



# Automated Delivery with C-B30 Courier Robot

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## Motivation:

- This project is designed to create a user friendly robot that can assist people with delivering packages to others in their proximity.
- Creating a more user friendly robot that can be controlled through voice commands can increase the amount of people that are able to use the product.
- This type of robot can easily help people with disabilities affecting their movement abilities.
- The robot courier can also help save time in office and academic spaces by delivering papers and other packages to colleagues.

## Tools:

- Turtlebot 4
- Mail Delivery Package - from Turtlebot 4 Tutorials
  - ROS Nav2 stack
- ROS 2 Whisper - Speech to Text package

## Command Processing Node

The command processing node dictates whether or not the robot is in Listening mode or Task mode. In Listening mode, the robot receives the data being published from the Speech Recognition node. Task mode is used when the robot is actively attempting its assigned task.



Figure 1. The courier robot in action, delivering a package to a professor's office in Woods.

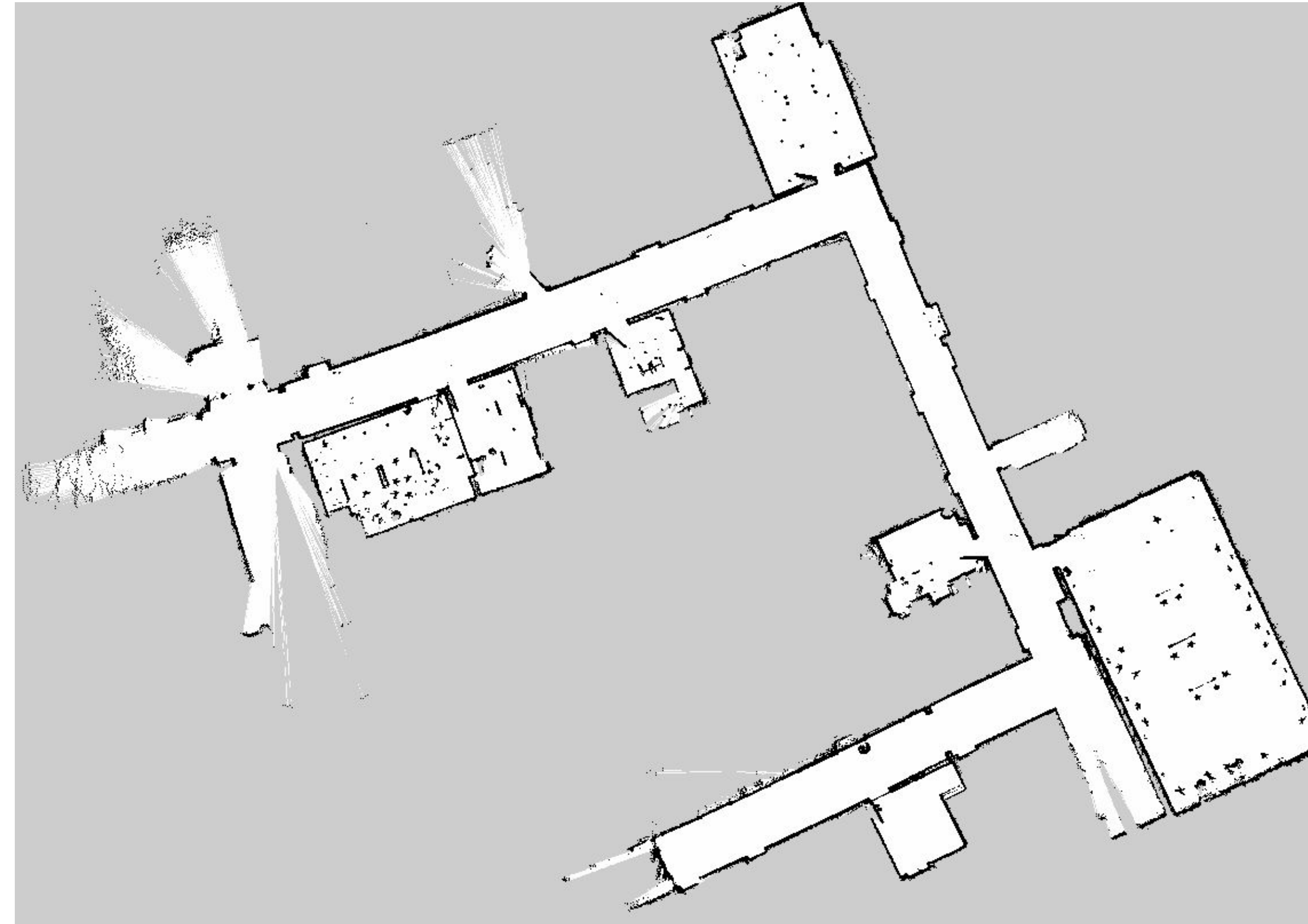


Figure 2. The map we developed with the Turtlebot's SLAM (simultaneous localization and mapping) functionality.

## Navigation Node:

This node subscribes to the Command Processing node. When the Command Processing node switches to Task mode and publishes a task, that task will dictate the goal pose to the Navigation node. It can then call the “startToPose” function given by the Nav2 stack and start its delivery.

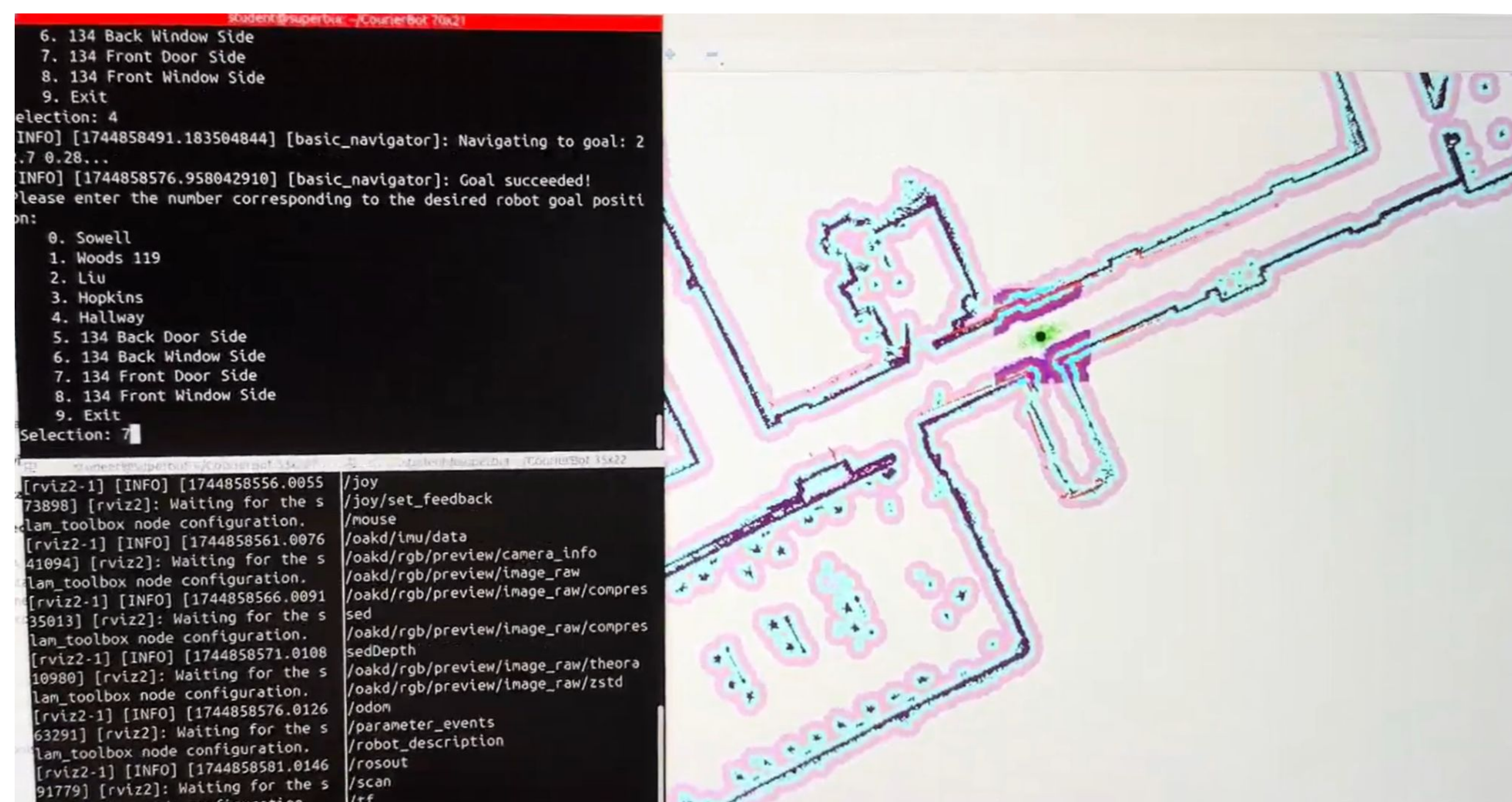


Figure 3. The output of the mail\_delivery program in action. The terminal window on the left shows interaction with the window, and the window on the right shows the Turtlebot's RViz 3D visualization.

## Speech Recognition Node

Speech recognition functionality is implemented through a dedicated node using the ROS 2 Whisper package. The node continuously processes and outputs spoken input. Detected speech is published as a string message for the Command Processing node to handle.

## Courier Robot Action Flowchart

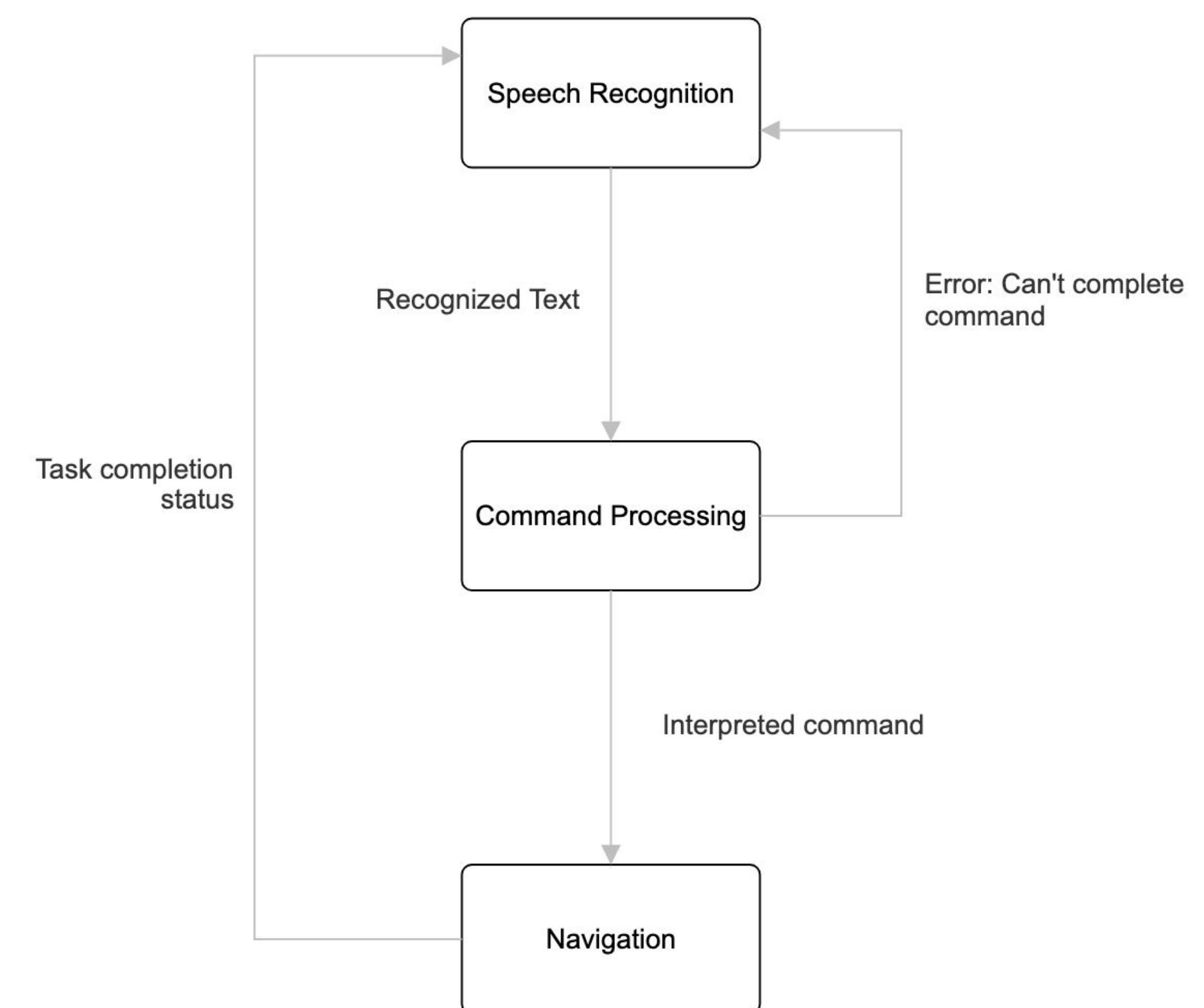


Figure 4. A flowchart showing the process of interacting with the courier robot

## Results:

- **Inconsistent Initialization:** The robot's programs fail to initialize correctly about half the time, requiring multiple restarts to achieve a successful demonstration.
- **Successful Operation:** Once running properly, the robot reliably plots courses, navigates around newly detected obstacles, and provides task completion notifications.
- **Obstacle Detection Limitations:** Low-lying obstacles not detected by the LIDAR can cause the robot to get stuck, and it can take a significant amount of time before it reports a task failure.
- **Hardware Accessibility Challenges:** Running the speech recognition system requires specific NVIDIA GPUs for compatibility with the ROS 2 Whisper package, reducing the system's accessibility for broader public use.