1. Project Problem Statement & Scope

Problem statement: The objective of the project is to construct a quadruped robot. The Open Dynamic Robot Initiative will be used as guidance. The robot is intended as a cheaper and more open alternative for robot smart agriculture than what is currently available in professors Roundy and Leang's laboratories.

The only change is that field navigation was changed from "Must be part of scope" to "Optional scope"

Must be part of scope	Optional Scope	Not included in Scope
1. Runs on ROS 2 2. Use ROS 2 Humble 3. Autonomous; no tether 4. On-board Power System that can run for minimum 30 minutes 5. Modify design to enclose electronics –weathertight 6. Easily storable, carryable (handles, box) 7. Utah red colors	1. Can navigate to four points in a field. 2. Rebuild chassis with stronger materials during second semester (fiberglass infused ABS)	- Additional actuators - Additional sensors - Efficient walking - Manipulators - Radio beacon triangulation - 12 degree of freedom

2. ME EN 4010 Milestones & Tasks

ME EN 4010 Assignment	Milestone(s)	Metric of success	Measurement	Tasks
Design Review 1 (01/27-01/31)	Foundational Control Code complete	Command capability, sensor reading	1. Able to switch modes, load movement ramps for an arbitrary number of legs	Write the following nodes: - Central command node - Primitive loader - Leg control and IK node - IMU node - Filter node - Service to return to neutral position - Node to convert primitive to ramp, offset according to IMU
	Majority of robot body complete	Proportion of components mounted	>90%	- Print all body components - Assemble body - Mount electronics - Wire everything up
	Some legs complete and mounted	Number of actuator modules built	At least 2	- Print legs in CFPLA - Assemble actuators - Mount actuators as they are completed
Midterm Prototype & Report (02/21)	All legs mounted	Number of actuator modules built	All 8	- Print remaining legs - Finish assembly - Mount remaining actuators
	Body finished	Proportion of components mounted	100%	- Complete any remaining tasks from above - Add any necessary sensors for navigation

	Basic Motion achieved (Not necessarily including speed variance, rough terrain)	Number of directions of motion available	6	Create primitives to: - Walk forward or backward - Turn left or right - Stand up - Lay down - battery test (how far can it go?)
Design Review 2 (03/17-03/21)	Fully autonomous; no tether.	No physical connections necessary to direct and move	0 physical connections without loss of functionality	- Build the power system to be self sufficient - Implement wireless command system
	On-board Power System can run for minimum 30 minutes	Runtime in general walking scenario	>30 minutes	- Develop an endurance test - Run the test, log results - Test additional battery sizes if results are disagreeable
	Full motion	Variable speed, rough terrain capability	At least two additional gaits, IMU integrated into primitive ramp creation	- Add IMU modification to target joint angles - Create additional primitives for faster or slower gaits
	Basic Navigation (optional scope)	Can navigate to beacons with wireless detection	Navigation to at least one beacon.	- Implement necessary additional sensors - Write a simple seeker node
Final Report (04/14)	Optimize Navigation (optional scope)	Can reach target number of beacons during runtime	Can hit all four beacons without incident, and return within runtime	- Optimize navigation algorithm

3. Team Member Roles

Austin- I will be helping Ben with the 3D printing and assembly. Along with that I will be leading the charge on documents, assignments, and slides. I will be very involved in testing and debugging. I will also be available to help the coding team and power system in any way I can.

Ben- I will be leading 3D printing and assembly along with being lead 3D modeler. I will be very involved in testing the design structurally, especially fixing the mechanical design if it breaks or needs to be fixed. I will also help the power system team in any way I can.

Sam - I also will be working on the layout and mounting hardware for the internal components. I will also be working on the power system. This will include creating cables and solving cable management problems, as well as implementing a power distribution board which supplies the required current and various voltages.

Kevin - I am the lead on both design and implementation of our code. I will be coming up with the general arrangement of nodes to control our robot, refining them with the rest of the group, then actually implementing them. For any nodes where performance is a concern, they will need to be implemented in C++ which is my purview. I will also work to make sure that all components integrate together effectively, and that no robot components clash with each other's functionality.

Jordan - I am the second main programmer on the team and will help design and implement our code. I'll be helping to write and organize nodes, primitives, and control algorithms for our robot and will also be focusing on the kinematics of our robot to implement into our control algorithms. I will also be helping out with the assembly as much as I can when I'm not working on the code.

Yang - I am helping with code and building as needed. I'm looking into and helping with programming auxiliary functions, like sensors. I'm primarily responsible for keeping track of the bill of materials, budget, and submitting buy orders.

4. Final Deliverables

- Final assembled robot
- Email\flash drive with all code and 3d printed part models
- ME EN 4010 Final Report, poster presentation files
- Documentation for setup and code use
- Bill of Materials
- Videos of robot working
- Any spare or extra parts and materials

5. Concerns, Challenges, Special Needs, etc.

Our biggest challenge for the semester is to make the walking software. Making good primitives is going to take a lot of time.

6. Advisor Approval
This document must be approved by your faculty advisor and/or project sponsor. You may upload a PDF copy of an email from your advisor or sponsor saying that they have read and approved the Project Milestones document. Alternatively, you may have them sign a digital copy of the document.