Group B2: Robotic Indoor Plotting
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Statement of Work

With the newly developing situation, our group faces a couple logistical challenges to finishing our project as proposed. Luckily, our project is fairly modularized so that we are able to evaluate the feasibility of each component separately. Earlier this week, we met online to discuss how we can still deliver a finished project with appropriate modifications. We took into account our concerns with the original scope, components we could possibly remove, and potential additional features we could substitute for them.

Concerns about original project

- *All parts located in Pittsburgh while most of the team is not*. Since our project is centered around one connected robot, all our parts should remain together in the same place. Additionally, the fragility of the robot will make it difficult to transport. In order for us to verify that the entire system integrates and works as expected together, only Aditi (who is in Pittsburgh) will be able to access and work on them, resulting in a long testing cycle
- *Not able to test on original test cases.* The original indoor building test cases we designed our project around public spaces located in Pittsburgh. These spaces include Tepper Quad, and hallways in Wean Hall and Hammerschlag Hall. The computer vision portion of our project was dependent on standardized text labeling located near doorways. With upcoming campus and public space closures, we may not be able to test as originally planned.
- *No access to TechSpark.* For the mechanical assembly of our robot, we were planning on laser cutting and 3D printing a stand for the camera and lidar to sit above the robot.
- *Missing equipment at home.* Because the labs are closed, we will each be remotely working at our respective homes separately. However, Aditi needs a monitor, keyboard, and mouse for Raspberry Pi interfacing. Also, Shanel and Alex are considering buying their own Pis to be able to test at home.
- *Long integration and communication cycles.* Because all team members are not physically near each other and located in different time zones, syncing our work schedules and availability proved to be very difficult. Additionally, Shanel currently lives in an area with poor internet connection, not suitable for video calls.

Removing from original project

In the revised scope of our project, we will be removing the computer vision component completely. This means we will no longer use a camera for door detection and text labeling.

Consequently, we won't be using the ultrasonic sensors, since they only served to protect the tall camera mount. Removing this part of the project will allow for simpler mechanical assembly of the robot; we won't have to create a stand and fixtures to hold the camera and sensors. This will save us time with assembly, integration and testing, and free up additional processing on the Raspberry Pi.

Proposed additions to project

To substitute for the computer vision component, the easiest area for us to add is to the user-facing web application. Originally, our user interface would have been a basic image display. Some possible enhancements to the web application include: stitching multiple floors together, user correction or control, Google Maps API integration, and a visualization of the mapping progress in real time. We will first start with a real-time visualization of the process, and then integrate with Google Maps and expand user controls for editing if time permits.

If possible (or needed during the development process), we will also write our own simulation of the robot completing an indoor map cycle. This could be used as a visualization tool for the user before using the actual robot, and will also be a useful tool for us while we develop the navigation capability from different physical locations. We would be expecting to use existing visualization RViz tools to create a custom simulation of the navigation.

These software additions are much easier for us to test and contribute to remotely and during asynchronous work periods. They can be tested instantaneously from our own machines and do not have many dependencies, and still add to the same user experience.

Future communication and process

All three team members are in different time zones and locations, meaning that we will have to work on the project remotely. Shanel is in Pacific Time, Alex is in Central Time, and Aditi is in Pittsburgh on Eastern Time. Because Aditi is in Pittsburgh, she will have access to all the collective parts. We will be pair programming a lot of the navigation algorithm and SLAM together, and Aditi will test extensively on her own. The web application component will mostly be done by Shanel and Alex.

New MVP: Our expected output of the project will still be a robot that generates a map of an indoor space, using SLAM and a custom navigation algorithm. During the mapping process, the user will be able to see progress of the generated maps on a web application. The quantitative requirements of power, speed, and accuracy will remain the same.