# Project proposal

Project name

"Hull Integrity Bot"

Group members

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Abstract: Succinct Abstract

The robot will perform the task of detecting and possibly repairing damage to the hull of large vessels (space station, cargo ships, NASA spacecraft, etc.) We will need to utilize a wide variety of sensory equipment to assess damage to various parts of the hull, plan a route to scan for damage, and maintain the bot's position relative to the main structure. Depending on whether we are performing damage sweeps in spacecraft or oceanic vessels, we will also need to plan for physics in low-g or zero-g environments.

Equipment

1) Robot: https://cyberbotics.com/doc/guide/robots (I think these three robots have the best chance of being useful for this project)
    a) DJI' Mavic 2 PRO
    b) BioRob Salamander
    c) micromagic's Mantis
2) Actuators:
    a) Manipulator arm
    b) Propulsion device
3) Sensors:
    a) Camera sensor
    b) DistanceSensor Sensors
    c) Lidar Sensor
    d) Range Finder Sensor
4) Objects
    a) Ship/Space Station
    b) Geometries
    c) Obstacles
    d) Shapes
    e) Robot Extension Nodes
5) Appearances
    a) Sea Floor/astronomy background textures
    b) Space station/Oceanic ship textures
    c) Sharks, fish, squid, jellyfish, etc.
    d) Asteroid/mineral textures

Deliverables and implementation plan:

1) Decide which robot/sensor implementation to use - Lead: ***Vanessa*** Deadline: **April 11, 2021**
    a) Research the available robot prototypes in webots
    b) Research different sensory equipment
    c) Experiment with sensory data from each, and decide which sets of robot/sensory equipment is best suited for the task
    d) Integrate the sensory equipment into the robot and code the python classes necessary to use the new equipment.
2) Image/sensor interpretation algorithm - Lead: ***Jeff*** Deadline: **April 15, 2021**
    a) Determine the sensory equipment necessary
    b) Determine parameters for damage
    c) Develop an algorithm to detect and interpret damage from sensory data
    d) Report damage location in world coordinate system
    e) Perform unit testing
    f) Perform integration testing
3) Path planning algorithm - Lead: ***Yifan Chen*** Deadline: **April 15, 2021**
    a) Make sure to go through the whole surface of object
    b) Detect whether it is a target object
    c) Algorithm to prioritize area based on the relative danger and frequency of damage to that area
    d) Avoid obstacles from environment
    e) Track the position of robot relative to the ship
    f) Perform unit testing
    g) Perform integration testing
4) Webots (or other simulator) world file - Lead: ***Yifan Chen*** Deadline: **April 13, 2021**
    a) World files for underwater environments and space environments
    b) Need to determine how to simulate the physics for both environments
    c) Space will have additional concerns like: radiation, noise, debris, etc. so we will need to simulate these external forces
    d) Underwater will also have unique problems like animals, other ships, low light, high external pressure. We will need to simulate these external forces.
    e) Determine what kind of robot is best for each scenario, what kind of sensory equipment is available, available robot actuators/control schemes
    f) Import any additional software packages necessary to implement the special physics/environmental concerns for space and for underwater.
5) Inverse Kinematics Algorithm(path following) 1- Lead: ***Vanessa*** Deadline: **April 23, 2021**
    a) Determine the inverse kinematics to navigate using the path planning algorithm
    b) Take the motion of the robot, the ship, currents, and wind into account

    c) Perform unit testing
    d) Perform integration testing
6) Inverse Kinematics Algorithm(make repairs) 2- Lead: ***Jeff*** Deadline: **April 23, 2021**
    a) Determine the kinematics formula to use the robot's manipulator arms to perform repairs
    b) Implement an algorithm to perform these repairs with the actuators available
    c) Perform unit testing
    d) Perform integration testing
7) Integration of the project - Lead: Everyone Deadline: **April 28, 2021**
    a) We need to integrate all of the deliverables into a single project
    b) We need to test that everything works together
    c) We need to practice our presentation and decide who will present what parts, take questions individually or as a team at the end, etc.

Demo

We will make a powerpoint and a demo to present our project.

- In the powerpoint, we will have intro slides to illustrate problems we focus on solving in our final project, then we will show how we did each of the components from our deliverables.
- We will also record a demo about how our robot works. The plan for now is one video demonstrating our robot making a pass over the hull searching for damage to repair and another video demonstrating the robot fixing the repairs.
- After the video demo we can spend a little time discussing any difficulties that we ran into implementing our project, then take questions from our classmates and colleagues.