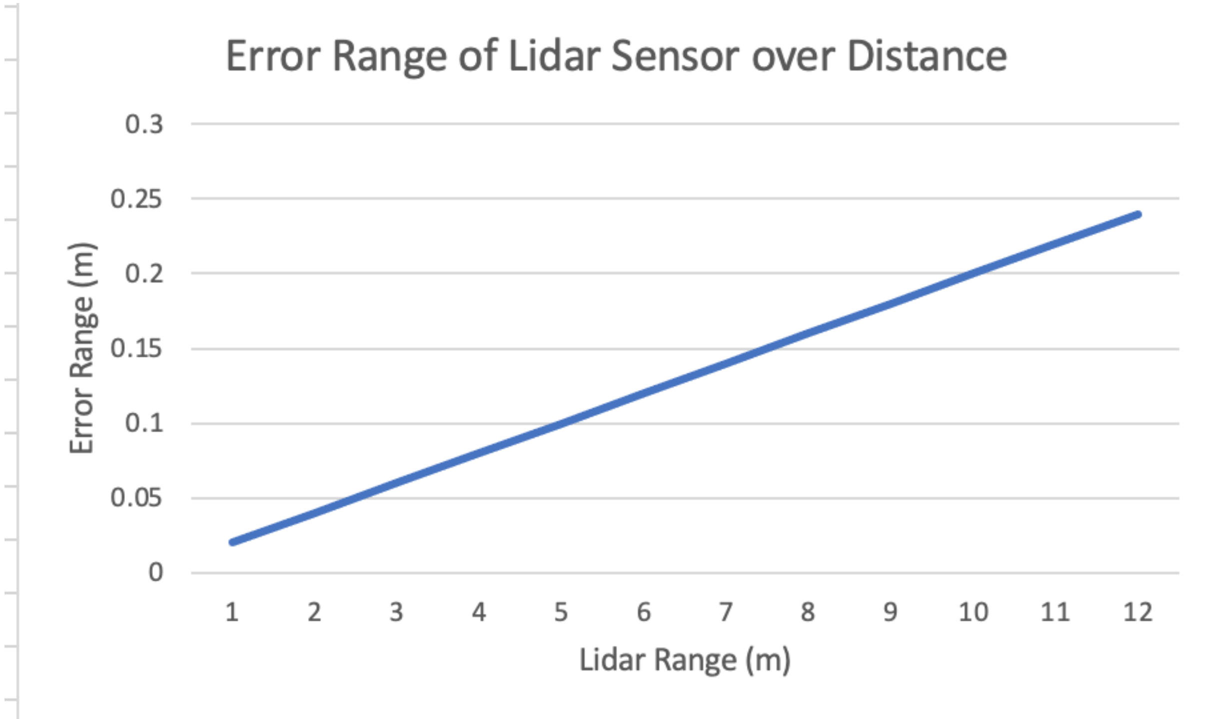
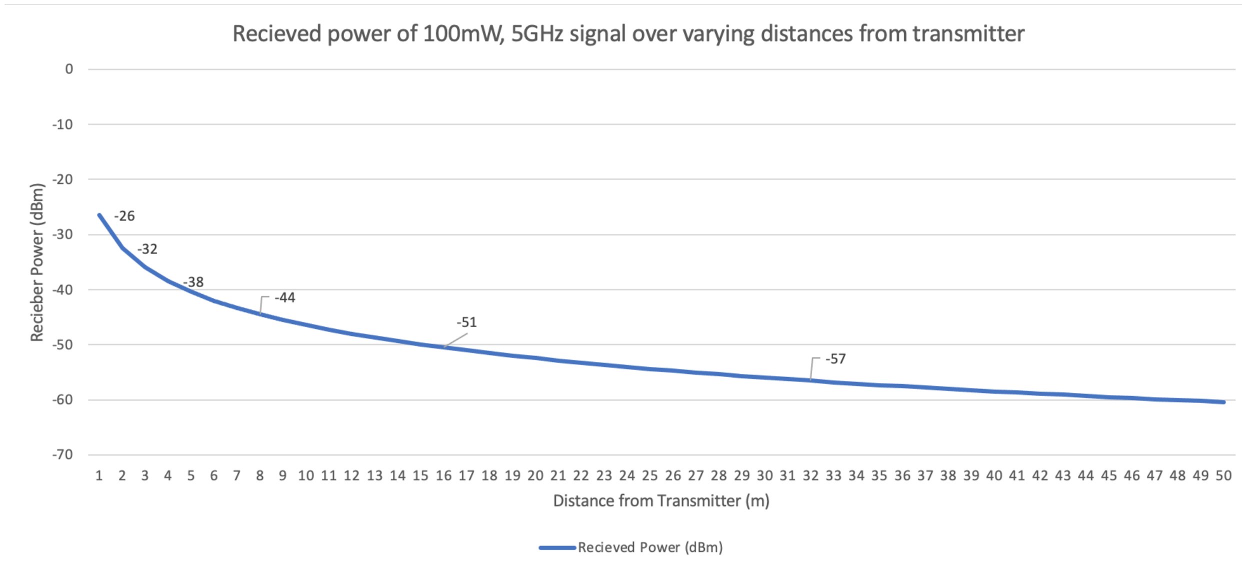
Numerous challenges arise when designing an autonomous navigation system. The principal challenges include localizing in a setting with non-unique features, detecting obstacles from a safe distance, and fast path-planning and path-correction capabilities. To address these challenges, an array of sensors connected to a powerful controller will be used.

The first challenge is robot localization. Before autonomous navigation can begin, the system needs to first determine its precise coordinates and direction in the environment. In order to achieve a high-resolution estimation of its pose, the robot will be equipped with an A2M8 360 degrees Lidar sensor. This device produces a high-resolution dot map of its environment. Provided that the robot's current setting has unique features, it can compare the Lidar map with a stored map of the floor and estimate where it is. The lidar sensor will scan along the horizontal plane parallel to the floor to observe a 2D map of the environment. Having the Lidar in this position will enable it to detect all obstacles around it which intersect this plane.

A limitation of this sensor is that its range is limited to 12 meters and the error in its readings linearly increases with distance from .02 meters at a 1-meter radius to a quarter meter at 12-meters. This limitation means that the sensor will have limited effectiveness at further distances despite having an effective coverage of 113m^2.



In its application, the robot may have to localize in an environment without unique features. In this situation, a coarse localization method is needed to determine the robot's general location. The Lidar sensor will then improve upon that rough estimation with its precision accuracy. This coarse localization will be accomplished by using the numerous Wi-Fi routers that will be communicating with the robot. The robot will average the Received Signal Strength Indicator (RSSI) of each router and determine its approximate location.



This figure shows predicted power readings in dBm of a 100mW router transmitting at 5GHz. From reading the received power level of the router, the robot can interpolate a distance from the router. As the plot shows, the rate-of-change in power will decrease the further from the router the receiver is. However, this can be mitigated by adding numerous routers across the environment. Three would be needed to triangulate the robot's approximate position.

A wide-angle camera will be used to detect obstacles which are beneath the horizon of the Lidar sensor. Machine learning algorithms can be used to detect said obstacles. When used in tandem, the RSSI measurements, Lidar sensor, and camera will enable localization abilities which satisfy the goals the group set out.

To run all these sensors and their associated algorithms, a powerful platform is needed. Nvidia Jetson's Nano is a powerful Linux-based computer designed for low power consumption. The processing power will enable the navigation and machine learning algorithms to run locally without interruption.