

Autonomous Ground Vehicle for Agricultural Applications Team 20

Project Description

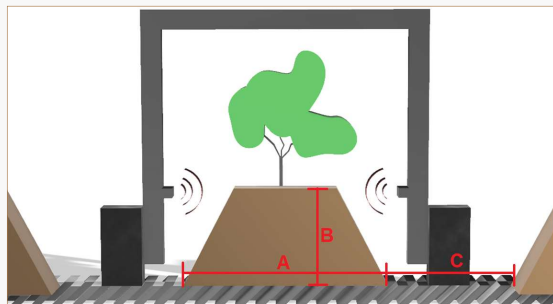
- The Autonomous Ground Vehicle (AGV) is responsible for weed growth observation in various agricultural applications
- The AGV is powered by two DC brushed motors that can be manually or autonomously controlled to navigate the fields
- The AGV is width adjustable for adaptability to any field [1]

Current Weed Management Technologies

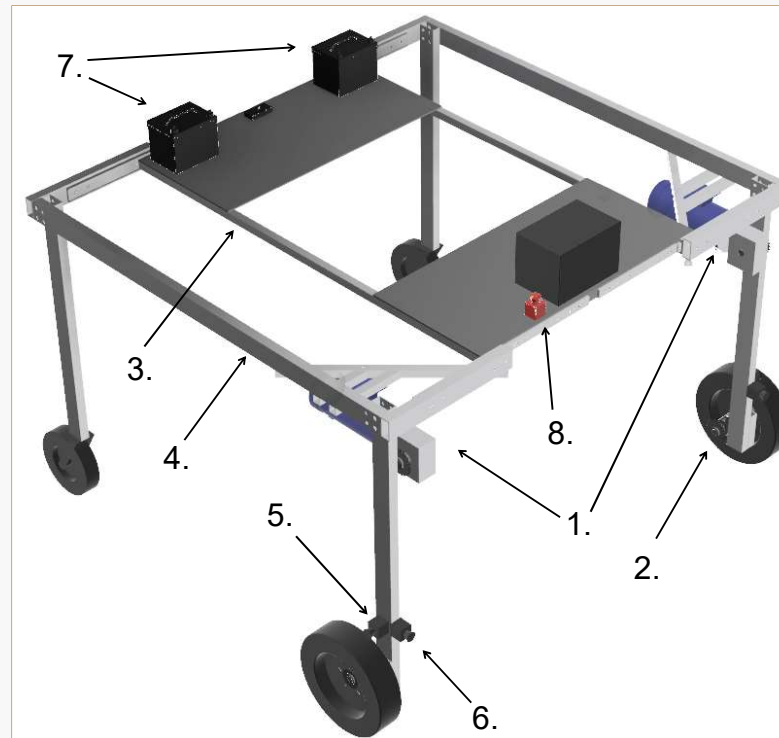
- High labor costs and labor time [2]
- Current technologies have little innovation [2]
- Most mechanical weed control equipment is manually operated [3]
- Most equipment still rely on diesel powered engines
- Heavy weight leaves impact on soil structure

Potato Ridge Characteristics and Interactions

- Dim A: Ridge width varies between 45 to 75 cm [4]
- Dim B: Ridge height varies between 20 to 40 cm [4]
- Dim C: Track width approximately 30 cm [4]
- Loam soil: 20 % clay and 40 % sand-silt mixture [2]
- High rolling resistance due to soil deformation [2]
- Ultrasonic sensors propagate waves towards the ridge to check for distance variation
- Vehicle height needs to accommodate potato vegetation growth with a minimum clearance of 20 cm



1. Two electric motors for front wheel drive steering
2. Chains and Sprockets to drive front wheels
3. Fixed Inner frame to mount weed monitoring system
4. Outer frame adjustable to 3 distinct positions
5. Side ultrasonic sensors to aid in driving the vehicle autonomously
6. Front ultrasonic sensors to detect unexpected objects during operation
7. Two 24 Volt 35Ah batteries to operate vehicle for 10 hours
8. Visible emergency stop



Design Requirements

- Shall operate for a minimum of 10 hours
- Shall have adjustable width range from 4 to 6 feet
- Shall have capability to reverse with speed of 1 km/h
- Shall come to complete stop within 2 meters away from unexpected object
- Shall have manual drive capabilities for mobility
- Shall navigate autonomously and not deviate from potato ridge path exceeding 80 cm in any direction

Design Verification

- Operated both motors at the moderate speed for 2 hours with a 2-battery series configuration
- Manually adjusted AGV width between 4 to 6 feet
- Reversed vehicle with manual steering code
- AGV comes to a complete stop when approaching an object closer than 2 meters
- Manually operated with user input
- Navigated autonomously in a linear pathing using simulated ridge and vegetation

Design Features

- Lightweight and rigid frame for easy transportation and strength
- Simple pin and slot width adjustment that can be executed safely by one person
- Easy to adjust code for accommodation for various agricultural locations not limited to Atlantic Canada

Recommendations

- Add two 260 W solar panels on top of AGV to extend operation life
- Change lead acid batteries to lithium-ion batteries with a BMS for higher energy density
- Implement GPS to track position in reference to ultrasonic sensors for higher precision
- Add light and weather shield on the sides of AGV to ensure maximum camera quality

References

- [1] <https://www2.gnb.ca/content/dam/gnb/Departments/10/pdf/Agriculture/WeedControlPotato.pdf>
- [2] <http://www.potatoes.co.za/SiteResources/documents/Technical%20news%20-%20Understanding%20ridging.pdf>
- [3] <http://www.thetechnology.co.uk/projects.html>
- [4] https://www2.gnb.ca/content/gnb/en/departments/10/agriculture/content/land_development/field_selection.html