# Executive Summary

Background:

Robotics is a key part of modern efficiency strategies, reducing the need for workers to complete repetitive tasks, thereby freeing them up for work that demands human ingenuity. One field that has always required the adaptability of a human is security and inspection, as there are a wide range of potential situations that require differing responses, with a high probability of multi-tasking being needed. There have been a few notable forays into this field however, notably, the KnightScope ADM and the General Electric FAST platform. The FAST Platform makes use of cameras and ultrasonic sensors to navigate its surroundings, which it utilizes for pipe and tank inspections, to ensure that they are still structurally sound. The ADM focuses on managing highly fluid, human dominated environments, checking for dangers. The Multi-Robot SLAM system will be a unique example, where it attempts to find threats in a low traffic environment.

Mission Statement:

The purpose of this project is to develop an efficient and accurate system for navigation and mapping of both small and large areas within naval vessel that may be foreign or unknown to the location.One of the main goals of this project is to get the network of robots to autonomously monitor an entire vessel and ensure that the ship is safe for humans to enter. This network will need minimal human operators so that resources are reduced. It is a problem when there is a foreign or unknown ship and humans have to be sent in to inspect the areas. This could potentially expose humans to harmful materials, objects and unknown people. This network of robots will inspect cargo holds, weapons munitiations, cabins, as well as other large areas of the ship.The network will navigate the space and potential obstacles autonomously while communicating and merging data together to create a single and accurate 2D map of the area.

Scope:

The network of robots will consist of three robots that will integrate together to create 2D LiDAR maps and identify any potentially hazardous objects or foreign people aboard a ship. The system will be used on a ship, which influences some constraints that the team needs to consider. The size, mobility, weight, type of information, platform of sharing information and others are all constrained by this specific environment of operation. One function that the robots will need is a platform to share information between each other, store the data and send it to the remote user. This poses a challenge as wireless signal is usually absent among many vessels. The team is also constrained to their $5,000+ budget as well as deadlines set by the Senior Design ME-423-X2 Course. The team’s goal for the Fall Semester is to have one fully functioning robot generating accurate 2D maps. By the end of the Spring Semester, the team’s goal is to have all three robots communicating together and generating accurate 2D maps of the environment.

Company Description:

This project is being sponsored by L3 Technologies Communication Systems-East, a company with a large focus on communication systems that are placed in many different types of products including submarines, naval vessels, and aircrafts. Some of their products include communication systems, data storage, encryption and cyber security solutions. The Senior Design Team is working with L3 Technologies to ensure that their network of robots properly and safely communicate with each other to allow for a more innovative and efficient way to monitor and inspect large areas of a ship. This solution is eliminating the need for humans to inspect a ship and ensure it’s safety before bringing a crew aboard to further inspect this ship. The network of robots will be deployed onto an unknown or foreign ship and inspect the ship to ensure that the ship is safe for humans to enter upon. This network will be a safety monitoring system so that there is no need to subject humans to any dangers before the areas are cleared by inspection through the network of robots.

Design Selected:

The team was given a $5,000+ budget for this project which allowed them to find a solution that would incorporate at least 3 robots into their system. The team used this criteria of having at least three robots as part of their selection criteria when evaluating the price of potential robots. In the end, the team selected the Turtlebot 3 Waffle as the robot for this system. The team made this selection based on the known specifications of the project, customer needs, as well as the capabilities and sensors included in the Waffle.

Implementation:

Results:

Significance: