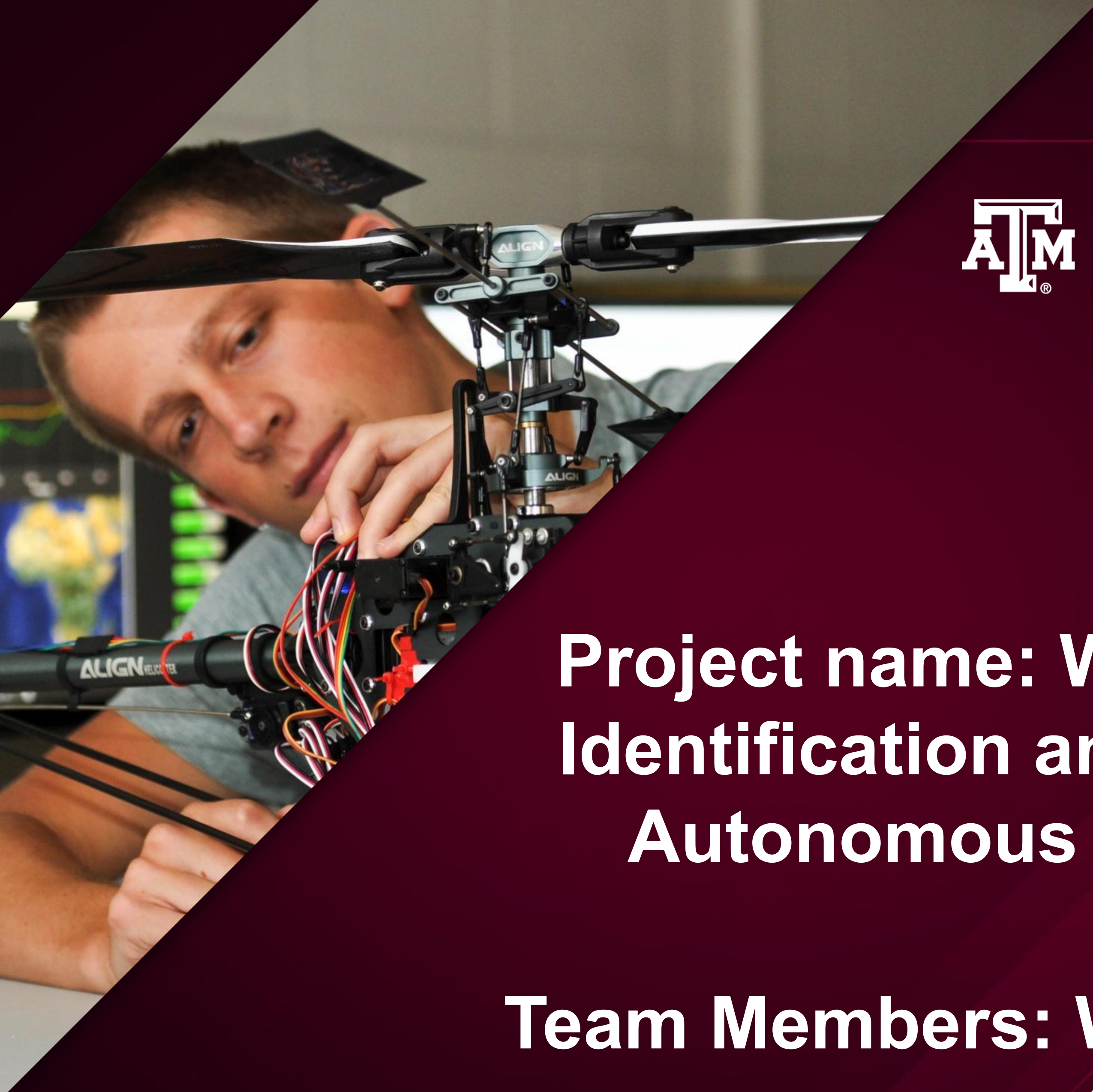

Dwight Look College of
ENGINEERING
TEXAS A&M UNIVERSITY

Project name: WIZARD (Weed Identification and Zapping via Autonomous Robot Device)

Team Members: William Fenno, Conner Mullen

Problem Statement

- Organic farming practices face significant challenges in controlling weeds within crop fields and need an ecological method of eliminating weeds with minimal time investment and labor use.

Solution Proposal

- Develop an autonomous robot system equipped with machine learning camera recognition and a targeted high voltage impulse zapper to effectively identify and eliminate weeds.

thws
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of Applied Sciences
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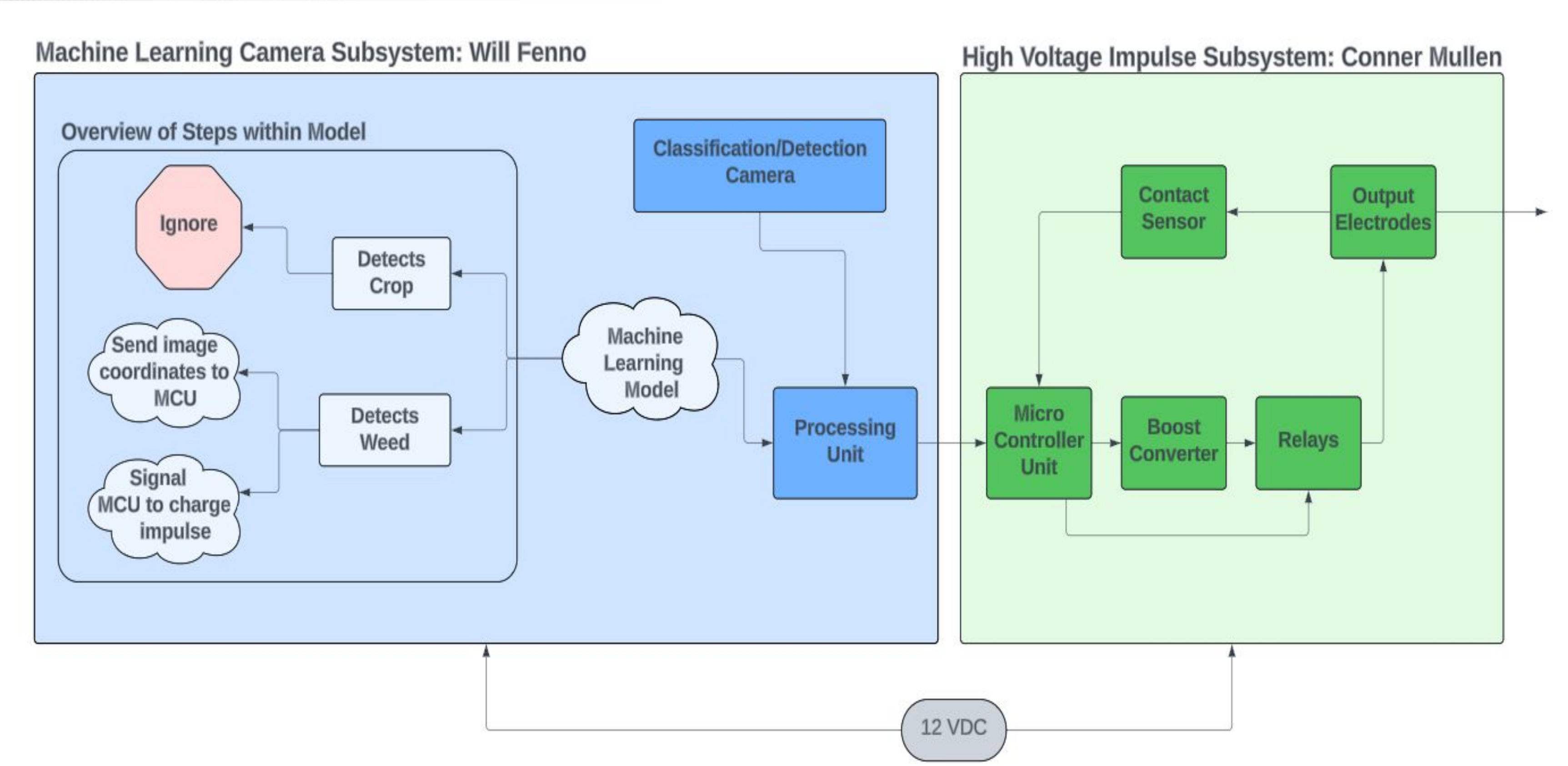
Diagram of Subsystems & Interface



Task Partition

- Will: Develop and train a machine learning model to distinguish between crops and weeds in real time.
- Conner: Create a high voltage impulse that can effectively and safely kill weeds.

Machine Learning Camera Subsystem Progress in Past 1.5 Months

1. Research what species of crops and weeds that our system will use for recognition and classification.

2. Gather data from the internet to create a image dataset of both crops and weeds.

3. Download Miniconda (Jupyterlab) and set up virtual environment.

4. Install and import dependencies (TensorFlow, OpenCV, Albumentations).

5. Label data and create bounding boxes using LabelMe software.

6. Apply data augmentation to expand the size of the dataset.

7. Split the data into Training, Testing, and Validation sets.

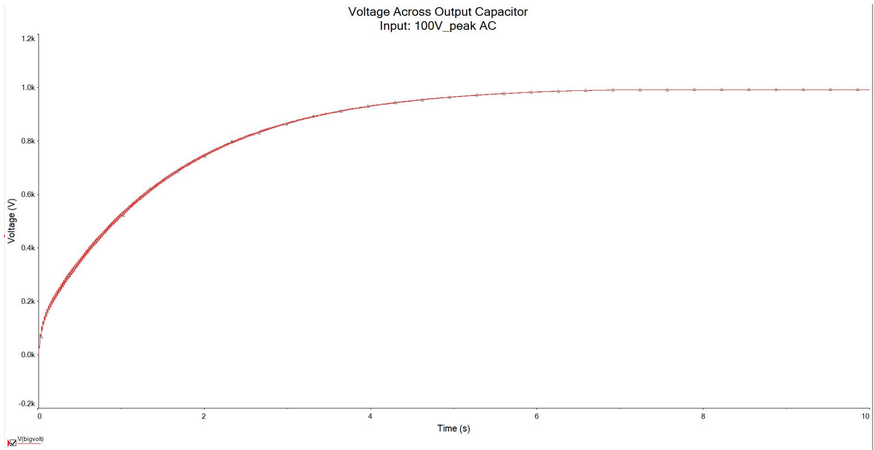
High Voltage Impulse Subsystem Progress in Past 1.5 Months

1. Research viable power sources

2. Research existing electrical weed control technology and previous experiments.

3. Install SPICE and Altium

4. Simulate boost conversion



Execution Plan

WIZARD Project Schedule																
	AUG		SEP				OCT					NOV				DEC
Deliverable/Task	8/20	8/27	9/3	9/10	9/17	9/24	10/1	10/8	10/15	10/22	10/29	11/5	11/12	11/19	11/26	12/3
Project Assigned 08/20																
Meet With Sponsor, German Team																
Preliminary Research																
Assign Subsystems																
Power Conversion Research																
Software Installation & Virtual Environment Setup																
Identify Species of Both Crop and Weed																
Create Image Dataset for Crops / Weeds																
ConOps First Draft, Send to Sponsor																
ConOps Revisions																
ConOps Report Due 09/15																
High Voltage Schematics and Simulations																
Label Images and Clean Data																
Set Milestones for Rest of Semester																
FSR, ICD, Validation Plan First Draft, Send to Sponsor																
FSR, ICD, Validation Plan Revision																
Midterm Presentation 09/23																
FSR, ICD, Milestones, Validation Plan Due 09/26																
High Voltage Component Research and Selection																
Build Object Detection Model																
High Votlage PCB Design																
Train & Test Model																
Status Update Presentation 10/14																
High Voltage PCB Layout Review																
Order Parts and PCB																
PCB Assembly and Smoke Test																
PCB Validation																
Work on Improving Accuracy of Model																
Final Report First Draft, Send to Sponsor																
Final Presentation 11/11																
Final Demo Due 11/26																
Final Report Revisions																
Final Report Due 12/05																

Annotations

- Not Started
- In Progress
- Completed
- Behind Schedule

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	UNTESTED	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	UNTESTED	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	UNTESTED	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 weedes are incorrectly identified and calculate results	UNTESTED	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	UNTESTED	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	UNTESTED	Conner Mullen
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	UNTESTED	Full Team
3.2.4.1.	Power Source	12V DC is converted to correct voltages for all components	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	UNTESTED	Conner Mullen
3.2.4.2.	Inputs	All buttons/switches work as expected, as indicated by LEDs	Power system on, set to each combination and confirm that the proper LED indicators are on, and test for necessary continuities	UNTESTED	Conner Mullen
3.2.4.3.	Outputs	LEDs all light up as expected Energy discharges through electrodes (Germany)	Verify that proper LEDs light up under proper circumstances Charged capacitor is discharged following contact with target plant	UNTESTED	Conner Mullen
3.2.4.4.	Interface Between Processor and Electronics	I2C signal sent from processor is received and properly interpreted by microcontrollers	Send I2C commands from processor to microcontrollers, verifying that every necessary function is initiated properly	UNTESTED	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	UNTESTED	Full Team
3.2.5.2.	External Contamination	Casing keeps contaminants off of electronics when exposed to large amounts of dirt	Bombard empty casing with dirt, grass, and other particles; open casing and visually inspect inside	UNTESTED	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	UNTESTED	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	UNTESTED	Will Fenno