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ENGINEERING
TEXAS A&M UNIVERSITY

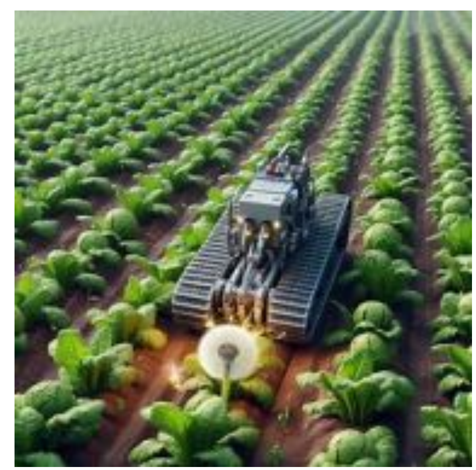
Team 72: WIZARD (Weed Identification and Zapping via Autonomous Robot Device)

Bi-Weekly Update 1

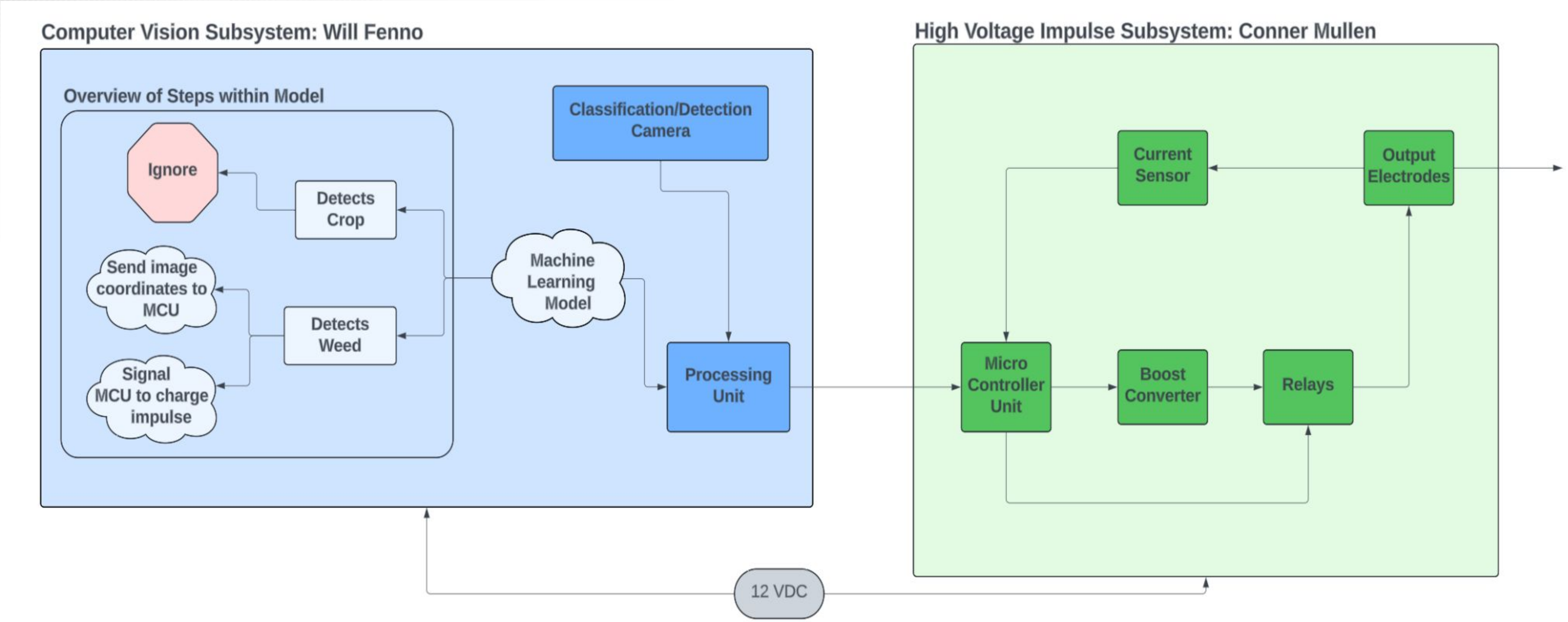
Will Fenno
Conner Mullen
Sponsor: Dr. Markus Zink
German Team: Leon Jaksch, Michael Dachender, Lisa Krug
TA: Sabyasachi Gupta

Project Summary

- Organic farming does not allow the use of herbicides for weed control; an alternative method is required.
- WIZARD will use camera recognition through machine learning to accurately identify weeds and deliver a targeted electrical impulse.



Project/Subsystem Overview

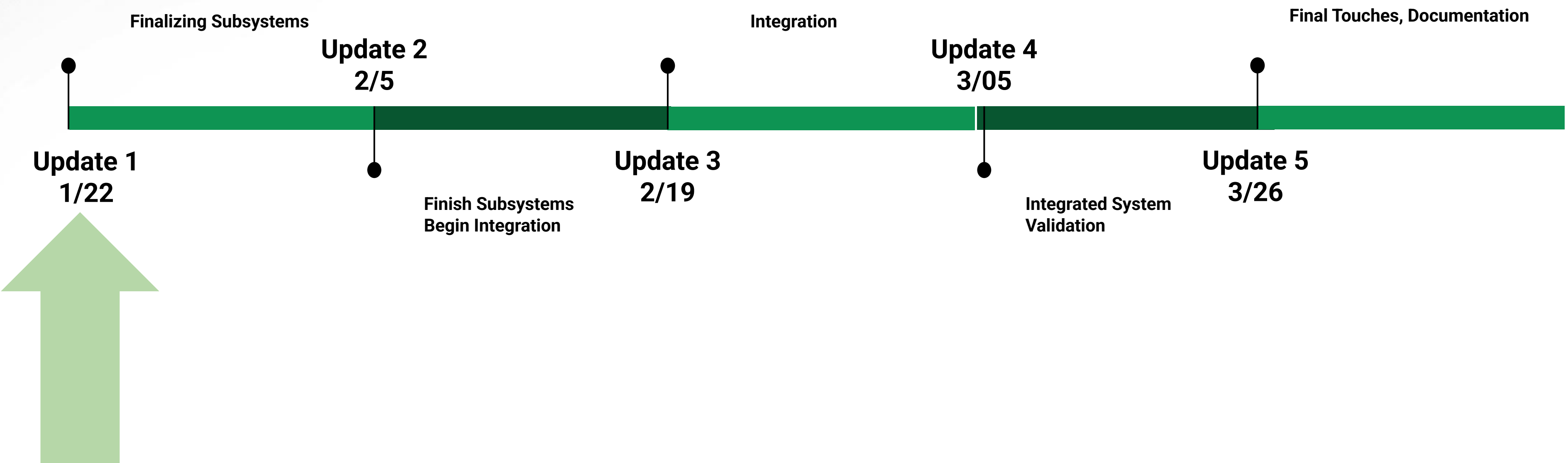


Major Project Changes for 404

German students are conducting research on killing the weeds, which includes work with the electrodes.

The robotics (movement of electrodes and entire system) is not within the scope of our project.

Project Timeline



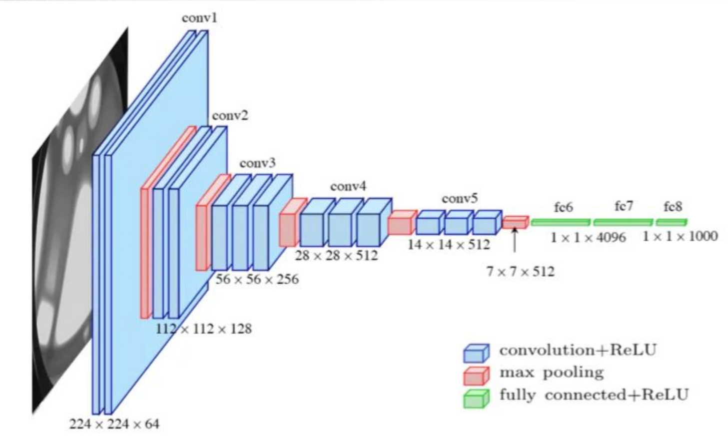
Subsystem 1 - Computer Vision

Will Fenno

Accomplishments since 403 10 hrs of effort	Ongoing progress/problems and plans until the next presentation
Transferred code and ML model from laptop to the Jetson via Github. Integrated the CSI camera with GStreamer enabled OpenCV.	Finish configuring the Jetson and installing necessary softwares. Test machine learning code on the Jetson in preparation for integration.

Subsystem 1 - Computer Vision

Will Fenno



The WIZARD model was built with a VGG16 architecture implemented with a classification and a regression head for dual output.

Real-time testing prediction of a growing weed next to a row of soybean crop.

ML model confidently classes the weed correctly and predicts a bounding box enclosing the weed's location.

Subsystem 2 - High Voltage

Conner Mullen

Accomplishments since 403 4 hrs of effort	Ongoing progress/problems and plans until the next presentation
Documented changes made to PCB during 403 and updated schematics	Recalculate power supply component values Update PCB layout and place order

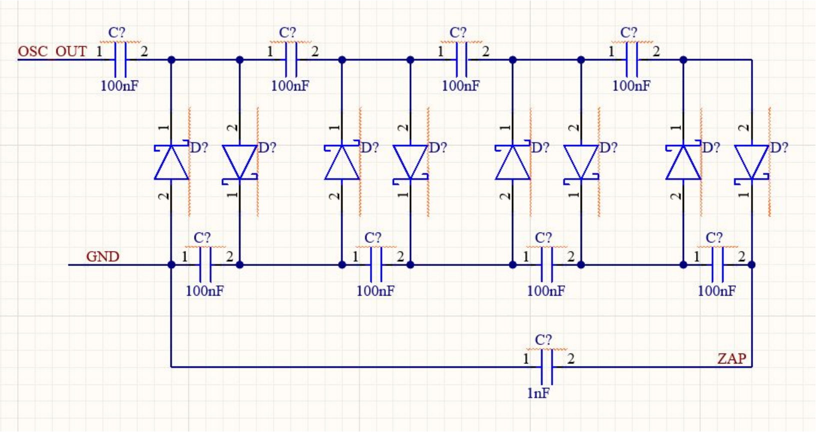
Subsystem 2 - High Voltage

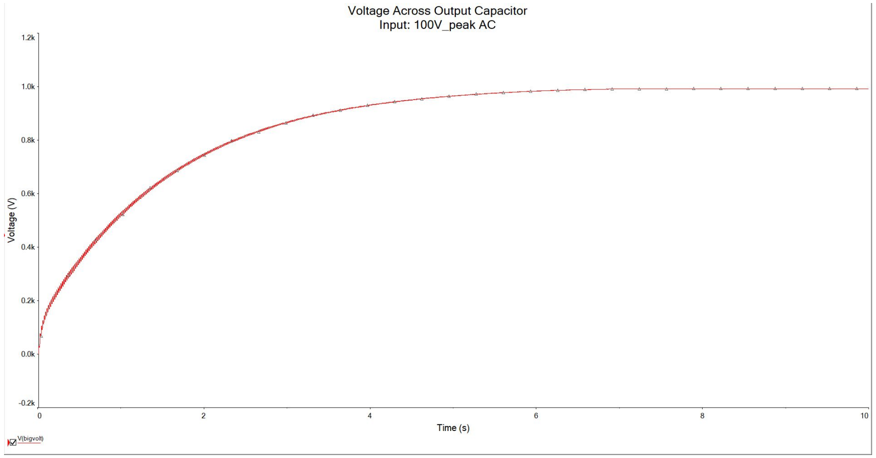
Conner Mullen

High voltage impulse generation:
- H-Bridge generates -12/+12V alternating voltage
- Cockroft-Walton Generator outputs boosted DC voltage

I2C control

5V:2A power supply
- 100mV of ripple
- Will be reworked





Parts Ordering Status

All parts and PCB will be ordered by the end of the week.

Execution Plan

WIZARD Project Schedule

Deliverable/Task	JAN			FEB				MAR					APR			
	1/12	1/19	1/26	2/2	2/9	2/16	2/23	3/2	3/9	3/16	3/23	3/30	4/6	4/13	4/20	4/27
Complete Code Transfer to Jetson																
Set up Jetson & Install Software/Packages																
Integrate CSI Camera with Jetson																
Status Update Presentation #1 (01/22)																
Test ML Code on Jetson & Fix Potential Issues																
Update Schematics and PCB Layout																
Adjust Power Supply Component Values																
Order PCB and Parts																
Computer Vision Subsystem Ready for Integration																
Status Update Presentation #2 (02/05)																
Assemble Revised PCB, Quick Validation																
Begin Subsystem Integration																
High Voltage Subsystem Complete for Integration																
3D Model/Print Casing for Electronics																
Status Update Presentation #3 (02/19)																
Troubleshoot Any Integration Problems																
Status Update Presentation #4 (03/05)																
Meet with Sponsor and Team in Germany																
Make Small Changes from Sponsor Feedback																
Design Blitz																
Status Update Presentation #5 (03/26)																
Integrated System Validation																
Final Presentation 04/09																
Implement Necessary Project Adjustments																
Generate Detailed Documentation																
Send Final Report Draft to Sponsor, Make Revisions																
Final Demo 04/24																
Final Report 04/28																
Annotations	Not Started															
	In Progress															
	Completed															
	Behind Schedule															

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Validation Plan

Paragraph #	Test Name	Success Criteria	Methodology	Status	Owner
3.2.1.1.	Capacitor Charge and Discharge Time	Time between start of charge up and end of discharge is less than 8 seconds	Measure voltage across output electrodes throughout a charge and discharge cycle, calculate time delta	TO BE TESTED	Conner Mullen
~~3.2.1.2.~~	~~Electrode Discharge Mode~~	~~Electrodes are only connected to high voltage output after contact is detected~~	~~With no contact: confirm that the voltage across electrodes is low~~ ~~With contact: confirm that indicator LED is on, and that the voltage across electrodes is high~~	~~TO BE TESTED~~	~~Conner Mullen~~
3.2.1.3.	False Positive Rate	FPR of less than 5% to prevent unintended crop damage	Conduct image classification test using a validation set with known crop and weed labels. Track the number of images where crops are incorrectly identified and calculate results	COMPLETED	Will Fenno
3.2.1.4.	False Negative Rate	FNR of less than 5% to prevent missed weeds	Conduct image classification test using a validation set with known crop and weed labels. Track the number of images where weeds are incorrectly identified and calculate results	COMPLETED	Will Fenno
3.2.1.5.	Camera Field of View	System detects objects at a range of 62.2 degrees horizontally and 48.8 degrees vertically	Measure the system's response to objects placed inside and outside the specified field of view	COMPLETED	Will Fenno
3.2.2.1.	Electrode Placement	Arcing does not occur across electrodes	Charge system to maximum voltage, visually confirm that no arc forms	TO BE TESTED	German Students
3.2.2.2.	Mounting	All components are secured properly	Visually inspect all connections to the robot or other platform, then attempt to move mounted components around to test strength of mounts	TO BE TESTED	Full Team
3.2.4.1.	Power Source	12V DC is converted to 5V, capable of 2A	Before powering on: Perform continuity test for all 12V points Power on board with 12V DC source and test voltage at output of power converters	COMPLETED	Conner Mullen
3.2.4.2.	Inputs	All control signals work as expected, as indicated by LEDs and relay clicking	Power system on, set to each combination and confirm that the proper LED indicators are on and listen for relay clicking	COMPLETED	Conner Mullen
3.2.4.3.	Outputs	LEDs all light up under correct circumstances Energy discharges through electrodes	Verify that proper LEDs light up under proper circumstances Voltage at electrodes reaches 80V	COMPLETED	Conner Mullen
3.2.4.4.	Interface Between Processor and Electronics	I2C signal sent from processor is received by MCU, correct output is observed (specific output and input signals will be updated as we finalize designs)	Send I2C commands from processor to microcontrollers, verifying that every necessary function is initiated properly	COMPLETED	Full Team
3.2.5.1.	Temperature (Thermal Resistance)	System functions in complete range of temperatures (10C to 45C)	Low end of temperature range exists outside in Texas, high end will be created with temperature chamber	TO BE TESTED	Full Team
3.2.5.2.	External Contamination	Large particles are kept out of the electronics casing	Bombard empty casing with dirt, grass, and other particles; open casing and visually inspect inside	TO BE TESTED	Full Team
3.2.6.1.	Built-In Test (BIT)	The system will activate a red LED in the case of camera failure during the startup process	Intentionally simulate camera failure via disconnection to verify LED activation response	TO BE TESTED	Will Fenno
3.2.6.2.	Isolation and Recovery	In the case of a BIT fault, the system will be reset and restore normal operations	Conduct a reset test in response to a camera detection failure	TO BE TESTED	Will Fenno
Note	Specific values and signals will be included as we continue to develop and finalize our designs				

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Thank You!