

Project Requirements - DirtNav

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Abstract

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1. Project Description

1.1 Purpose

The purpose of this rover is to serve as a practical outdoor utility platform for residential lawncare. Its primary role is to collect elevation and soil moisture data across a property at a significantly lower cost than commercially available lawncare robots.

1.2 Scope

The scope of this document is limited to the pre-control aspects of rover development. This includes the proposed mechanical design, electrical architecture, wiring and harness routing strategy, and structural layout. A functional prototype (“mule build”) and all rover control software are explicitly out of scope for this phase.

1.3 System Overview

The rover is intended to operate year-round and must therefore withstand precipitation, temperature variation, and high winds. It will traverse multiple outdoor surfaces—including grass, dirt, pavement, ice, and snow—and maintain traction on varying inclines. The design philosophy prioritizes durability, serviceability, and functional performance, while maintaining a clean and professional appearance.

2. Specific Requirements

2.1 Mechanical Requirements

- Must climb inclines up to 30°.
- Must operate reliably in rain, snow, and high-wind conditions.
- Must traverse snow, ice, dirt, pavement, and grass.
- Must achieve a minimum straight-line speed of 13 mph.

2.2 Electrical Requirements

- Must provide at least 60 minutes of continuous runtime per charge.
- Must operate on a 12 V electrical bus.
- Must be controllable remotely through internet-based communication protocols.
- Must include actuated soil-moisture sensing capability.
- Must include elevation and terrain-profiling sensing capability.

2.3 Harness Routing Requirements

- No wires may be free-hanging within the chassis.
- No twisted, nested, or uncontrolled wire bundles are permitted.
- No wiring harnesses may be visible externally when the rover is fully assembled.

2.4 Structural Requirements

- All electronic enclosures must be fully waterproof.
- The rover must survive a 6 ft drop onto any face without structural or functional damage.
- The complete assembly must fit within a $2\text{ ft} \times 2\text{ ft} \times 2\text{ ft}$ volume.

2.5 Functionality

The rover shall autonomously collect and store environmental data, relay information to a remote operator, and navigate outdoor terrain using onboard sensors and a remote communication link. Additional functional requirements will be developed in later phases as control algorithms and operational behaviors are defined.

3.3 Design Constraints

- The rover shall operate on a 12 V electrical system, and all components shall remain compatible with this power architecture.
- All electronics shall be enclosed in waterproof housings to ensure safe operation in outdoor environments.
- The complete mechanical and electrical assembly shall fit within a $2\text{ ft} \times 2\text{ ft} \times 2\text{ ft}$ volume.
- Wireless communication shall comply with standard FCC regulations for consumer-grade devices.
- All wiring shall be routed internally, with no exposed or loosely suspended harnesses on the exterior of the rover.

3. Non-Functional Requirements

3.1 Performance Requirements

- The rover shall respond to sensor inputs and operator commands within approximately 200 ms during normal operation.
- The rover shall maintain stable traction across grass, dirt, pavement, snow, and ice under typical outdoor conditions.
- The rover shall be capable of reaching a minimum straight-line speed of 13 mph on flat pavement.
- The rover shall continuously collect and log moisture, elevation, and general telemetry data while in motion.

3.2 Reliability Requirements

- The rover shall operate reliably for a full 60-minute session without unexpected shutdowns or major faults.
- The rover shall recover from common issues—such as temporary sensor errors or communication interruptions—without requiring a full system reboot.
- The rover shall function in rain, light snow, and winds up to 30 mph without loss of essential capability.
- The rover shall tolerate minor impacts with obstacles such as rocks, branches, or edges of pavement without sustaining damage that affects operation.