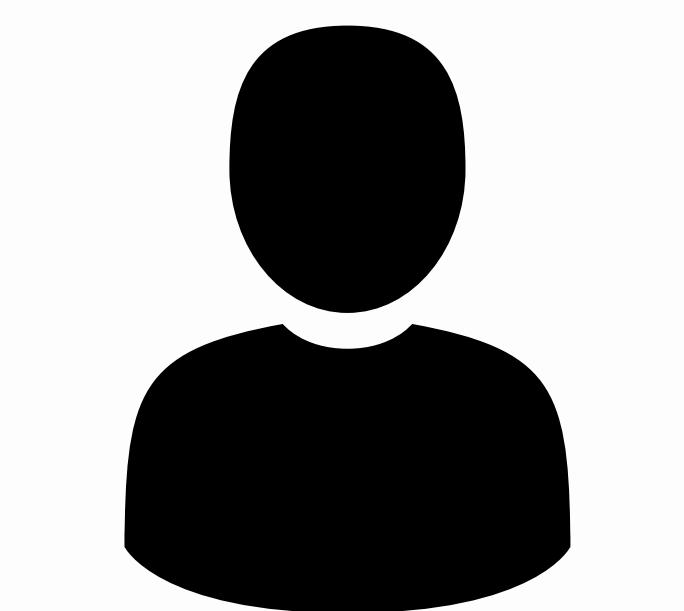
Louis Douglas
Computer Scientist



Alex Purser
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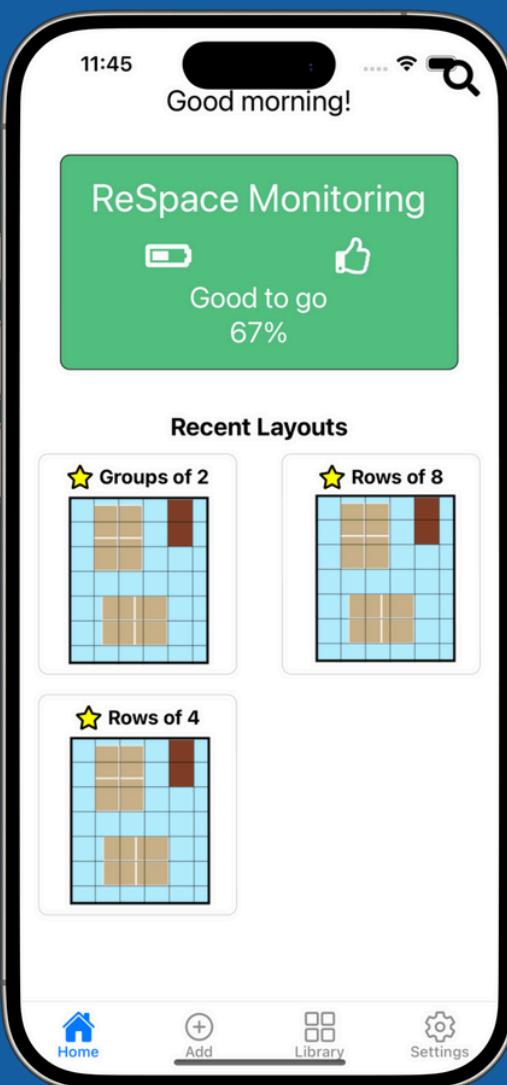
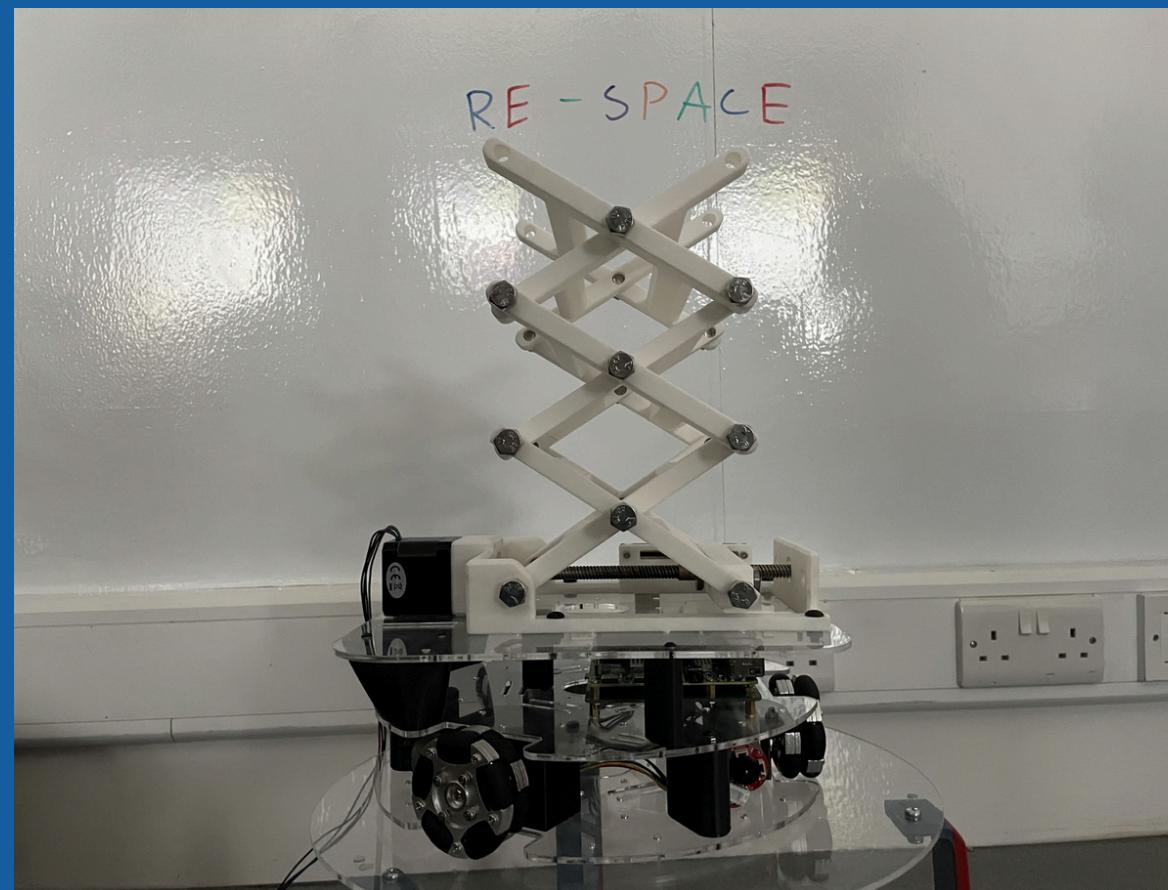


Victor
Computer Scientist



Cas Penfold
Robotics Engineer

The Product



MARKET RESEARCH



Market Research - Convention halls

Market Demand & Financial Implications:

High Setup Costs: A pre-feasibility study for a banquet hall with **500 guests** showed direct labor costs of ₹3,540,000 annually (~£10,300). (Source: commerce.gov.pk)

Efficiency & Cost Reduction:

- **Labor Costs:** Convention hall venues rely on manual labor for furniture setup, making the process **costly and time-consuming.**
- **Time Investment:** Setting up event spaces takes time, a *skilled workforce* and meticulous coordination.

Market Trends:

Increased Budgets: 57% of UK businesses plan to **increase their conference budgets** next year, additionally convention halls like NEC Birmingham bring in 3,000,000 visitors annually . (Source: imagovenues.co.uk)

Similar Products - Warehouse Robots



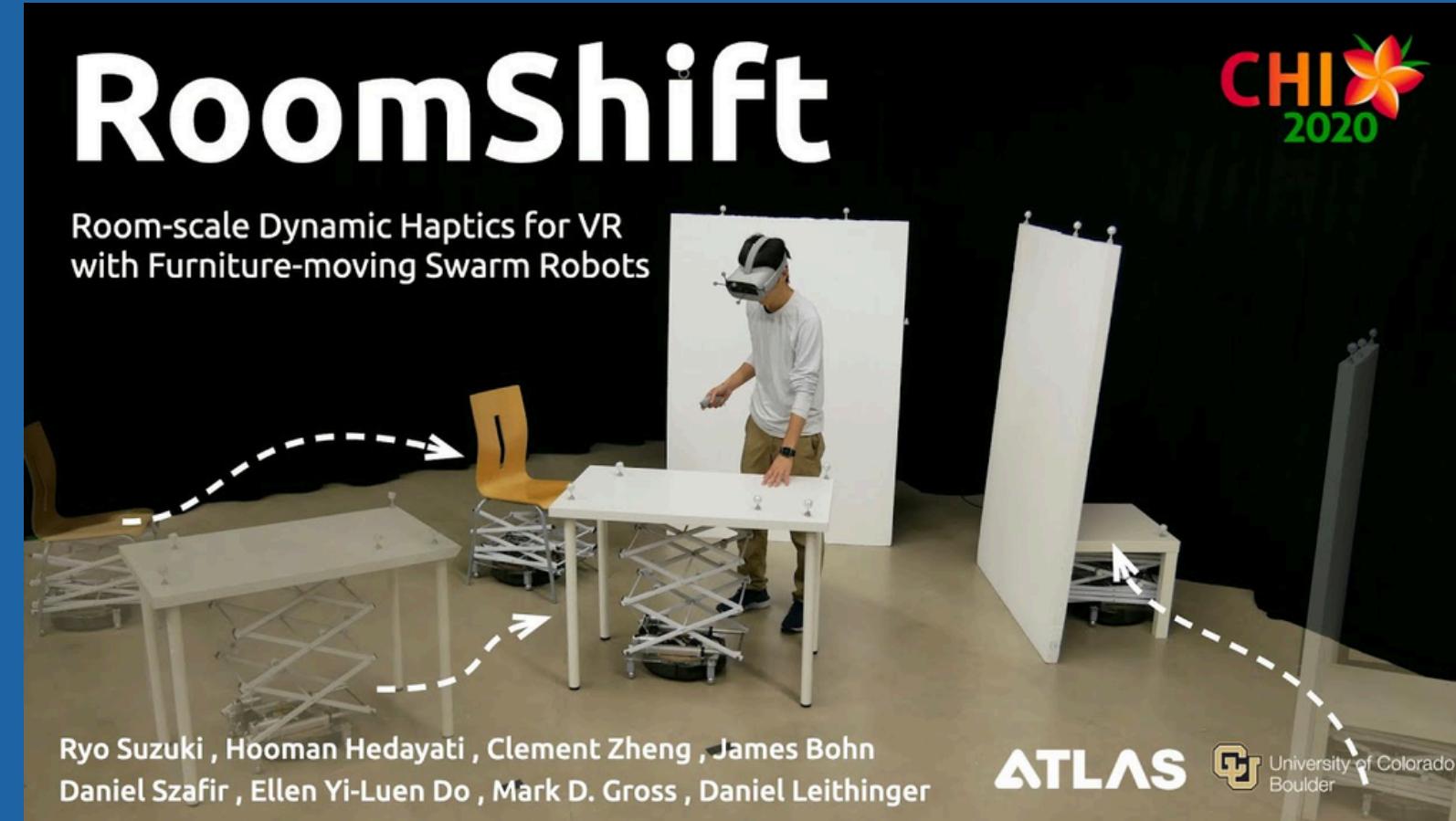
Navigation:

- Use sensors (e.g., LiDAR, cameras) to map the warehouse.
- Move along predefined paths or autonomously avoid obstacles.

Box Identification:

- Read barcodes, QR codes, or RFID tags.
- Use cameras for visual recognition.

Similar Products - RoomShift



- Swarm robots designed to reconfigure physical spaces
- Synchronises with a VR environment
- Shows feasibility of using multiple robots to work together to dynamically move and reconfigure physical objects.
- The robots are equipped with scissor lifts made from expandable laundry racks.
- The system adjusts the physical layout in real-time

DEVELOPED SYSTEM

Minimum Viable Product

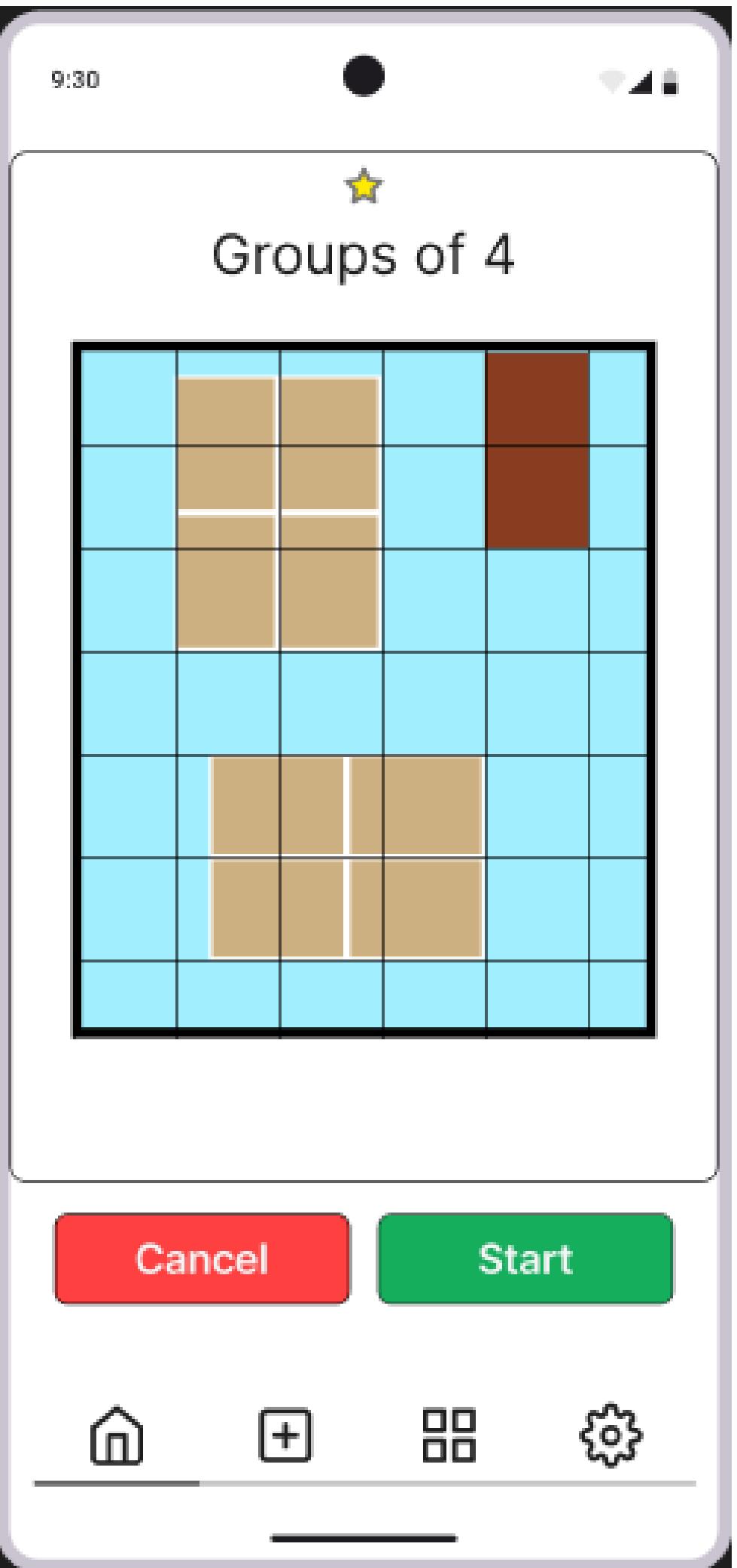
Our minimum viable product is a fully operational robot that is able to communicate with our app. The robot will be able to move to a specified location and lift a bespoke piece of furniture and move it to desired location.

A user friendly app for easy organisation



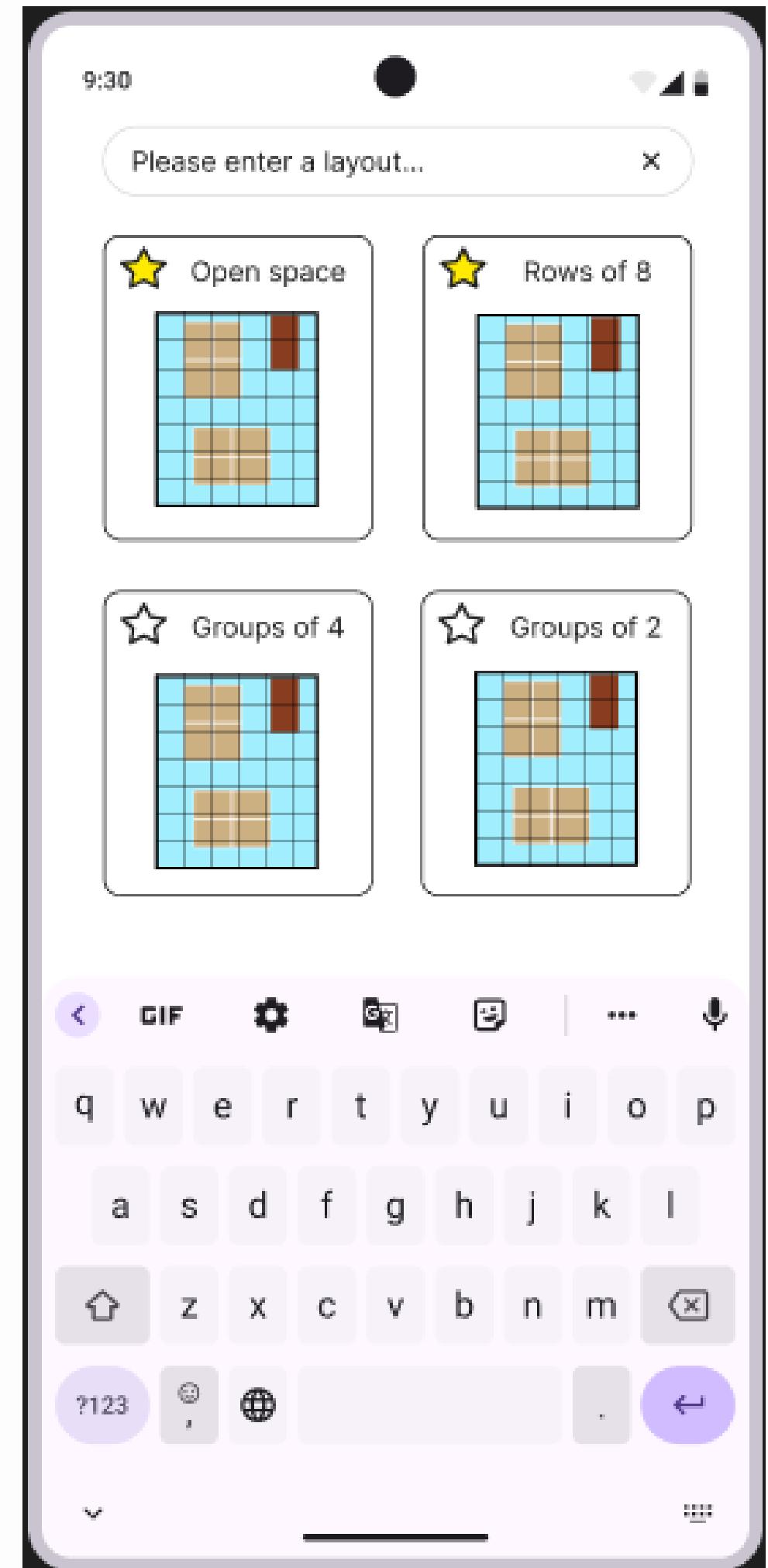
Drag and Drop

- Grid-based.
- Components will “snap” to the grid layout making it easier to use.
- Customisable name.
- Favourite button for easy access.
- Visual objects will be made from user input and sized accordingly.
- Menu located on side for adding and placing new objects.
- Each grid tile will be the squared width of the robot allowing for accurate placement regardless of object size.

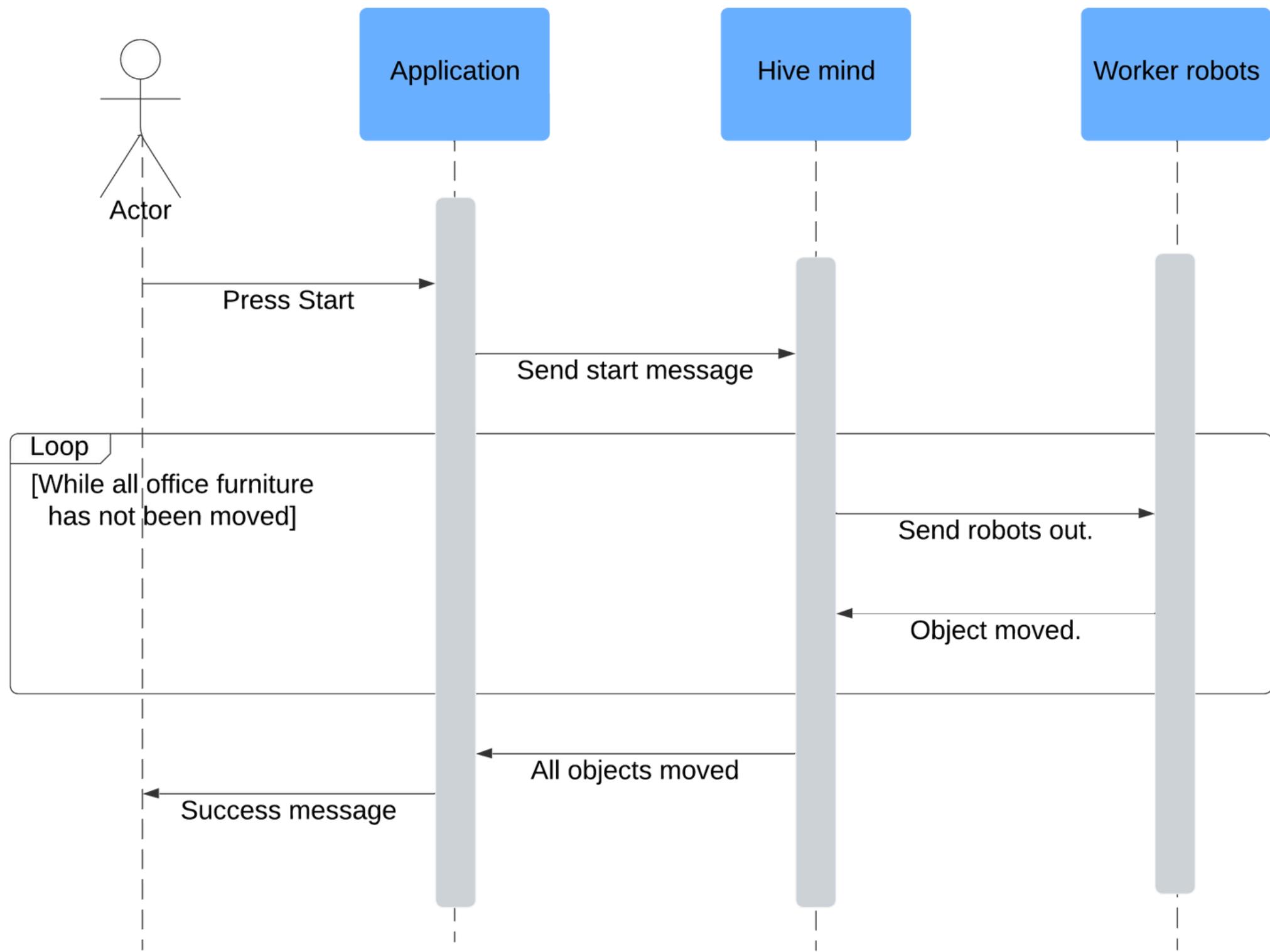
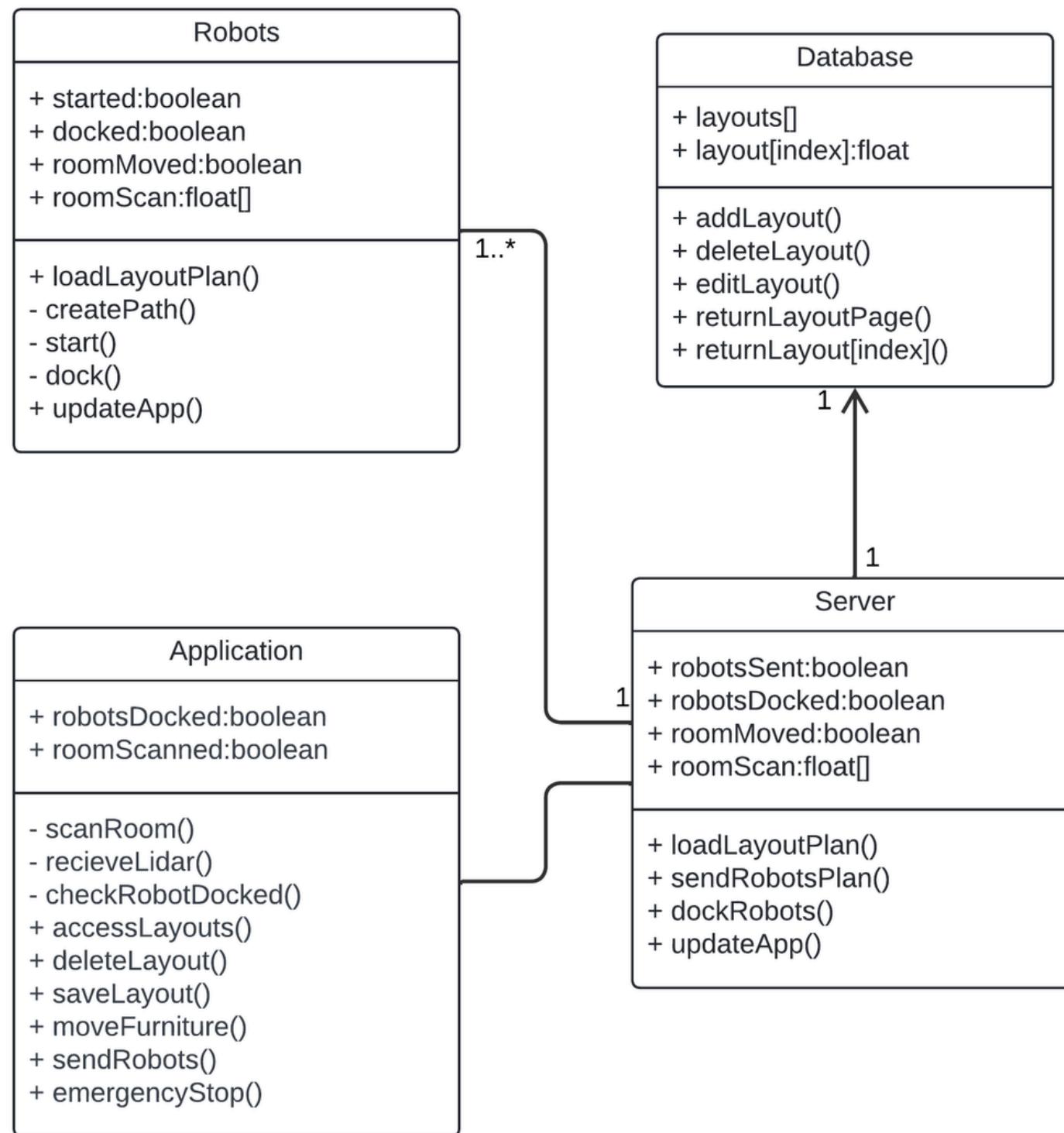


Library and Storage

- Search bar for filtering and identifying desired layouts.
- Layouts are stored with a title and image for quick access.
- Filters for type of layout and quantity.
- All stored locally using JSON.

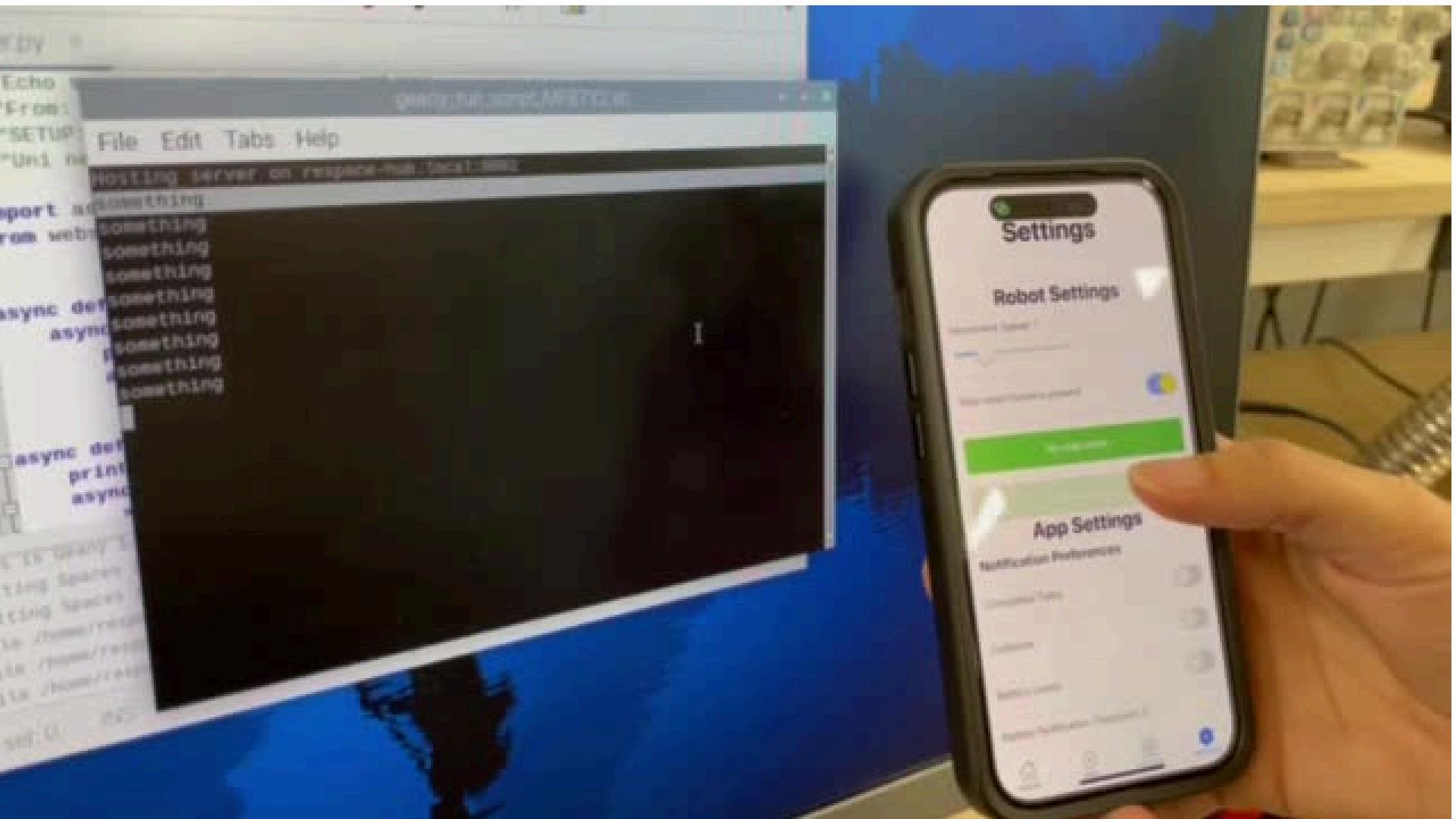


Behind the Application

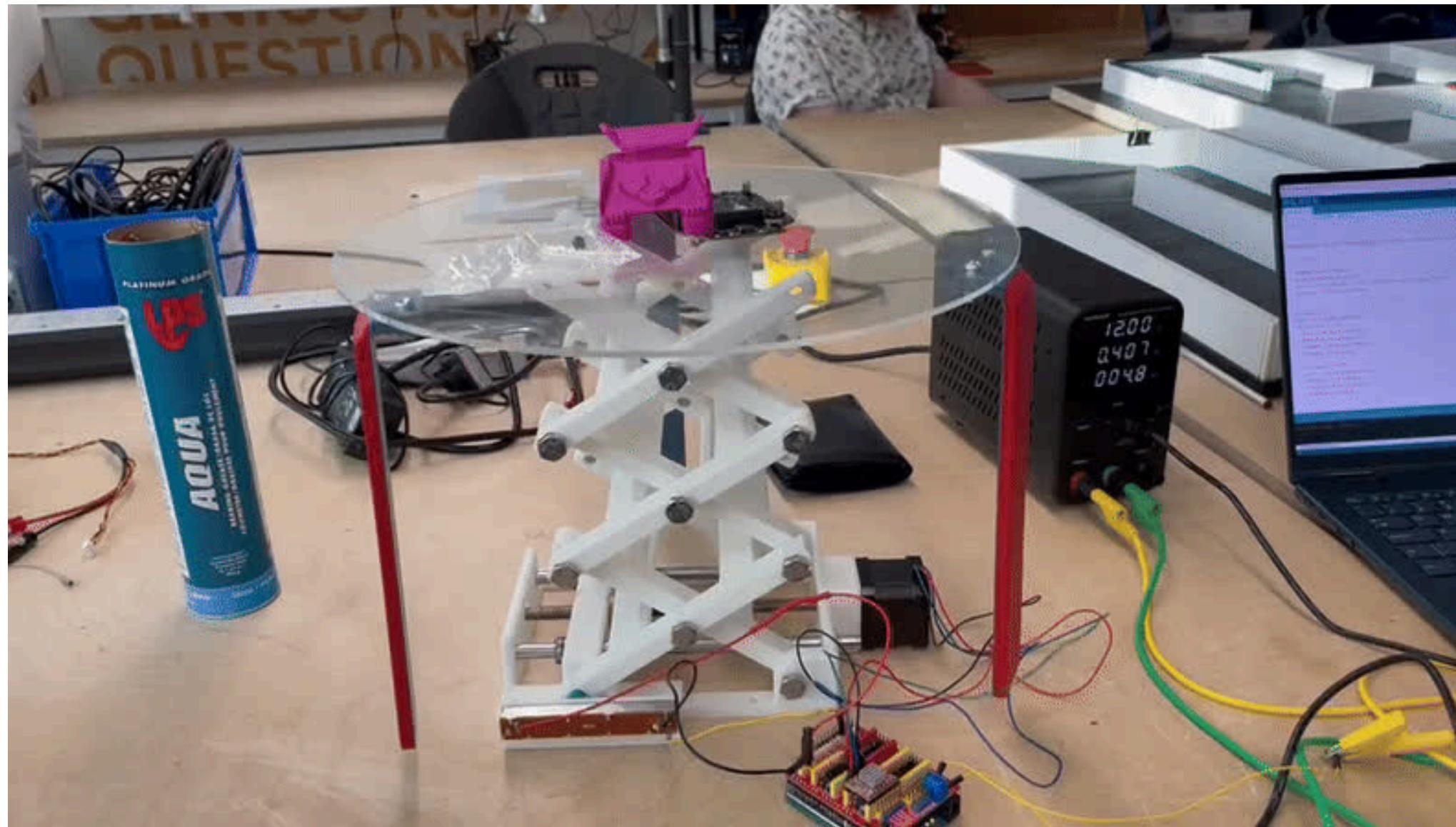


Communication Hub

- The gateway server between the app and the robot will run on a Pi4
- All Devices/Components connect to a Local Area Network (LAN) via WIFI with unique preset hostnames for easy identification.
- React Native App uses a WebSocket API with JSON for simple two-way communication with the HUB.
- HUB/Server receives instructions from the App, relays information to swarm using a WebSocket connection.
- Swarm Robots communicate directly for instantaneous transmission of information to assist in simultaneous collaboration.



Development of Robot - Scissor Lift



Goal Weight: 7kg

Goal Max Height: 500mm

Initial Prototype Specs

Lifting Weight: 0.5kg - 0.8kg

Max Height: 420mm

To do this use of an improved stepper motor and a smaller increment lead screw will be used that is project to provide 13.4kg-21.4kg

Development of Robot - Wheels

Aluminum Alloy Omni Wheels will be used for this project

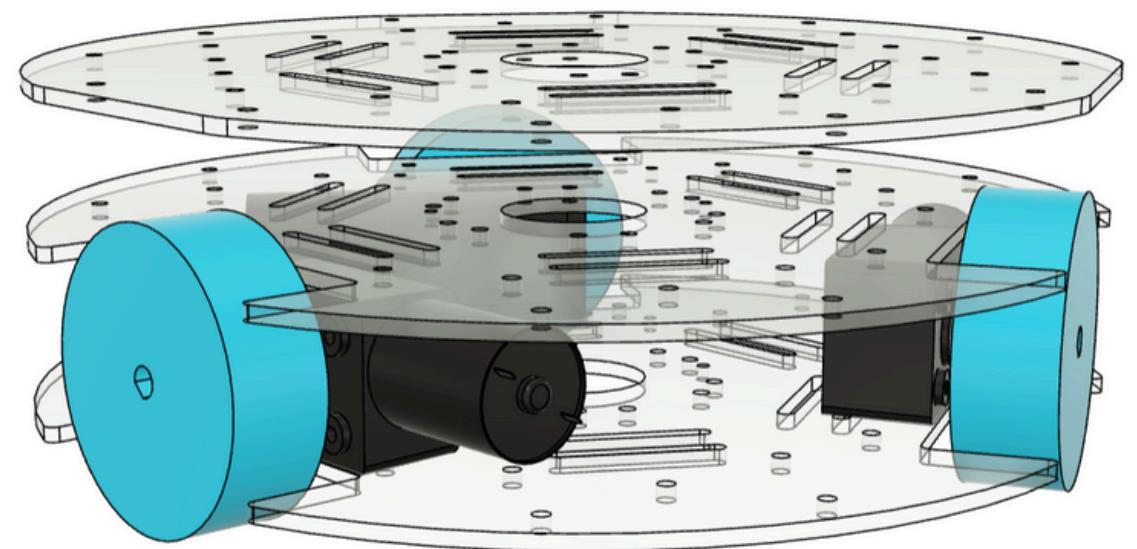
Single Wheel Capacity:

- Each wheel supports up to 15 kg**



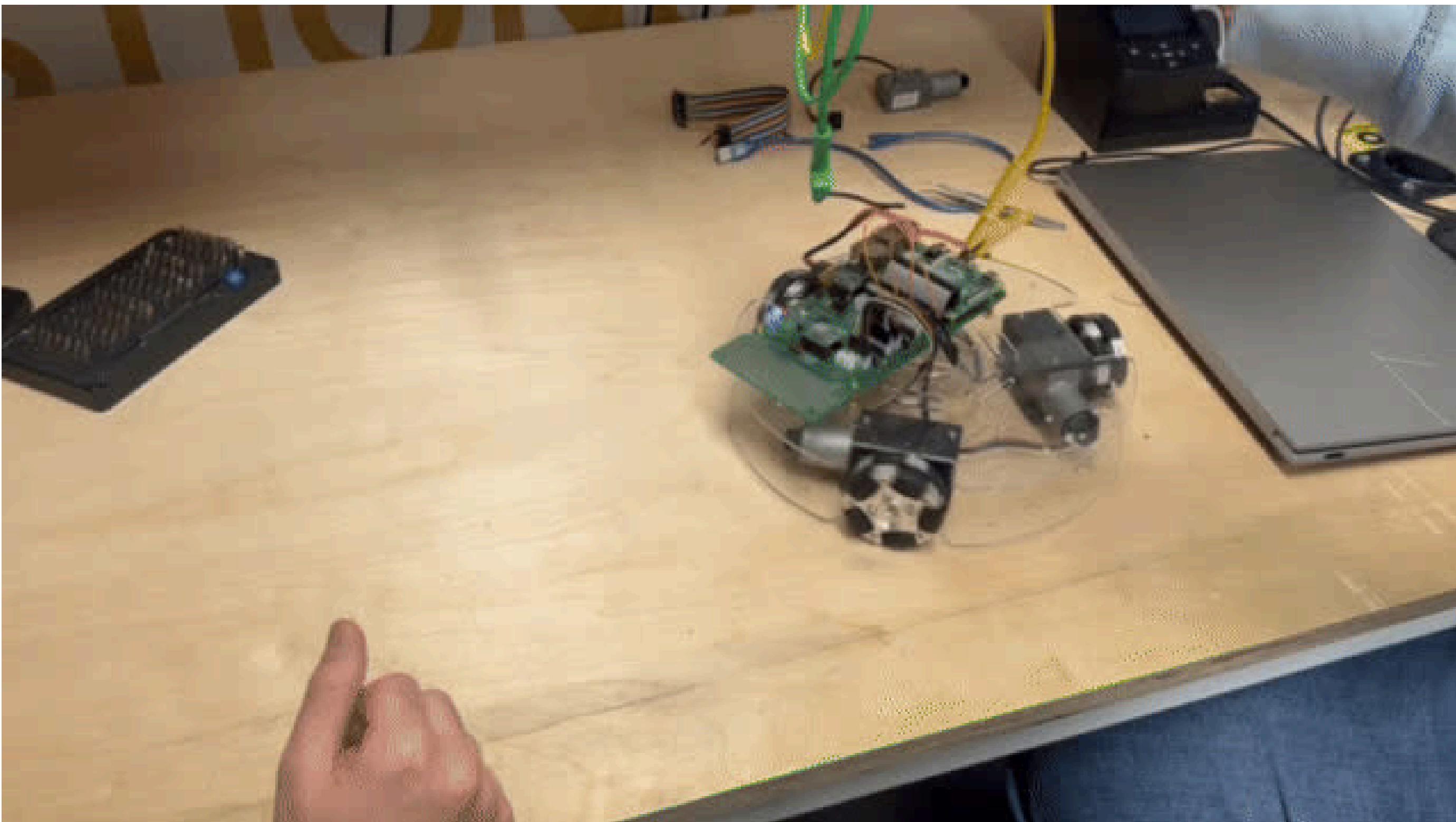
Three-Wheel Design:

- when the load is distributed equally among the three wheels the total capacity would be 45kg
(operational capacity would around 40kg)**



This leaves us a lot of breathing room as the current prototype is 2.5kg

Development of Robot - Locomotion



Development of Robot - Lidar

Functionality:

- **Enables room mapping and furniture target detection.**
- **Process:**
 - a. Initial Scan: Maps the room's size and layout.**
 - b. Secondary Scan: Identifies the positions of chair and table legs.**

This ensures precise navigation and efficient furniture handling.



Development of Robot - Camera

Camera: PS3 EyeToy

- **Well-suited for machine vision tasks.**
- **Affordable and widely available.**

Planned Mounting Location:

- **Positioned on the top plate of the scissor lift to avoid obstructions.**

ArUco marker detection:

- **ArUco Markers: Basic QR codes that can encode an integer between 1-255 (custom dictionaries can increase this limit)**



Development of Robot - The Swarm



Will be making use of a centralised swarm system that allows for dynamic amounts of worker robots and easy task designation.

Safety Features

01

By using the LiDAR sensor, detection of any moving objects (humans) within a specified range will cause the system to immediately stop

02

When system is operating, there will be appropriate high visibility lighting and audio cues to ensure nearby people are aware of the potential hazard

03

Enclosed charging hub, ensures that access to the robot is controlled and secure

04

Emergency stop button will be active on the application when the system is running. In the event an error occurs, the user can press the button and shut down all the active robots. Uses WebSockets for fast real-time communication.

Cybersecurity

01

Login system and user authentication. Users will be prompted with a login system featuring a username and password for correct authentication.

02

Internet connectivity detection. The system will detect if the network is unresponsive and shuts down the robots to ensure safety.

03

Data protection. Accounts will be stored locally but will be salted, peppered, hashed, and encrypted, providing the maximum possible security.

04

End-to-End encryption for communications by using WebSockets over SSL/TLS, this ensures actions and updates are secured to only the user with the app and the hub/workers.

FINANCES

Subscription Service

Component and Manufacturing Costs:

- Robot Cost Breakdown:
 - Components: £258.40
 - Manufacturing, development, and team support: £741.60
 - Total cost per robot: £1,000

Monthly Subscription Pricing Calculation:

- 1.Cost Recovery Over 24 Months:
 - Monthly subscription fee per customer: $\text{£1,000} \div 24 = \text{£41.67}$
- 2.Cost Recovery Over 12 Months (Faster ROI):
 - Monthly subscription fee per customer: $\text{£1,000} \div 12 = \text{£83.33}$

Factoring a profit margin by multiplying our costs by a factor of 1.3, would give us profits of 400 pounds over a year, $1,000 \times 1.3 = 1400$, $1400 \div 12 = \text{£116 per month}$

Service Offering:

- Subscription Inclusions:
 - Access to Respace drones for automated furniture relocation.
 - Technical support team for setup and debugging.



PROJECT TIMELINE

RE-SPACE

Development Timeline

The Gantt chart illustrates the project timeline from Week 1 to Week 15. The tasks and their durations are as follows:

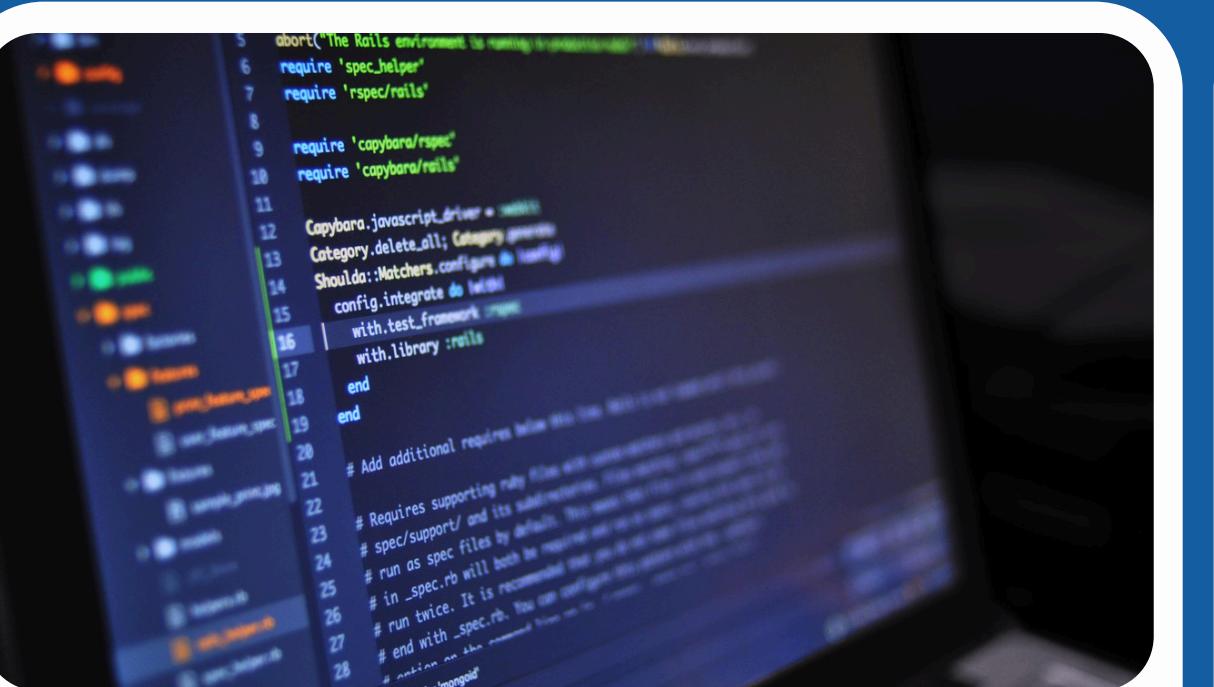
- Swarm**: Week 6 - Week 10 (5 weeks)
- Second robot manufacture**: Week 8 - Week 11 (4 weeks)
- Camera**: Week 1 - Week 3 (3 weeks)
- Lidar**: Week 1 - Week 5 (5 weeks)
- Drag and drop for app**: Week 4 - Week 7 (4 weeks)
- App integration**: Week 1 - Week 3 (3 weeks)
- Central hub**: Week 8 - Week 12 (5 weeks)
- Cyber security**: Week 6 - Week 10 (5 weeks)
- Testing and polishing phase**: Week 12 - Week 15 (4 weeks)

Potential Goals



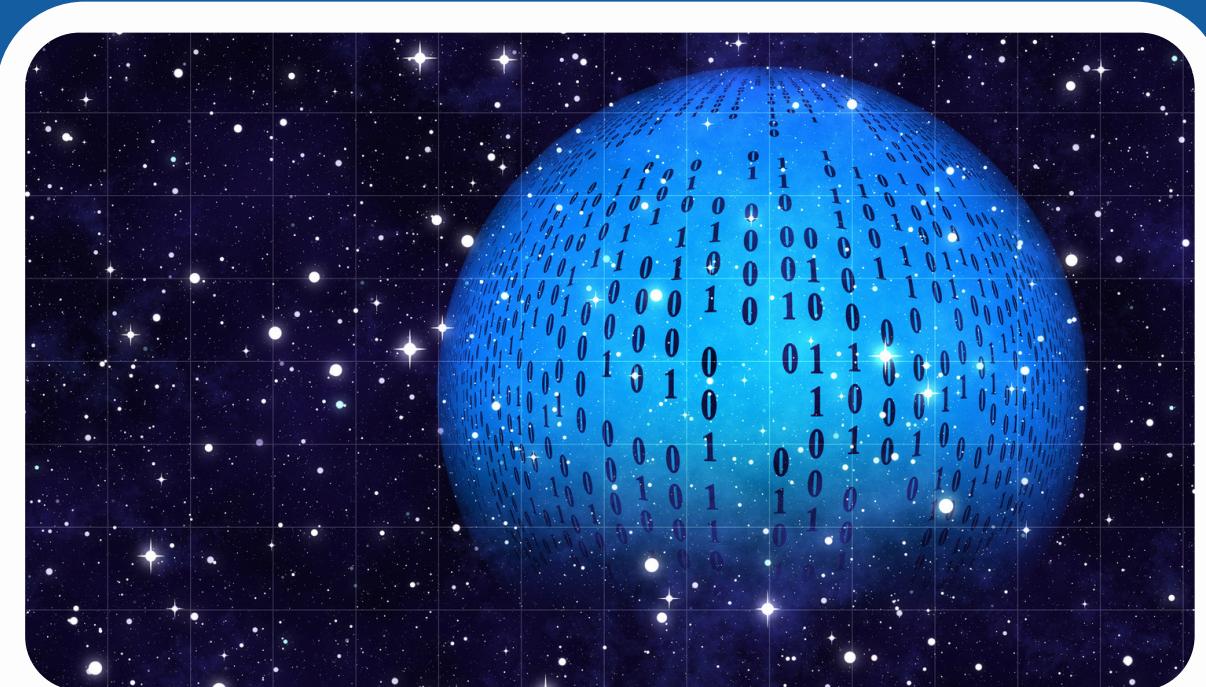
Manual Control

Manual control will be added for driving the robot via the app. This allows for more precise and unique movements, achievable through a controller built into the application.



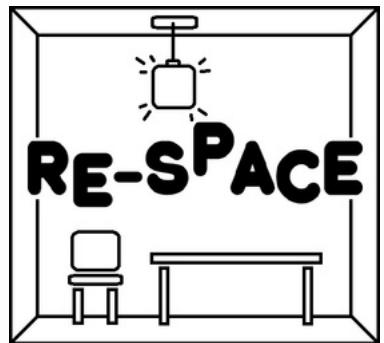
Modular Charging Hubs

For increased convenience and functionality, charging hubs will be made modular. Modular hubs allow for different sizes and quantity to match demand, providing reliable and suitable access to charging.



Two Factor Authentication

For further security, two-factor authentication will be added for users. The authentication will be achieved through either the use of email or message, potentially both if necessary.



THANK YOU!

ANY QUESTIONS?

