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PURDUE UNIVERSITY | College of Agriculture
AGRICULTURAL AND BIOLOGICAL ENGINEERING

Problem Statement and Background

The agBOT Challenge is an international competition to create autonomous robots capable of performing agricultural tasks. The competition is hosted by Purdue Agriculture and Gerrish Farms. This year's team will be competing in the Weed and Feed Competition and will need to design a vehicle capable of completing the following tasks (*constraints*) autonomously:

- Maneuver two or four 150-ft rows at a time and turn at each end. The bot must make two passes.
- Observe crop plants to assess health of the corn plant.
- Deliver fertilizer to distressed corn plants.
- Identify three common weeds within and between rows: giant ragweed, cocklebur, and foxtail
- Arrange for weed to be eradicated chemically or mechanically
- Provide real-time observations and feed back to the base station.

Criteria

- Weight
- Level of autonomous operation
- Accuracy of weed or crop identification and treatment
- Decreased turning radius from existing design
- Versatility / Expandability

Impact and Sustainability

- Revolutionize the world of farming by providing proof of concept of autonomous vehicles
- Compensate for shortage of qualified farm laborers
- Increase field operation efficiency and put money back into the pockets of farmers
- Reduce excessive application of herbicides and fertilizers by up to 70%
- Allow farmers to allocate their time and laborers to more important tasks

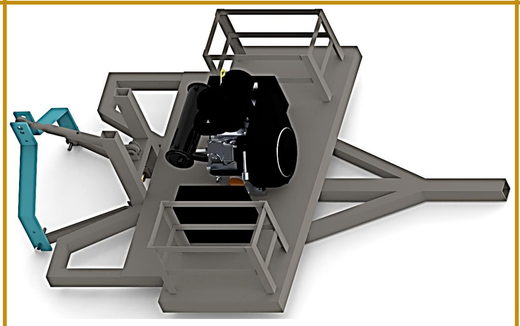
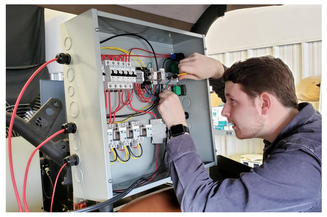
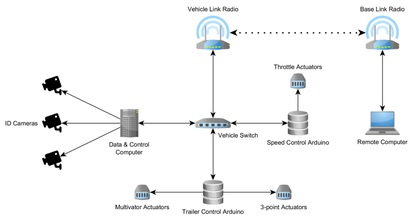
Team and Task Breakdown

Building off of last year's BOT, we realized there was still quite a lot of work to complete. We decided to divide tasks into three different subgroups to ensure completion of the BOT for the competition. These subgroups include:

- Weed and Feed System
- Electrical Control System
- Vehicle Control System

	Weed and Feed System	Electronical Control System	Vehicle Control System

Alternative Solutions	• Replace existing castor wheels with:
	  • Single, large, rear wheel
	  • Multiple rear wheels
	• Design a trailer to house the weed and feed implements
		• Object classification vs. Object detection
		• Fix vs. Replace existing wiring
			• Linear actuator vs. McCruise cruise control
			• Trimble vs. John Deere navigation
			• Fix vs. Replace existing network

Engineering Tools	• PTC Creo – CAD modeling software used to design, visualize, and analyze trailer before fabrication	• NVIDIA CUDA – software to interface with GPU • Darknet – open-source software for YOLO real-time object detection	• Electrical test bench – area designated to testing individual components. Features adjustable power supply, soldering iron, and electrical measurement tools
Final Design	 • Solid axle trailer designed for loads up to 2500 lbs. • Modular design to restore functionality of vehicle when desired. • Reduction of turning radius by 20% • Stand alone 3-Point hitch increases versatility of platform 	 • Complete overhaul of existing wiring to incorporate a failsafe e-stop  • Object detection provides the same accuracy as classification at 10-20 times the speed. • Object detections opens the door for much more precise sprayer placement because the system can "pinpoint" targets.	 • Redesigned vehicle network that allows for remote control of vehicle and real-time feedback to operator  • Trimble navigation and Linak speed control allow precise application of treatment.
Economic Analysis	** $ 6,634.88 **	$ 2,310.81	*** $ 13,640.00 ***
	** Auxiliary motor ($2,379.95) donated by Purdue ¼ Scale Team ** Linear actuators ($3,000.00) donated by Linak		*** Navigation system ($13,500.00) donated by Trimble *** Linear actuator ($140.00) donated by Linak
	Grand Total :	**$ 22,585.69**	

Sponsors: LINAK, Trimble, Ford Distributing, John Deere, Yamaha

Technical Advisors:
Dr. Roger Tormoehlen
Mr. Richard Fox

Instructors:
Dr. John Lumkes
Dr. Robert Stwalley
Dr. Margaret Gitau
Dr. John Evans

Acknowledgements:
Mr. Scott Brand
Mr. David Wilson
Mr. Dave Moorman
Mr. Treg Beer
Mrs. Rachel Gerrish
Purdue ¼ Scale Tractor Team

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