PURDUE UNIVERSITY

CAPSTONE/SENIOR DESIGN EXPERIENCE 2018

agBot Challenge: Weed & Feed

Agricultural & Biological ENGINEERING

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Problem Statement and Background

The agBot Challenge is a national level competition hosted by airBridge, llc., designed to encourage and spur innovation around the use of autonomous vehicles in agricultural production. The 2017-18 Purdue ABE team will be competing in the Weed and Feed Challenge, which consists of designing a vehicle that can complete the following tasks:

- Autonomously maneuver two or four 1000-ft rows at a time and turn at each end. The agBot shall make four 1000-ft passes
- Autonomously observe crop plants and fertilize plants as needed
- Identify three common weeds: Giant Ragweed, Cocklebur and Redroot Pigweed within and between rows
- Arrange for weed eradication through chemical and/or mechanical means
- Provide real time observation methods of fertilizing and/or treating the plants back to the base station

Impact and Sustainability

- Proving feasibility and versatility of autonomous vehicles
- Decreasing labor costs and shortages for future farms
- Increase efficiency of field operations by reducing overspray and runoff
- Allow farmers time flexibility in order to precisely manage valuable time

Team/Task Breakdown

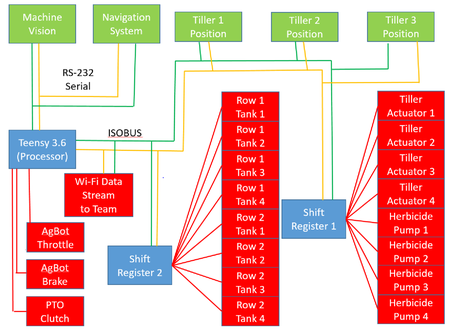
Following the team from last year, the various design aspects of the vehicle have been split up amongst the team members. Therefore, each team member was delegated aspects of the vehicle to redesign. Each area was chosen to focus on the team members area of expertise.

These groups include:

- Weed Identification
- Vehicle Control Integration
- Vehicle Navigation
- Implement Sprayer System
- System Power Supply

Engineering Tools

- NVIDIA DIGITS- Neural Network Platform for deep learning process used to classify images
- Python 3.6 - Programming language used for camera control
- C - Programming language used for system control integration



- Trimble Precision IQ - Guidance software for autonomous control of the vehicle

Potential Solutions

Weed Identification

- Update current classification system while decreasing data bottlenecking to improve performance
- Switch to object detection instead of object classification
- Improve low light and washout situations

Vehicle Control Integration

- Incorporate industry standard communication protocol (ISOBUS)
- Standardize attachment connections (ISOBUS Connector, Power, PTO, etc.)
- Use more common prototyping materials (C Language Microcontroller)

Vehicle Navigation

- Update and fix existing Swift navigation system
- Adapt and utilize off the shelf autonomous guidance systems

Implement Sprayer System

- Redesign central pump system with individual mixing tanks
- Utilize four pump, four tank individualized sprayer system

System Power Supply

- Tap into vehicle drive to create a live PTO system utilizing the vehicle engine
- Use an auxiliary engine to provide mechanical and electrical power

Final Design

Weed Identification

- NVIDIA DIGITS

Vehicle Control Integration

- Teensy 3.6 Microcontroller

Vehicle Navigation

- Trimble EZ-Pilot

Implement Sprayer System

- 4 Tank, Individual Pump System

System Power Supply

- Auxiliary Engine

Resource Outlay Analysis

Weed Identification	$125.78	Implement Sprayer	$928.72
Vehicle Control Integration	$287.10	System Power Supply	$193.89
Vehicle Navigation ***	$13,500.00	Total	$15,035.49

Sponsor: Ford Distributing, oerlikon fairfield

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*** Total Cost Donated By Trimble Navigation ***

Trimble, NVIDIA DIGITS, YAMAHA, MONOSEM

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