

Warren J. Baker Endowment

for Excellence in Project-Based Learning

Robert D. Koob Endowment *for Student Success*

The logo for Cal Poly University, featuring the words "CAL POLY" in white, serif, all-caps font on a dark green rectangular background.

FINAL REPORT due after completion of project

*Final reports will be published on the Cal Poly Digital Commons website
(<http://digitalcommons.calpoly.edu>).*

I. Project Title

Cal Poly agBOT 2017 Challenge Autonomous Corn Seeding Tractor

II. Project Completion Date

June 28, 2017

III. Student(s), Department(s), and Major(s)

(1) Charlie Ross, BRAE, June 2017

(2) Nate McCarthy, BRAE, June 2017

(3) Dillon Beatty, BRAE, June 2017

(4) Austin Della, BRAE, June 2017

(5) Matt Valentine, BRAE, June 2017

(6) Ryan Vyeniolo, BRAE, June 2017

(7) Caleb Fink, MS AG, June 2018

IV. Faculty Advisor and Department

Dr. Bo Liu, BioResource and Ag Engineering Department

V. Cooperating Industry, Agency, Non-Profit, or University Organization(s)

Gerrish Farms, Host of agBOT Challenge 2017

VI. Executive Summary

The Cal Poly agBOT team researched, designed, and built a Remote Controlled tractor to compete in Gerrish Farms' agBOT Seeding Challenge 2017. The tractor was procured from the BioResource and Agricultural Engineering department. The tractor served as the base unit, with supporting components mounted onto it. Steering the tractor was accomplished with a auxiliary hydraulic

motor mounted to the steering wheel. Throttle and choke were controlled by servo and linear actuator respectively. Both the three point hitch and PowerTakeoff was controlled by linear actuators. All controls were executed by an arduino microcontroller, which was equipped with a remote control. The steering was equipped with a potentiometer for steering feedback and travel direction of the tractor. The corn seeder attached to the three point was equipped with two hoppers, seed sensors, a seed rate motor, and two vacuums to switch between different seed varieties. The tractor effectively plants corn via remote control and competed on June 24th, 2017 at Gerrish Farms, Rockville, Indiana.

The days leading up to the event, the tractor was loaded onto a trailer. Three students rented a truck, loaded it up with camping equipment, and hauled the Cal Poly agBOT to Indiana in ~47hrs, with a single 5hr stop to rest. The students and tractor arrived safely, unpacked, and tested the tractor at Gerrish Farms. The day before the competition, Gerrish Farms held an expo for the surrounding community and guests. Many people from all ages and expertise walked around and were thoroughly interested in the Cal Poly teams efforts. The students competed and turned back to California. We placed 2nd in our competition, bringing home \$15,000 to support next years agBOT team.

VII. Major Accomplishments

- (1) Placed 2nd in the agBOT Challenge 2017 Seeding Competition, with a \$15,000 prize
- (2) Inspired creativity and ingenuity with the methods used to make a tractor remote controlled
- (3) Developed Positive Connections with Businesses, Companies, Investors, Students, Universities, and Community Members

VIII. Expenditure of Funds

The majority of expenses were travel. The fuel and food to deliver the tractor to and from cost ~\$2200. The truck rental was ~\$700. The remainder of the funds went to the tractor and components at ~\$1600. Which gives a total of ~\$4500.

IX. Impact on Student Learning

“We got 2nd. A mere \$15,000 prize. 7 teams competed and 5 of 7 were barely able to navigate on their own, for various reasons. Lots of from-the-ground-up builds. We think ours impressed due to its simplicity and practicality, and because it actually went around the field and planted rows like it was supposed to. Of course, it was remotely controlled, but I think settling for a succesful remote control rather than trying to implement autonomy at the last minute really helped us out in that we had an excellent demonstration. On the expo day people were constantly coming and checking out our tractor, complementing us on our ingenuity. Go figure! The guy who got 1st is a very clever farmer who has implemented near complete autonomy on a full size tractor that he actually uses to do his tilling and planting. Well out of anyone else's league but also well within our grasp to achieve at some point. We were very pleased to beat Ohio State Univ who showed up with a \$250,000 tractor and an enormous trailer with 3 40" flat screen TVs and 15 computers. It was like the mobile nuclear launch wagon.

Getting 2nd place aside, the whole event was awesome. it sounds like turnout was much bigger than last year, the first year of the event, and we were surrounded by very sharp, hardworking people, and everyone was

very friendly! What a great community! We were very surprised by how interested everyone was in our tractor. On Friday, the expo day, we didn't even have time to check out other team's builds we were so busy explaining ours to person after person. Pretty much everyone thought it was super cool. Some people were absolutely stoked about it (clutch actuation using tractor auxiliary hydraulics?? shop vacs to change seed variety?? cool!!) and they appreciated our resourcefulness in that it incorporated a lot of scrap material and a clearly seasoned tractor.

We made some awesome connections, with fellow universities, growers who are interested in this field (not least of which was Gerrish farms themselves who designed and hosted the event), people in industry (Yamaha in Silicom Valley COO George Kellerman and Climate Corp head of engineering Craig Rupp were a couple of our judges and sponsors, to name just a few), and other competitors. All very clever people, and companies ready to invest a lot in developing these technologies.

For our part, we are absolutely stoked om the whole thing and wish we had been doing this long before our senior year. It would be a mistake for Cal Poly BRAE not to pursue this in years to come. Not only has it been a thrilling experience for us personally, it has been great exposure for Cal Poly, and a great collaborative experience for everyone involved. We are fully convinced that this event and the ideas it supports are well worth pursuing. The support is there for future innovation on the part of the Cal Poly team, from the people we have met this weekend. We really didn't appreciate how great these people are and how accessible their knowledge and help is until this weekend.

Well to sum up our expectations have been far exceeded. I am writing this email on a cell phone in the car so I will stop now but I wanted to let you know we got some cheddar and exposure for Cal Poly and BRAE, we made some great connections and had a great time, and to encourage you to DEFINITELY continue this project and attend this event.”

Nate McCarthy and the Cal Poly agBOT Team 2017



Thank You Baker and Koob!

*Photo Top: Ryan Vyenielo, Charlie Ross, Dillon Beatty
Bottom: Caleb Fink, Austin Della, Nate McCarthy, Matt Valentine*