

SYSC 4805 - Project Proposal

Simulated Autonomous Snow Plow

Members:

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Deji Sayomi - Not Attending (MIA)

Date:

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Project Charter

Team Name: *Jazzberry Jam*

Objective:

To design and build an autonomous robot in CoppeliaSim to clear snow from a designated area in multiple varying test environments within a limited amount of time while avoiding collisions with obstacles.

Deliverables:

An autonomous vehicle capable of clearing snow from a designated area. The vehicle will be equipped with a unique plow to remove snow from the area as well as a number of sensors to allow the vehicle to detect various obstacles and the perimeter. The vehicle will be run using a Python API connected to CoppeliaSim. We will develop an algorithm to help accomplish all the tasks necessary, such as; keeping track of the area previously covered by the plow as well as areas to be covered, ensure the vehicle does not collide with objects and ensure that snow is pushed outside the perimeter of the area. To validate the snow plower and ensure the algorithm works as intended, we will devise a number of test scenarios to make certain all the deliverables meet the requirements of the project. To show the progress of our work, and inevitable changes we've made to the projects, we will also be making a progress report. The progress report will highlight all the tasks we've accomplished from what we set out to do, and what we have left to accomplish. Through this project we will be learning the life cycle of developing a product, from proposal all the way to the final product and presentation. We will also be learning how to work in a team environment to validate each other's work, to certify the best possible out-come.

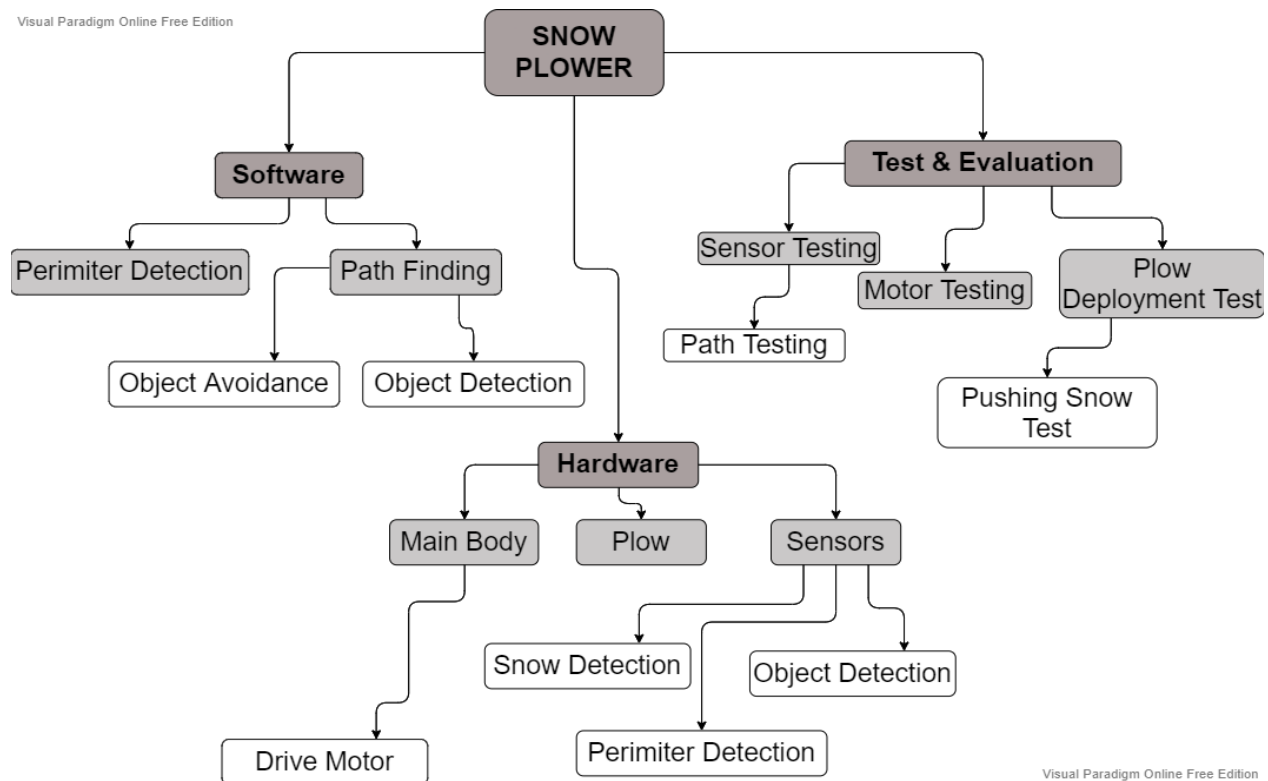
Scope

Requirements:

- The control algorithms for the snow plow will be programmed using python
- The snow plow will clear the enclosed area of at least 80% of snow orbs within 5 minutes
- The snow plow will clean the enclosed area without impacting other environmental objects (IE. walls and trees)
- The snow plow will not move at speeds that exceed 2 m/s
- When in the Parking Space the dimensions of the snow plow will not exceed 0.5m by 0.8m by 1m
- All all times the dimensions of the snow plow will not exceed 1 m by 0.8 m by 1 m

Work Breakdown Structure:

Visual Paradigm Online Free Edition



Visual Paradigm Online Free Edition

Description of Tasks:

TASK	Description
Discuss and compose Project Proposal	Write the project proposal
Discuss and Compose Progress Report	Write the progress report
Discuss and Compose Final Report	Write the final report, create the final presentation, deploy the program for demonstration
Build Robot Body	Construct robot body including motorised wheels with locations for the plow and various sensors
Create Unfolding plow	Design a plow with motor that fits into the required space and is capable of unfolding to its full length and manoeuvring as required
Experiment with Plow Shapes	Test various plow shapes to determine which are best for pushing and manoeuvring the snow
Attach Plow to body	Connect the designed plow to the robot and ensure both function together

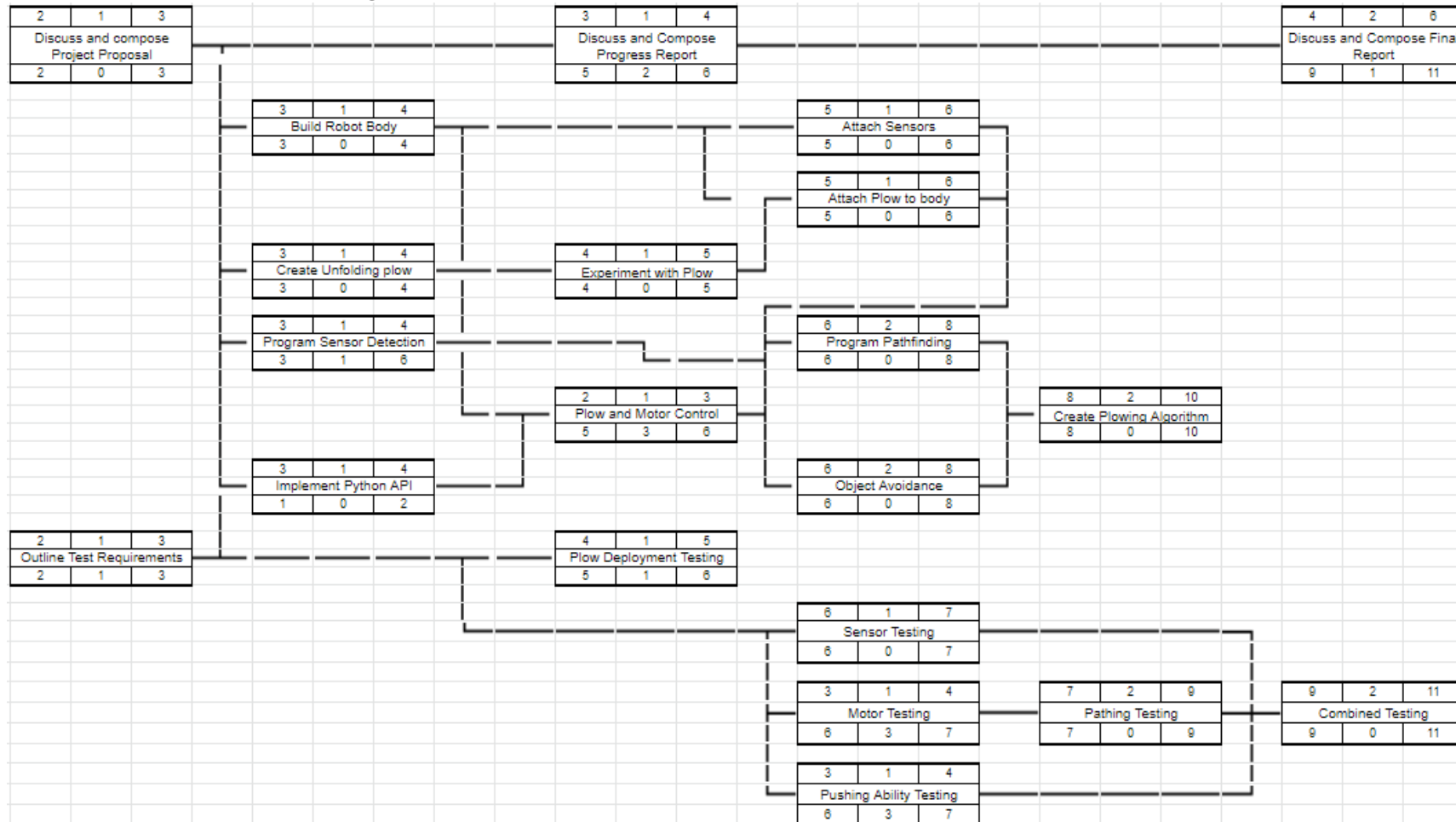
Attach Sensors	Attach the various required sensors at locations that work for their respective tasks
Plow and Motor Control	Control drive motors from Python API and track movement, build basic movement library
Program Pathfinding	The plow should evaluate a path to push snow off an empty map
Program Sensor Detection	Read values from sensors in Python through the API and detect various objects by their distinctions
Implement Python API	Connect CoppeliaSim to a Python Program through the API
Create Plowing Algorithm (Pathfinding + Avoidance)	Ensure snow detected by the robot and collected is removed from the perimeter and not left on the map
Object Avoidance	Re-evaluate a new path to push snow off the map based on the detected objects
Outline Test Requirements	Create detailed test plans for each feature based on the requirements and how the parts are constructed
Sensor Testing	Ensure that when the robots sensors pass over the black perimeter we should respond by dumping snow outside the perimeter, Ensure that when the robot's sensors first detect an object the plow should stop it's drive motors and determine how to carry on to not collide
Motor Testing	Ensure calculated movement amounts in Python are correctly translated into CoppeliaSim (1 meter movement testing)
Plow Deployment Testing	Ensure the plow fits within the 0.5x0.8x1m parking space when folded and extends to the full 1m width when deployed
Pushing Ability Testing	Ensure that when the plow is pushing a large amount of snow the motors still move the robot the correct distance when instructed
Pathing Testing	Ensure the CoppeliaSim robot's path mimics the path determined in python based on an empty and populated map
Combined Testing	Run the entire system in the test scene given for 5 minutes and determine our score. Iterate this test with various object, and snow positions.

Testing:

- Sensor Testing
 - Test Perimeter Sensors
 - Ensure the perimeter sensors can get a reading from the black perimeter line on all sides of the robot and alert the robot pathing that the edge has been reached
 - Test Object Sensors
 - Ensure the object sensors do not detect snow and can detect objects in all directions around the vehicle and alert the code when the vehicle is too close to an object
- Motor Testing
 - Ensure that the movement amounts sent from python code are correctly translated to distance travelled in CoppeliaSim so we do not exceed a speed of 2 m/s
- Plow Deployment Testing
 - Ensure the plow folds up to fit within the dimensions of the parking space and deploys to utilise but not exceed the full allowed dimensions when outside of the parking space
- Pushing Ability Testing
 - Ensure that the plow's motors still accurately translate the robot while clearing large amounts of snow
- Pathing Testing
 - Ensure the robot can successfully navigate the map in order to reach all the snow can
 - Object Avoidance
 - Ensure the vehicle can detect objects in all directions and modifies its pathing to avoid all collisions with nearby objects while still clearing snow effectively
- Combined Testing
 - Ensure the entire system can effectively clear 80% of the snow within 5 minutes without colliding with objects in the environment

Schedule

Schedule Network Diagram:



Gantt Chart:

[illegible]

Human Resources

Responsibility Assignment Matrix:

TASK	ALFRED	MICHAEL	EDMOND
Discuss and compose Project Proposal	Doing	Doing	Doing
Discuss and Compose Progress Report	Doing	Doing	Doing
Build Robot Body	Doing		Checking
Create Unfolding plow	Checking		Doing
Experiment with Plow Shapes		Doing	Checking
Attach Plow to body		Doing	Checking
Attach Sensors	Doing	Checking	
Plow and Motor Control	Checking	Doing	
Program Pathfinding	Doing		Checking
Program Sensor Detection	Checking		Doing
Implement Python API	Checking	Doing	
Create Plowing Algorithm (Pathfinding + Avoidance)	Checking		Doing
Object Avoidance	Doing	Checking	
Outline Test Requirements			
Sensor Testing	Doing	Checking	
Motor Testing		Doing	Checking
Plow Deployment Testing	Doing	Checking	Doing
Pushing Ability Testing		Doing	Checking
Pathing Testing		Checking	Doing
Combined Testing	Doing	Doing	Doing