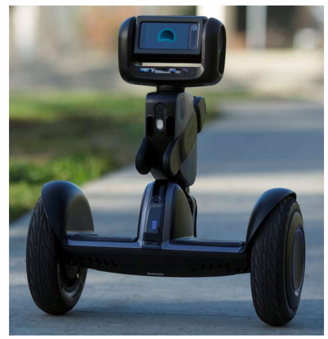
OKAY LOOMO

Karthik Malyala, Alex Secor, Saurin Patel, Lauren Mikula, Donald Wedding, Stone Barrett

UofL J.B. Speed School of Engineering — Engineering Design & Innovation Showcase

Abstract

Purpose of our research: To develop an autonomous robotic concierge service using the Segway Loomo at the Cincinnati Airport (CVG) for providing passengers with easier accessibility and efficient travel times.
Method: Utilize the concepts of Grid-Based Navigation and the A* Algorithm Heuristic with Java, Android Studio, and the Segway Loomo API [1] to find the shortest and most effective route to a desired destination (gate).



Introduction

Indoor Navigation & Locomotion with Mobile Robotics
This study demonstrates and aims to act as a prototype towards utilizing mobile robots as autonomous assistants in a non-industrial setting. Given that the previous Capstone team had worked on live language translation, our primary objective was to develop self-driving capabilities to allow Loomo to guide airport passengers to a specified gate in the shortest and most efficient path. The above was accomplished through indoor mapping and full-stack development.

Development & Methodology

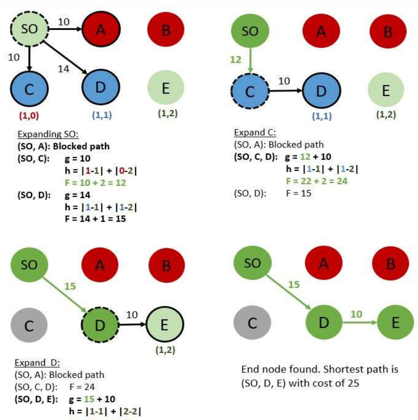
Navigation:

- We implemented the A* Search Algorithm to find the shortest path between the Loomo's starting position and the requested destination. To find the shortest path, A* determines the cost to reach a neighboring node and the cost to get from that node to the goal node. This function can be described as

$$f(n) = g(n) + h(n)$$

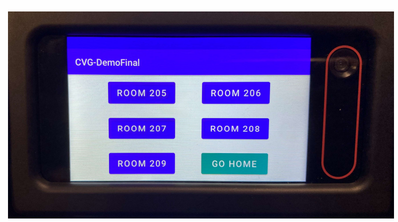
where g(n) is the exact cost from the start node to node n, and h(n) is the estimated heuristic cost from n to the goal node. We determine h(n) by calculating the Manhattan Distance between the current and goal node.

- The indoor map was converted into a pre-defined 2D array that identified obstacles and open areas which will allow for easy pathfinding through the A* algorithm.



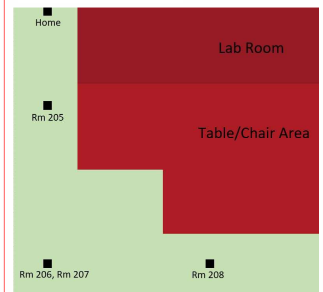
App Development:

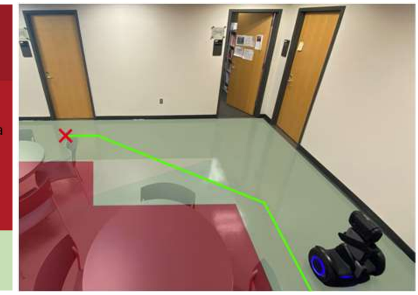
- Given that Loomo runs on the Android Operating System, the application was developed using Android Studio and Java. More specifically, Java was utilized for the backend development, including the A* algorithm implementation and API calls, of our project while XML was used for the frontend side to develop the User-Interface (UI).
- The UI allows users to select their desired destination (gate) from the onboard Loomo* application. After the user makes their choice, the Loomo's coordinates are passed onto the backend Java implementation that processes the shortest path to the desired location using the A* algorithm heuristic based on grid-based coordinates.



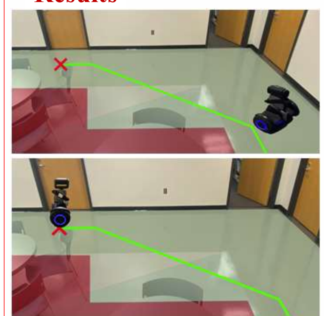
Java · Android Studio · XML

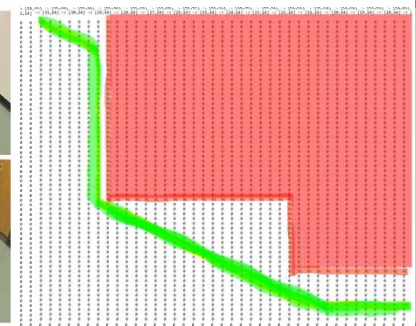
Experiments





Results





Conclusions and Future Work

The implementation and results observed during this semester project strongly suggest Segway's robotic Loomo devices could be used effectively as concierge and guide services in the grand scheme of mobile robotics. The A* Search algorithm was successful in finding the shortest and most efficient path to the destination with pre-defined obstacles. The above work can be extended to other autonomous pathfinding applications given the algorithm's versatility and usability.

To fully utilize Loomo's capabilities in serving as a concierge, future work for the teams to come can include:

- 3D-printed attachment that allows Loomo to pull a luggage cart.
- Voice command mapping to any desired action (navigation/translation).
- Autonomous return to the home base charger under low battery conditions.

Acknowledgements & References

This work was supported and funded by the Computer Science & Engineering (CSE) Department, Dr. Park, Dr. Imam, Manny Adams, and the Cincinnati Airport (CVG).

[1] https://developer.segwayrobotics.com/developer/documents/segway-robots-sdk.html.