Team 11
Robo-Weeder

Advisors:
Dr. Gupta
Dr. Hooker

Steven Miller
Zhang Xiang
Aquiles Ciron
Arriana Nwodu
Steven Williamson
Christopher Murphy

January 21, 2016

Sponsor:
Jeff Phipps

Presentation Overview

- Project Background
- Progress
  a. Mechanical Features
  b. Electrical Features
- Budget
- Scheduling
- Summary

Figure 1: *Orchard Pond Organics*

Project Background

- **Need Statement:** "Organic farming techniques rely heavily on labor intensive methods which create large production costs for organic produce."
- **Goal Statement:** "Develop a 'proof of concept' robotic machine that will enhance the production of organic crops."
- **Constraints:**
  - Mobile
  - Auger Style Shearing
  - Remotely Operated
  - No till
  - 1" soil interruption

Design Modifications - Mechanical

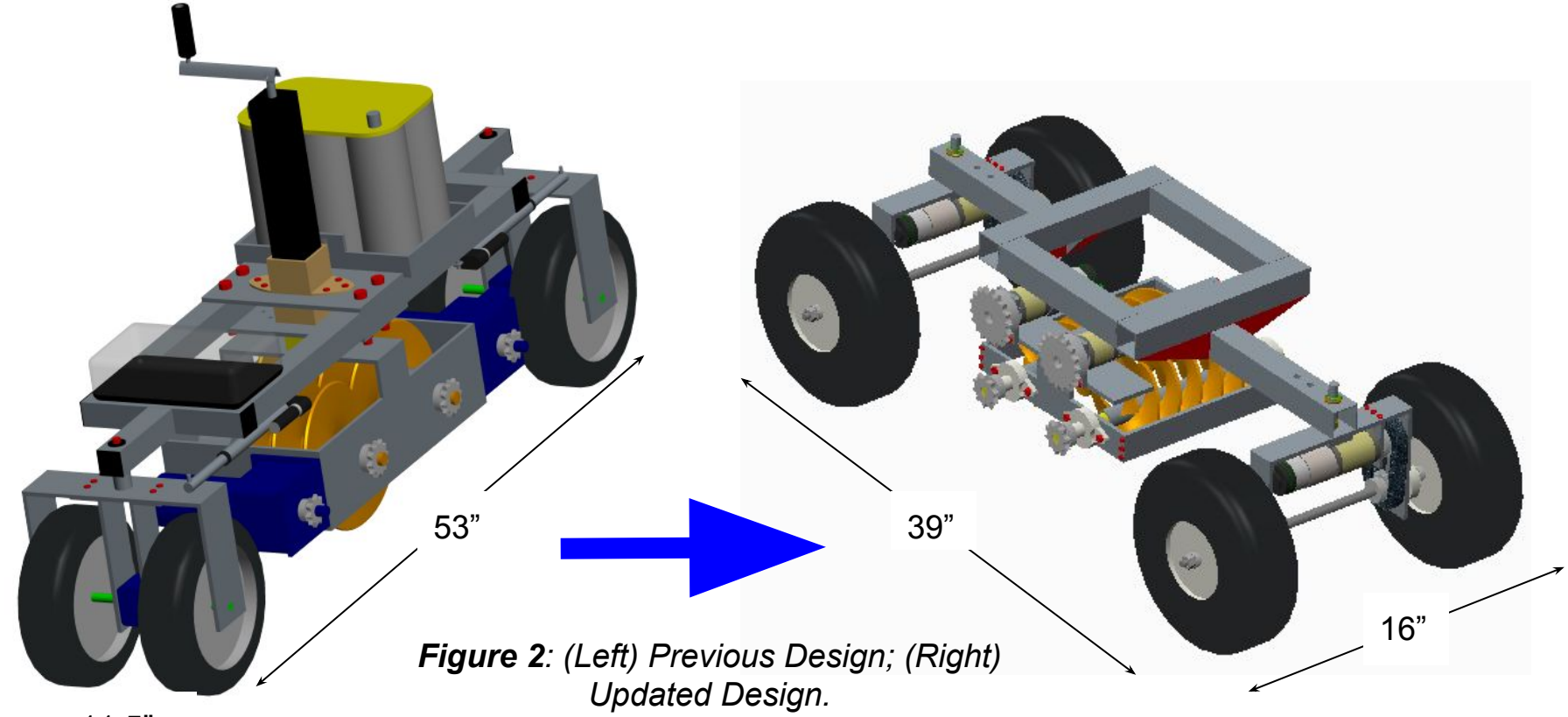


***Figure 2**: (Left) Previous Design; (Right) Updated Design.*

Shearing Mechanism

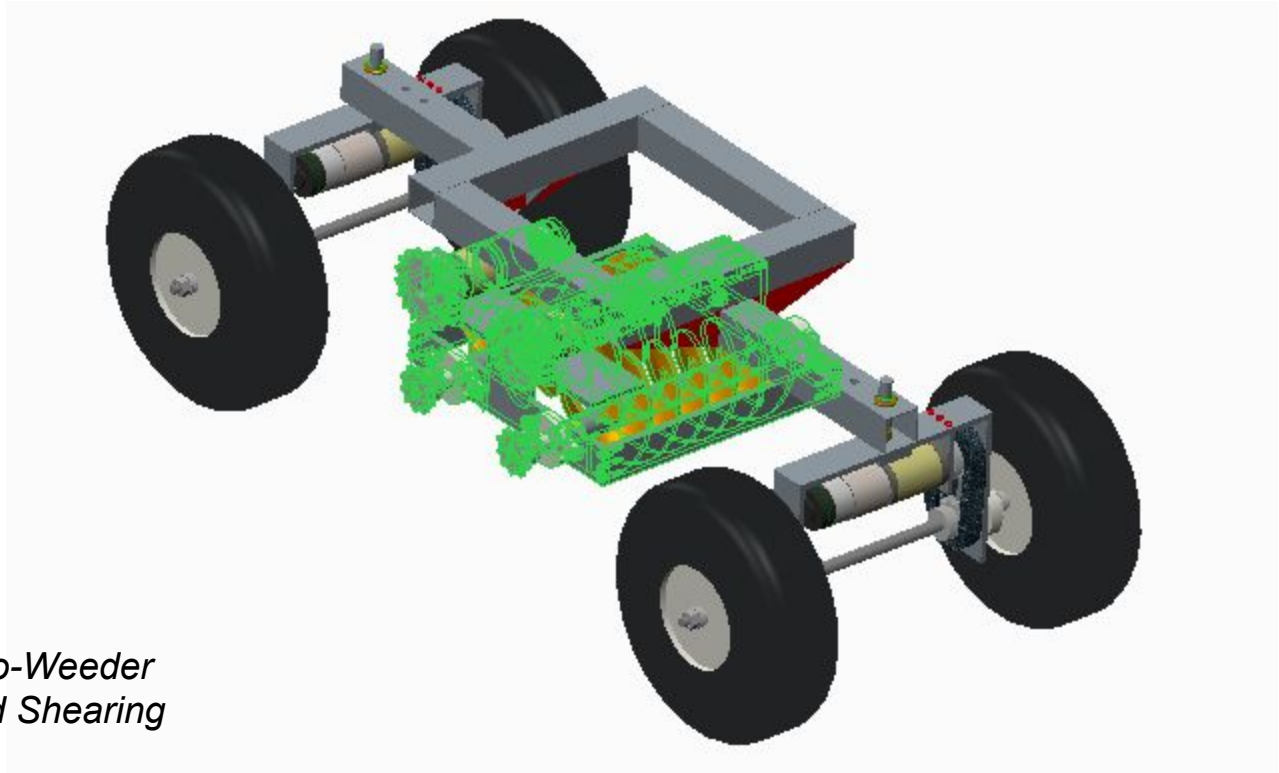


Figure 3: *Robo-Weeder with Highlighted Shearing Mechanism.*

Shearing Mechanism

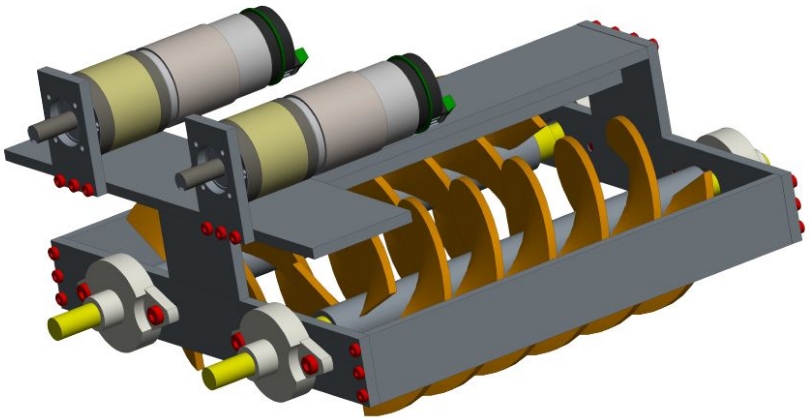


Figure 4: *Fully Assembled Shearing Mechanism.*

Mechanical Parameters:

- 2 Augers
- 4” Diameter Augers
  - Opposite handed Auger Flighting.

- Each Auger needs 70 in-lb Torque to operate effectively.
  - Roller Chain and Sprocket System

Custom Augers

- **Custom Auger System**
  - Bloom Manufacturing
  - 4” Auger Flighting
    - House up to 5” Diameter
- **1.3” Auger Pitch**
  - 3 Sections of Flighting
  - 120 Degree Angular Spacing
- **Mild Carbon Steel**
  - 7 Gauge (0.1793”)

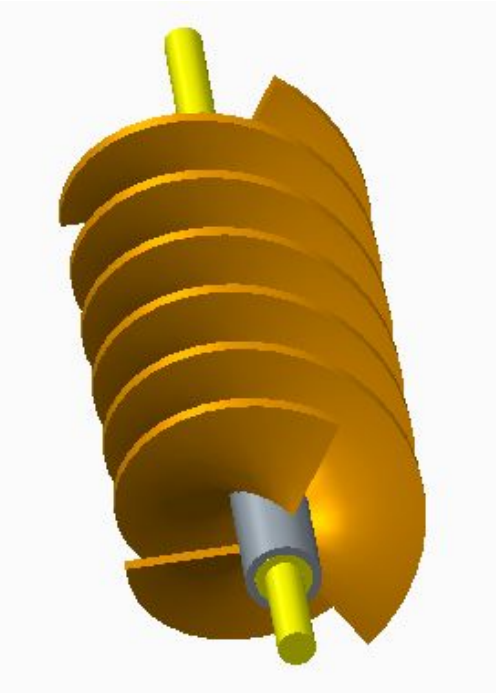


Figure 5: *Custom Auger Assembly*

Interchangeable Auger System

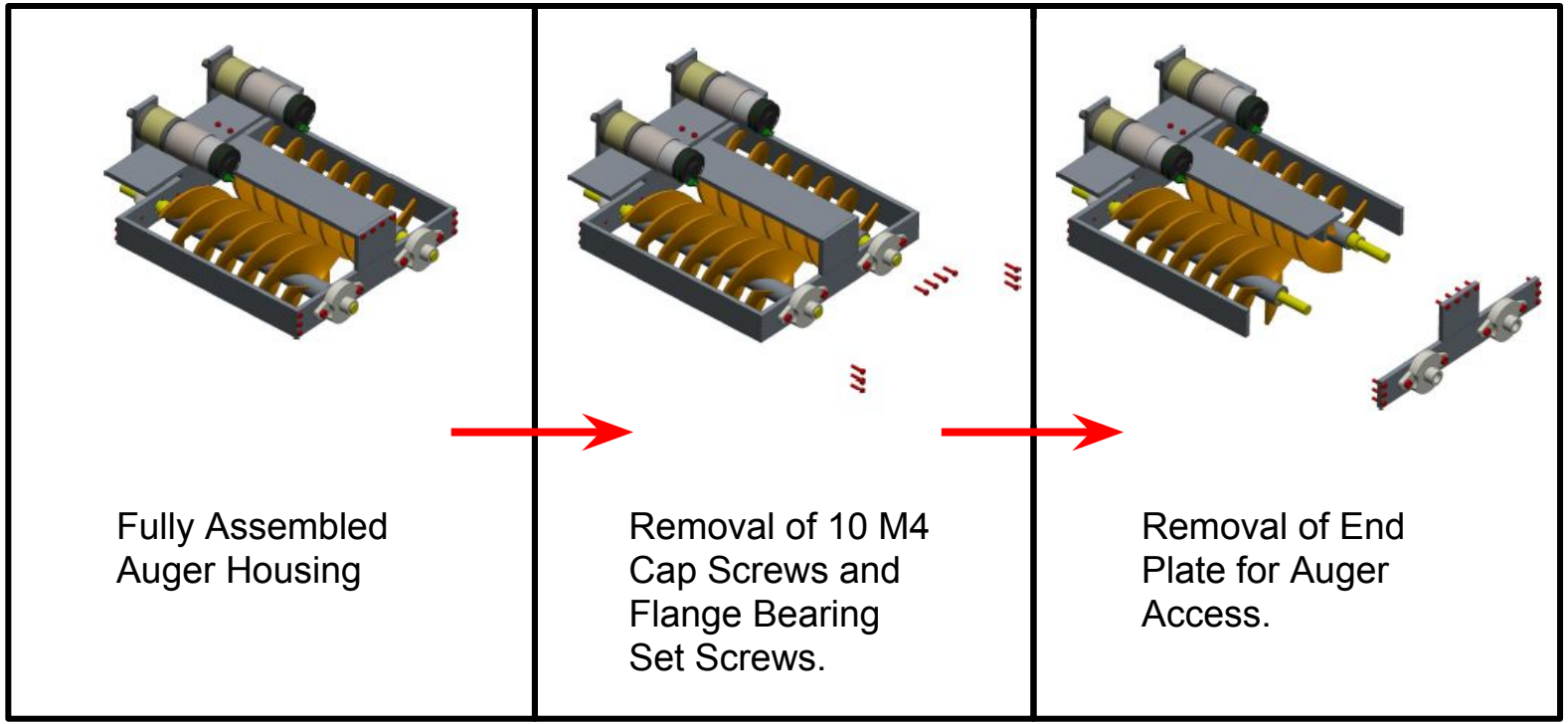


Figure 6: *Illustration showing the removal of the Auger Assembly.*

Drive Mechanism

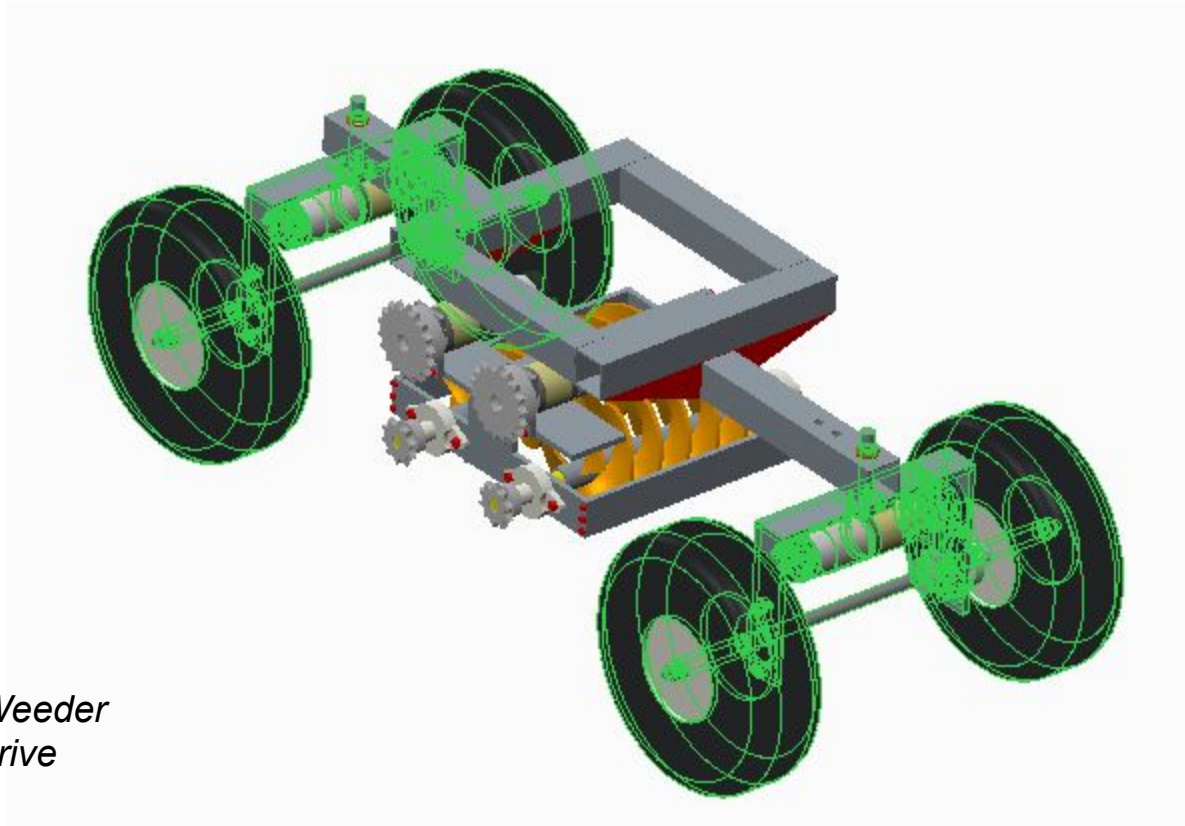


Figure 7: *Robo-Weeder with Highlighted Drive Mechanism*.

Drive Mechanism

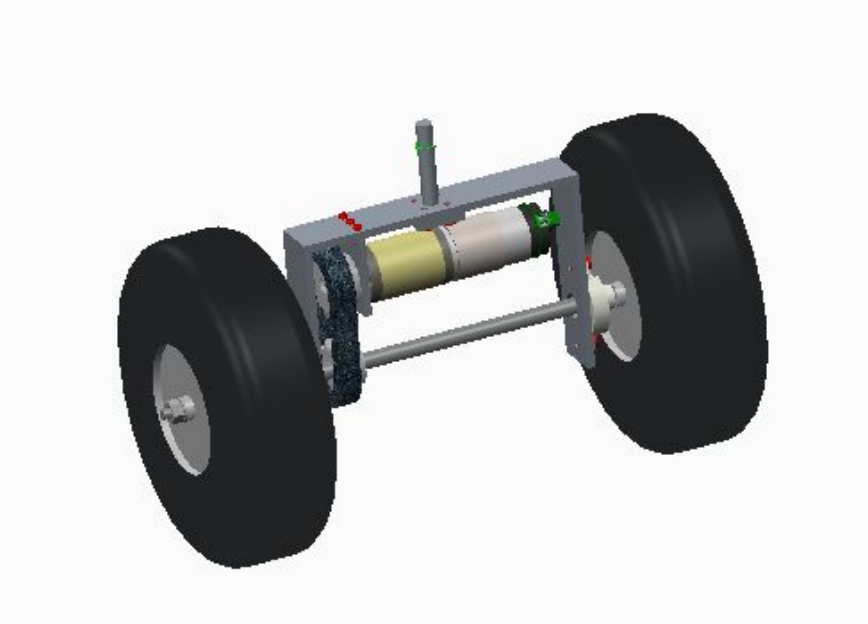


Figure 8: *Robo-Weeder Drive Mechanism.*

Mechanical Parameters:

- **Propulsion**
  - 100 in-lbs Torque
  - Roller Chain & Sprocket
- **10” Diameter Wheels**
  - High Traction
  - High Ground Clearance
- **30 Degree Turn**
  - Independent/Parallel
- **Steering Requirement**
  - 200 in-lbs Torque

Electrical Design Needs

- 1 Transmitter/ Receiver
- 1 Microcontroller
- 4 Motors
  - (2) Augers
  - (2) Drive
- 2 Steering Motors
- 6 Motor Controller Channels
- 12V Battery/Power Supply

Shearing Mechanism

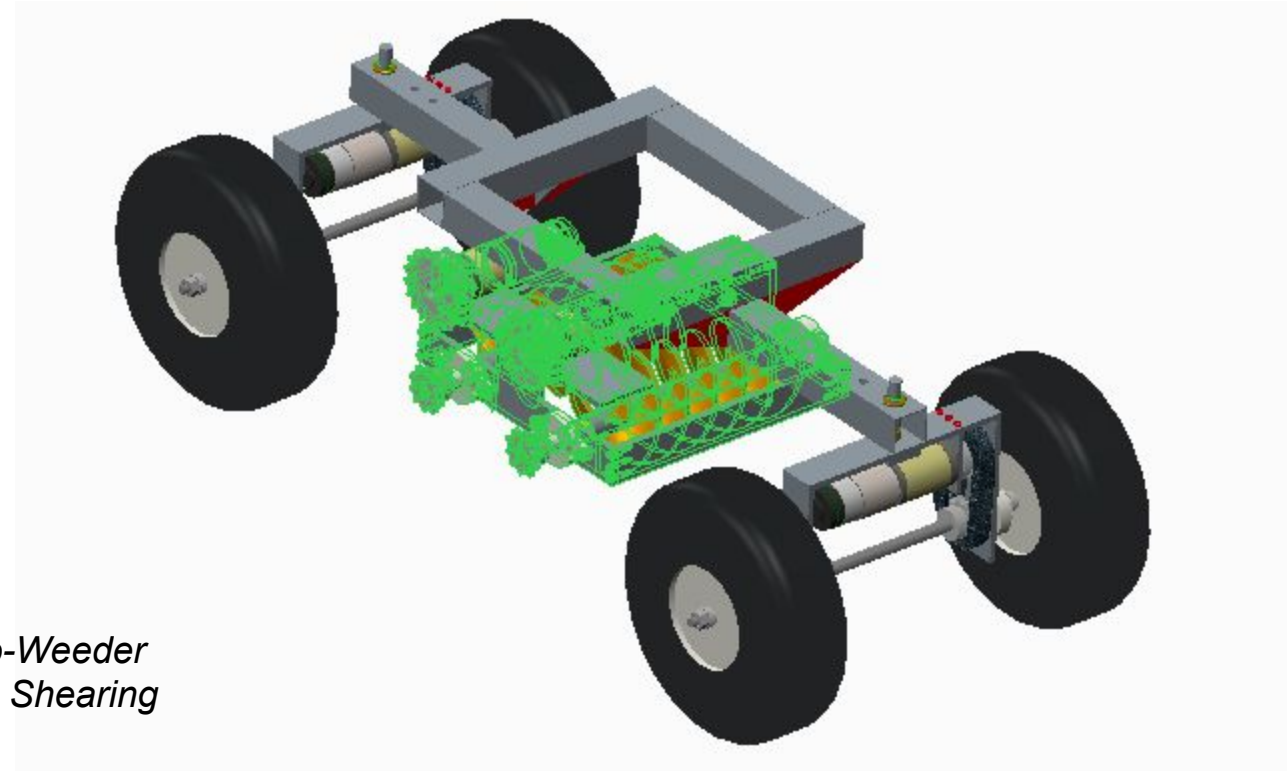


Figure 9: *Robo-Weeder with Highlighted Shearing Mechanism.*

Shearing Mechanism

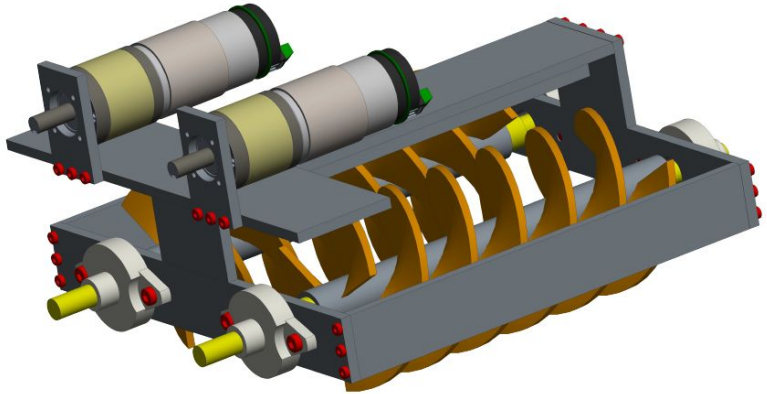


Figure 10: *Fully Assembled Shearing Mechanism.*

Electric Parameters:

- 2 Motors
- 70 in-lb Torque (per Auger)
- 100 RPM (per Auger)

Drive Components

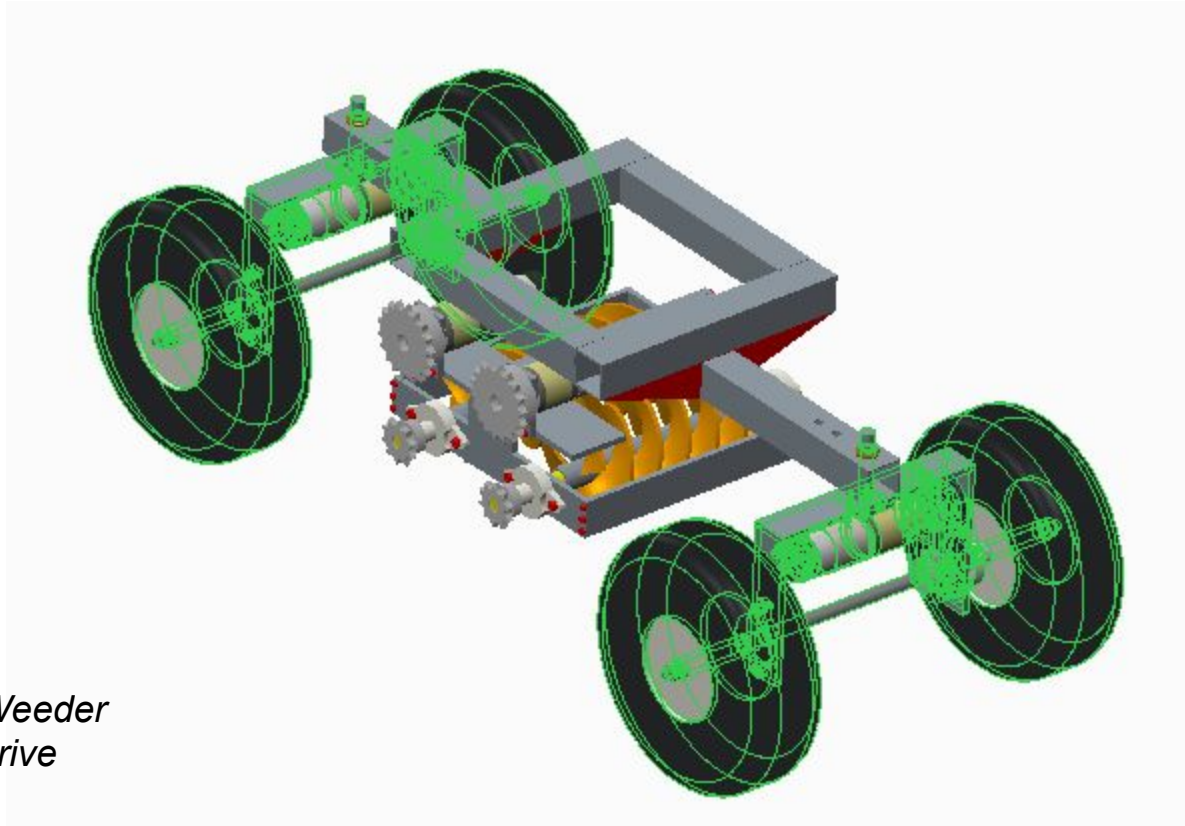


Figure 7: *Robo-Weeder with Highlighted Drive Mechanism*.

Drive Mechanism

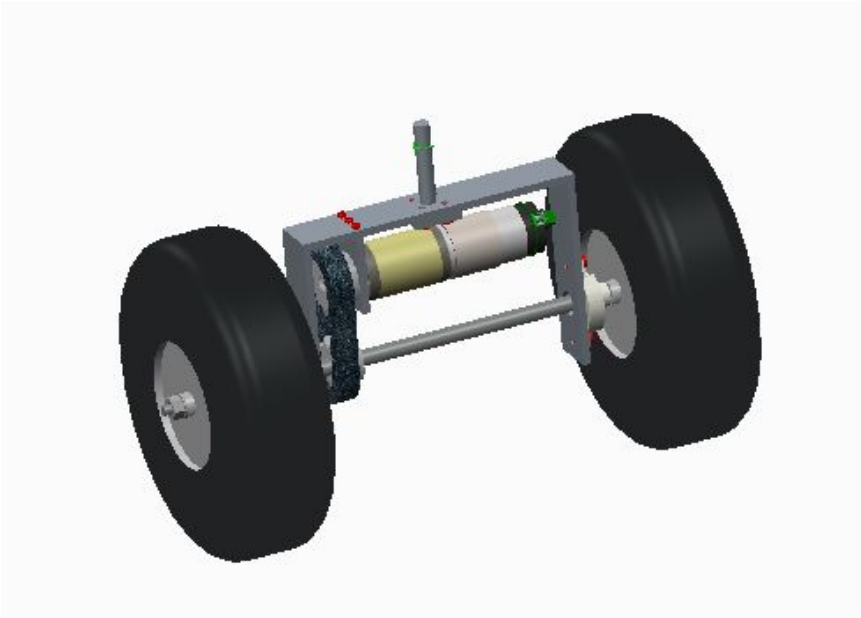


Figure 8: *Robo-Weeder Drive Mechanism.*

Electric Parameters:

- 2 Drive Motors
- ~100 lb-in Torque (Drive Motor)
- 50 RPM (Drive Motor)

Transmitter

- RadioLink T6EHP-E 2.4G 6CH Transmitter and Receiver ($30)
  - Transmits through Radio Frequency
  - 6 Channels
    - Augers
    - “Drive” Motors
    - Steering Motors

Figure 9: *Robo-Weeder Transmitter and Receiver.*

Microcontroller

- Arduino Mega 2560 ($45)
  - Processor: ATmega2560 @ 16 MHz
  - 54 Digital I/O Pins
    - 14 PWM Pins
  - 16 Analog Inputs
  - 7V - 12V Operating Voltage

Figure 10: *Robo-Weeder Microcontroller.*

Motor Controller

- Polulu 18v25 High-Power motor driver ($50)

  - Controls 1 Motor
  - Up to 25A continuous output per channel
  - 5V - 30V Operating Voltage

Figure 11: *Motor Driver for use on the Robo-Weeder.*

Motors

- Motor selected (pending approval)
  - advisor

- 4 Motors to operate:
  - Drive feature
  - Auger feature

Motor	**PG71 Planetary Gearbox with Motor**
Cost	$89
Speed	75 RPM
Torque	16.6 ft-lbs
Amperage	22 Amps

Figure 12: *Andymark DC motor for Drive and Shearing operation.*

Power Supply

- 12V DC Power Supply($24)
  - Maximum Outputs:
    - Up to 30A
    - Up to 360W
  - Will be used for testing purposes

Figure 13: *Power Supply for Bench Testing the Robo-Weeder Electrical Components..*

Coding

Drive-Code

Successfully Tested

Auger-Code

Successfully Tested

Steering

Pending

Budget

Total Budget: $3000.00

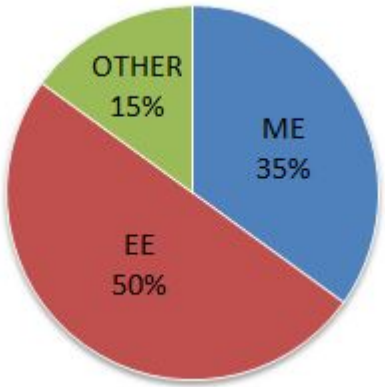


Figure 14: *Funding Breakdown for the Robo-Weeder Project.*

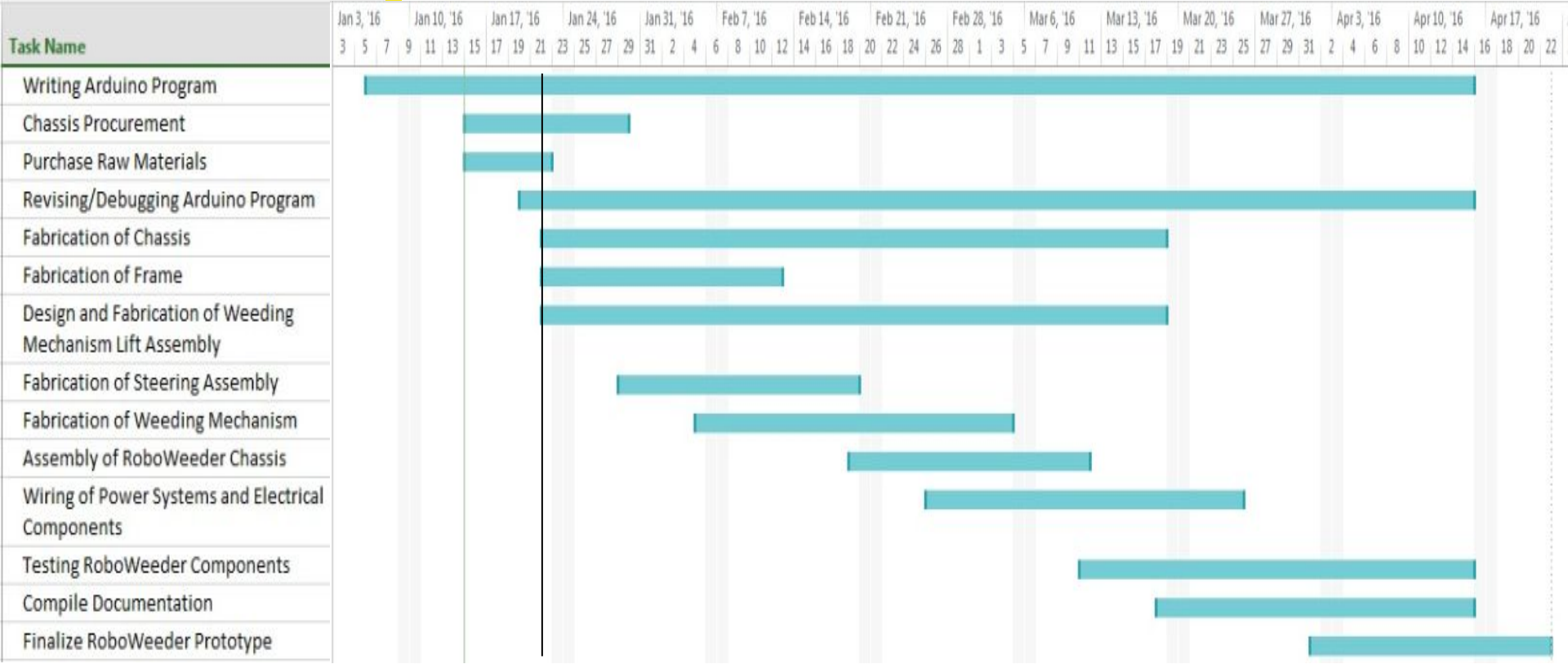
Current Cost: $302.7

Item Description	Part Number	Total Cost
Arduino Mega 2560 Microcontroller	RB-Rlk-03	49.99
Radiolink Transmitter and Receiver	RB-Ard-33	36.81
Auger Flighting - Right Hand	528	61.00
Auger Flighting - Left Hand	528L	61.00
10" Pneumatic Tire/Wheel	2252	19.98
12V 30A DC Universal Power Supply 360W	S-360-12	23.97
Heavy Duty Power Cord - 6 Feet	N/A	9.99
16 Pack 2800 mAh Rechargable Batteries w/ Charger	N/A	39.99

Future Cost: $755.8

Item Description	Part Number	Total Cost
Polulu 18v25 Motor Controller	758	199.80
(Auger Motors) PG71 Motor and Encoder	am-2971	178.00
(Drive Motors) PG71 Motor and Encoder	am-2971	178.00
Material		200.00

Gantt Chart


Task Name
Writing Arduino Program
Chassis Procurement
Purchase Raw Materials
Revising/Debugging Arduino Program
Fabrication of Chassis
Fabrication of Frame
Design and Fabrication of Weeding Mechanism Lift Assembly
Fabrication of Steering Assembly
Fabrication of Weeding Mechanism
Assembly of RoboWeeder Chassis
Wiring of Power Systems and Electrical Components
Testing RoboWeeder Components
Compile Documentation
Finalize RoboWeeder Prototype
Jan 3, '16
Jan 10, '16
Jan 17, '16
Jan 24, '16
Jan 31, '16
Feb 7, '16
Feb 14, '16
Feb 21, '16
Feb 28, '16
Mar 6, '16
Mar 13, '16
Mar 20, '16
Mar 27, '16
Apr 3, '16
Apr 10, '16
Apr 17, '16

Schedule

Current Project Tasks:

- Complete a Fully Operational Control Program (Arduino Code)
- Web design
- Material order

Future Project Tasks:

- Fabrication of Chassis
  - Fabrication of Frame
  - Fabrication of Steering Assembly
- Fabrication of Weeding Mechanism
- Fabricate the Weeding Mechanism Lift Assembly
- Test All Systems on the Full Assembly
- Compile Accurate Documentation for all Aspects of Project

Summary

Goal:

Design a remotely operated robotic system with an interchangeable shearing mechanism to remove weeds on an organic farm.

Robo-Weeder

Steering: Independent front and rear with parallel steering capability.

Weeding: Auger Style to minimize soil disruption.

Communication: Radio Controlled for ease of operation.

Challenges moving Forward

Time is the Team's major opposition.

References

1. http://www.todaysdietitian.com/newarchives/040715p40.shtml (organic vs conventional farming)
2. http://www.orchardpondorganics.com/images/gallery/original/1301371300_f7d5753c3bf1.jpg
3. http://www.ocia.org/sites/default/files/_documents/EN-QS-M-003_0.pdf Organic standards
4. https://en.wikipedia.org/wiki/Earthworm earthworms
5. https://www.arduino.cc/en/Tutorial/PWM (PWM Table, Microcontroller)

Questions?