**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 2016-2017 Purdue University combined ABE & ME team will be competing in the agBOT Weed & Feed Challenge, and will need to design a vehicle called the “agBOT” 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 the row and between the rows.
- **Eradicate weeds 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**

- Prove possibility and versatility of autonomous vehicles
- Decrease labor cost and problems of finding qualified labor for future farms
- Increase efficiency of overall field operations leading to better yield, reduced waste, and better environmental conditions
- Allow farmers more flexibility to focus on and accomplish a variety of other tasks, separate from vehicle operations

**Engineering Tools**

- **PTC Creo** – CAD modeling software used to generate and visualize design ideas and solutions
- **National Instruments LabVIEW** – Graphical programming software used to acquire data, and design and operate control systems
- **NVIDIA DIGITS** – Neural Network Platform for deep learning processing used to classify images and thus identify vegetation
- **Python 2.7** – A programming language used for camera control, running models, and communicating between systems

**Team / Task Breakdown**

With the various requirements the team has for this project, it was imperative to delegate tasks between groups of team members. Therefore, the team broke the project requirements down by creating six groups, which each specialize in addressing particular components of the project. These groups include:

- **Chemical Weed Eradication and Crop Fertilization**
- **Mechanical Weed Eradication**
- **Vehicle Steering and Controls**
- **Vegetation Identification**
- **Systems’ Power Supply**
- **Systems’ Communications**

**Potential Solutions**

**Chemical Weed Eradication and Crop Fertilization**

- Spray weeds within the row with 4 different dyes, via 4 different mix tanks/pumps or use eductor in lines to limit to 2 tanks
- Use an eductor to mix the dye and limit tank space on the vehicle

**Mechanical Weed Eradication**

- Individually drive and raise/lower Multivator heads, via hydraulic or electric motors, and hydraulic or electric linear actuators
- Simultaneously drive all Multivator heads with an auxiliary engine, using winches to raise/lower the heads individually

**Vehicle Steering and Controls**

- Autonomously steer vehicle by using linear actuators/GPS or retro-fit existing GPS/steering system onto the vehicle
- Use Swift GPS to control EPS, and linear actuators to steer vehicle

**Vegetation Identification**

- Image segmentation with color boundary thresholding
- Use deep learning to train a neural network for image classification, with NVIDIA DIGITS platform

**Systems’ Power Supply**

- Use a generator to provide mechanical and electrical power
- Use an auxiliary engine to provide mechanical and electrical power

**Systems’ Communications**

- Use a Raspberry pi as a micro-controller
- Use National Instruments (NI) myRIO

**Final Design**

**Chemical Weed Eradication and Crop Fertilization**

- Spray system with eductors and 8 nozzles

**Mechanical Weed Eradication**

- Winches and auxiliary engine

**Vehicle Steering and Controls**

- Swift GPS and linear actuators

**Vegetation Identification**

- NVIDIA DIGITS

**Systems’ Power Supply**

- Use a generator to provide mechanical and electrical power

**Systems’ Communications**

- NI myRIO and LabVIEW
- Ubiquiti products

**Resource Outlay Analysis**

<table>
<thead>
<tr>
<th>Task Group</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Weed Eradication and Crop Fertilization</td>
<td>$847.37</td>
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<tr>
<td>Mechanical Weed Eradication</td>
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<tr>
<td>Vehicle Steering and Controls</td>
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<tr>
<td>Vegetation Identification</td>
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<tr>
<td>Systems’ Power Supply</td>
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<td>Systems’ Communication</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>$7,304.93</strong></td>
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</tbody>
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*Total project also includes numerous donations*