SENIOR CAPSTONE/
SENIOR DESIGN EXPERIENCE

2025

AgGrowBot Automated Shifting

Samuel Dodson[1], Wade Kinnaman[2], Luke Sheward[3], Tate Hensley[4]

[1]Agricutral Systems Management ; [2]Agricutrual Engineering;
[3]Agricutral Systems Management; [4]Agricutral Systems Management

PURDUE UNIVERSITY
Agricultural and Biological Engineering

Executive Summary

The Ag Grow Bot Is a complex system that utilizes cameras and object-based detection methodologies to locate and identify weed species in corn plants. A commercially available system is used to steer and navigate the machine while the rest of the functions are built in house by past Ag & Biological engineering students. Prior to our teams work, the machine was not fully autonomous and could not keep within an acceptable speed control range. Our objective was to further advance the AgGrowBot by adding an autonomous shifter and improving the speed control system for increased field speed stability.

Project Characteristics and Limits

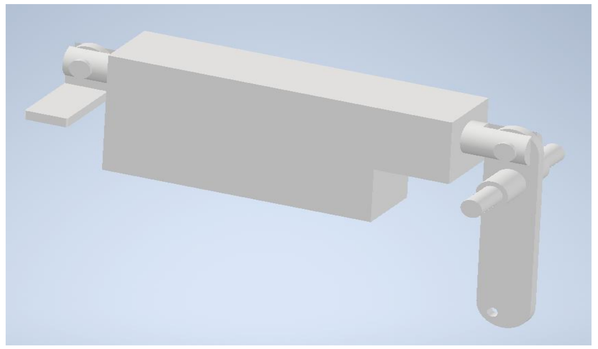
- Looking towards the future of autonomy and how it could be implemented on the AgGrowBot
- Speed Control is working sporadically and needs to be within given range

Constraints-

- Budget: $5000
- Limited area for fabricated parts and actuator
- Must operate between 3-3.5 mph

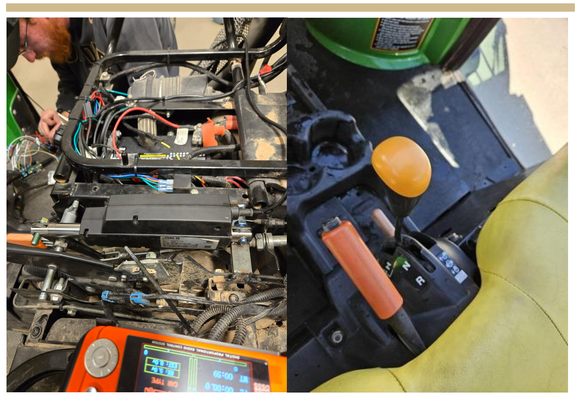
Criteria:

- Emergency shut off: safety feature
- Autonomy: to be shifted and operated without an actual person on the machine



Design and Development

Pictured above is the Final Design made with AutoCAD Inventor for the removal of the shifter and the insert of the fabricated parts and the LINKAK LA 12 actuator that is to be controlled via Arduino and remote control. Multiple pieces were designed for the complete assembly to be made.

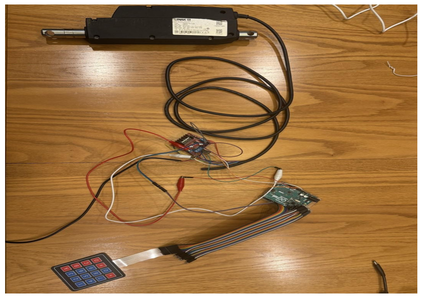


Project Solution Ideas & Selection

Our team generated a few designs, including an electrical linear actuator, an air powered cylinder, a hydraulic cylinder and a pilot circuit to achieve a mechanical over remote shifting. The final solution utilized a large electrical actuator and an Arduino to act as a liaison between the actuator and the remote control.

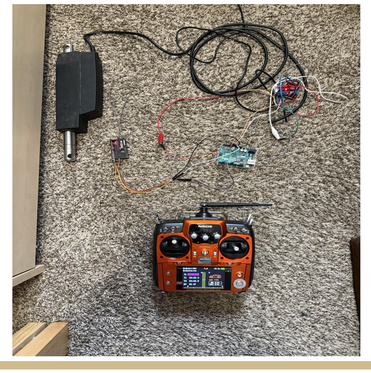
Project Research and Context

In our initial research for solutions, the team was able to investigate air powered solutions, hydraulic powered solutions and electrically powered solutions(as seen below) for the mechanical energy transfer.



The testing portion of the programming of the Arduino to make sure the code was working for the linear actuator. The code will tell the actuator the desired position of the operator whether High, Low, Reverse, or Neutral.

The Arduino was programmed using the Arduino IDE software. Multiple programs were used to test the functionality of the actuator. The first program was focused on moving the actuator with feedback from the actuator. The last program was focused on receiving the signal from the RC controller to move the actuator.

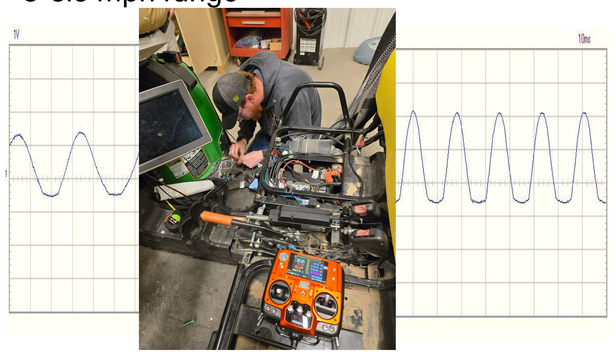


Prototype Testing And Feedback

The machine utilizes a MC cruise system from a UTV to control the speed.
The main problem:

- Thea amplitude is low on the system causing it to work sporadically, as seen below the wavelengths are sign waves and need to be a square wave

Solution: By adding a signal amplifier, we were able to strengthen wavelengths for the system to pick them up and work in the 3-3.5 mph range



Final Concept and Design

Technical Specifications –
Model – LINAK LA 12
Max Load – 750 Newtons

Design Features -

- Custom built brackets
- Built on easily removable setup

Value Proposition and Impact-

The value presented by this projected is both in monetary savings and an advancement to the future of production agricultural. Our contribution as well as past teams , rapidly accelerates the future of production agriculture. This in the end will impact not only our university, but the state, country and overall world around us.

Special Thanks to our sponsors Roger Tormohelen and Richard Fox.

All designs , figures, graphs and pictures were produced by the team and not externally referenced.