FPL Image Recognition for Pad Mounted Equipment

VDR4
Team 304

The Team

Kent Logue
Mechanical Design Engineer

Jordan Wilkerson
Mechatronic Design Engineer

Sam Hammermaster
Software Integration Engineer

Erin Murphy
Project Manager

Gage Irwin
Computer Vision Engineer

FPL

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Previous Work

Problem

Presenter: Erin Murphy

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Objective

- Design a method for identifying pad-mounted transformers that have detected a faulty current using computer vision.
- Hardware and software solution

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Targets

Beacon (hardware)

Quick Installation

No Interference

Weather Resistant

Integrated with FCI

Inexpensive

Computer vision (software)

Video & Images

50 ft Detections

Varying Visibility/ Obstacles

80% Accuracy

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Solution - Hardware

- Beacon that moves up and down to indicate fault
  - LED as a backup when fault occurs
- Firmly attached to the top of transformer and tamper proof design
- Minimal power usage
- Other options
  - Lever on side, thermal strip, radio signal

	Final Rating
1	0.2467
2	0.1017
5	**0.4127**
6	0.0949

Mount an external LED on the top of a stainless steel lever attached using rivets and powered by the transformer and infrared video input with YOLOv5 algorithm

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Solution - Software

- Image recognition model that can identify transformer, beacon, and state of beacon
- Model runs on drone footage from FPL Air

YOLO

Current Work

Current Work - Summary

- Designed a 3D model for printing
- Created a mock transformer for testing
- Developing of senior design website
- Tested drone camera capabilities
- Built a system for creating synthetic data

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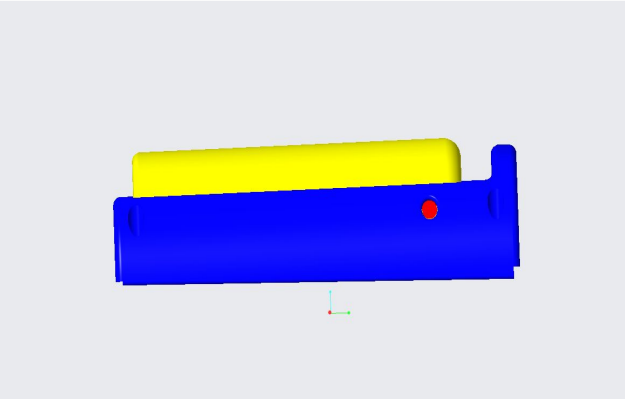
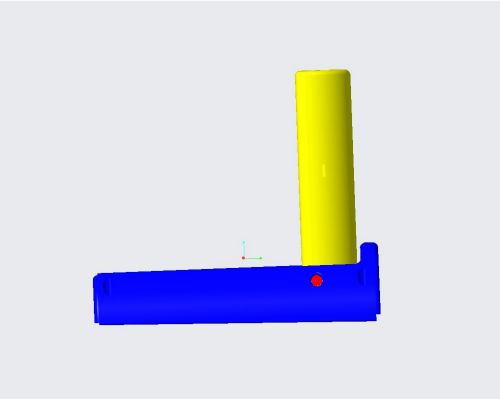
3D Model



Device in its standard state



Device after it has received fault signal

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3D Print

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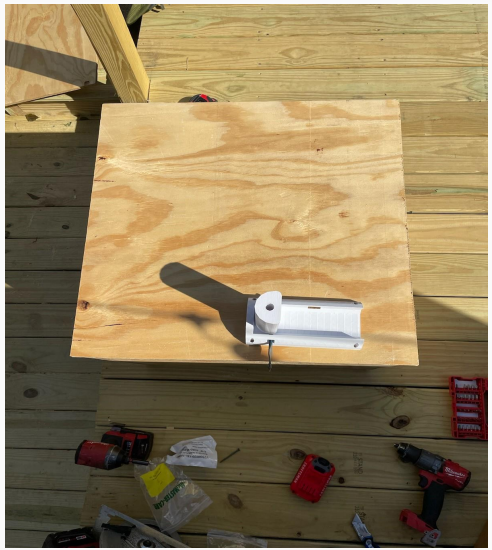
Mock Transformer



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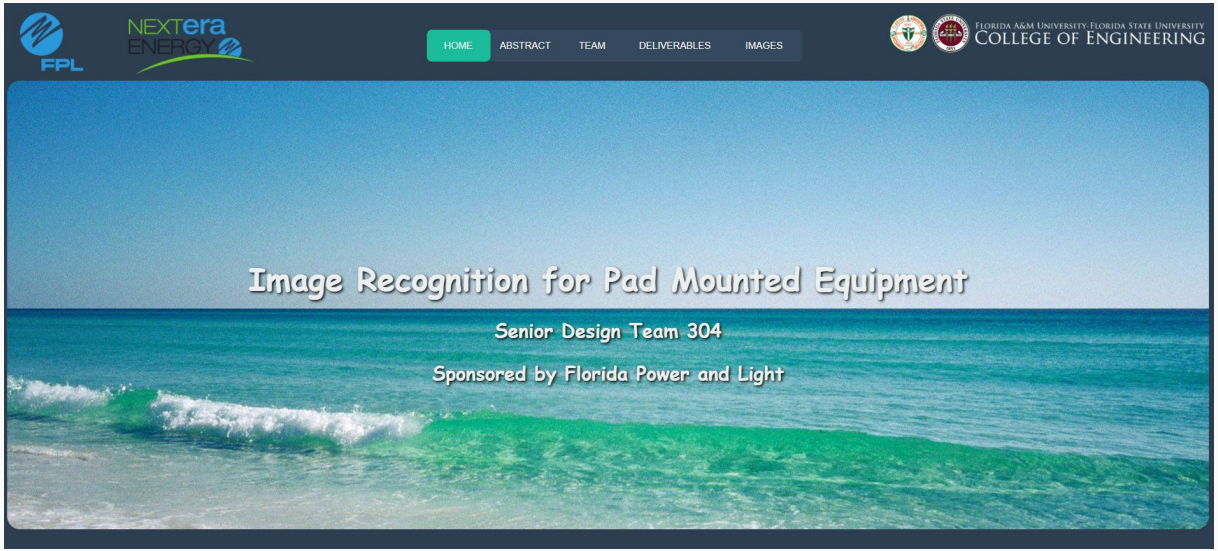
Website

- All CSS/HTML
- Built from scratch
- Nav menu goes to Home, Abstract, Team, Deliverables



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Drone Testing and Use Case

- FPL Donated Drone
- Parrot Anafi Thermal
- Drone Licensing and Registration
- Future use for image collection
  - 4k and thermal imaging

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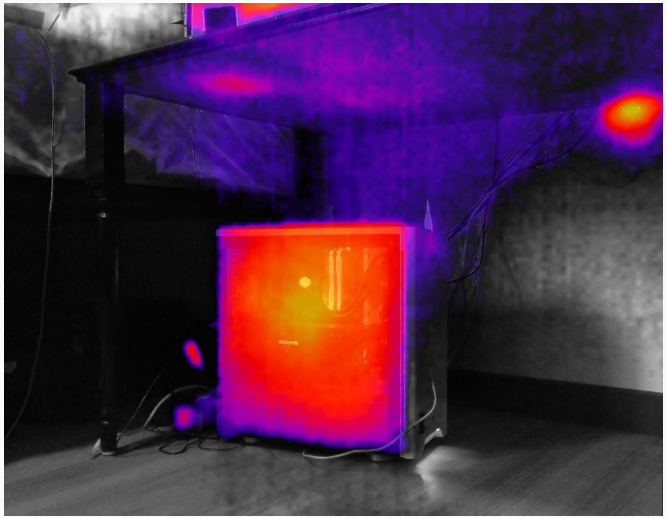
Drone Pictures

- No flights, but we can still use the camera
- Thermal temperature adjustment
  - Adjust pictures to see certain temperatures
- Pictures or video
- Thermal or regular



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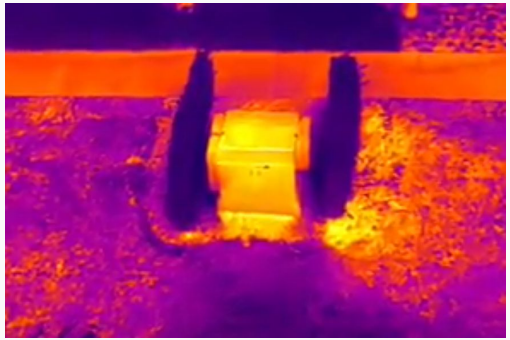
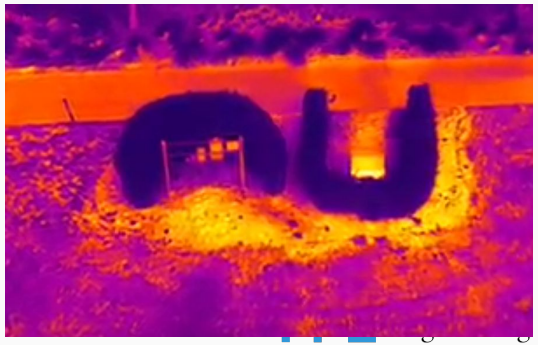
FPL Supplemental Images and Footage





Real and Synthetic Data

- Real:
  - Accurate to real life
  - Very inefficient to gather
  - Labeling done manually
  - Changes require gathering all new data
  - Limited to publicly accessible transformers
- Synthetic:
  - Similar to real life
  - Very efficient to create
  - Labeling done automatically
  - Changes require slightly modifying a script
  - More varied environments

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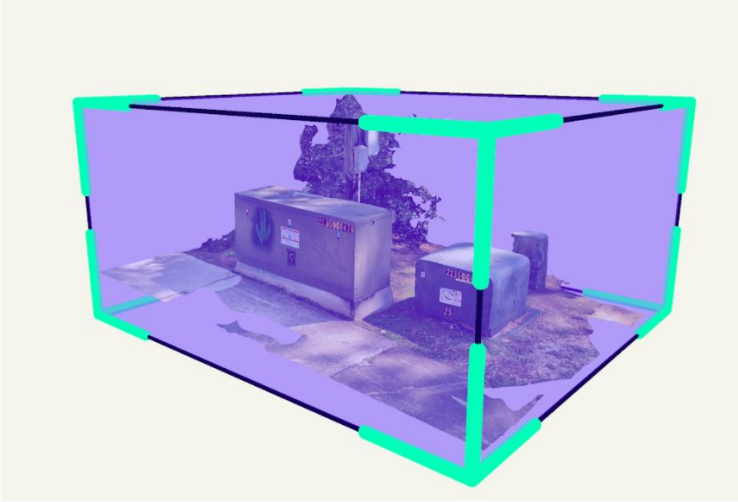
Scan Transformers Using LIDAR

- Find publicly accessible FPL transformers
- Scan using Polycam app and LIDAR Scanner
- Clean 3D model for exporting
- Export 3D model for use in blender



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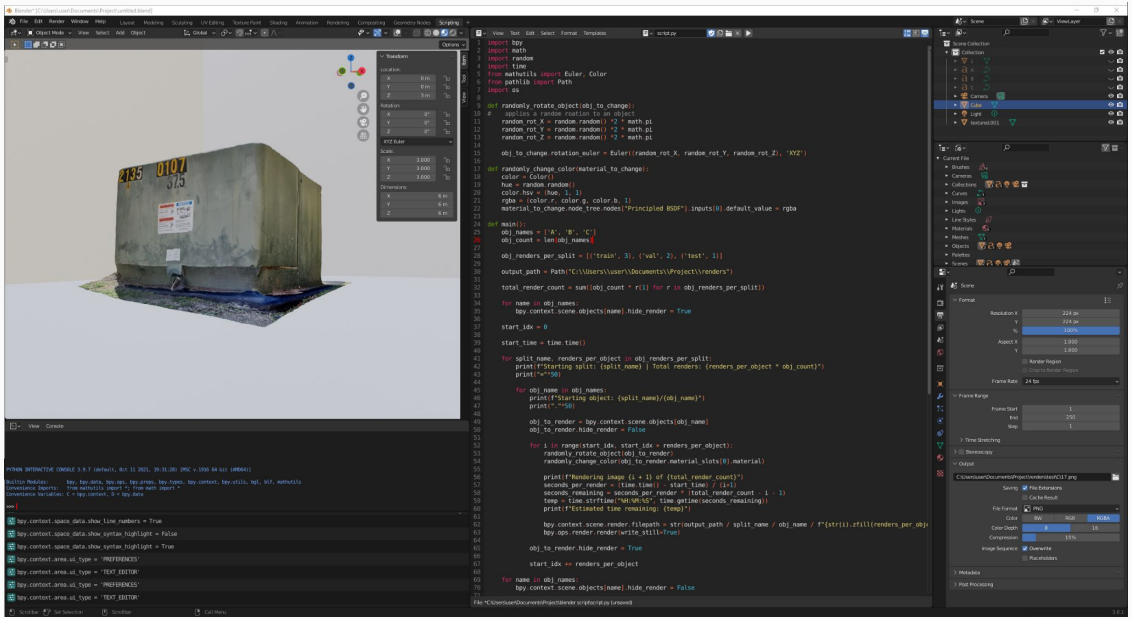
Blender and Python

- What is Blender?
  - Blender is a free and open-source 3D rendering program.
- Python in Blender
  - Blender allows custom scripting using python and the blender api.



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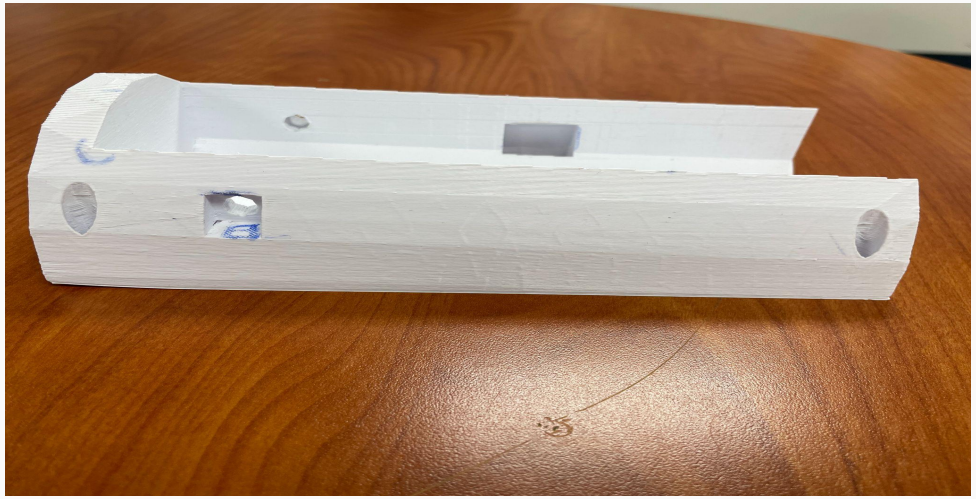
Future Work

Beacon Modifications

- Rivet holes
- Wire holes
- Servo housing
- LED housing
- Bolt Holes



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Beacon Modifications cont.

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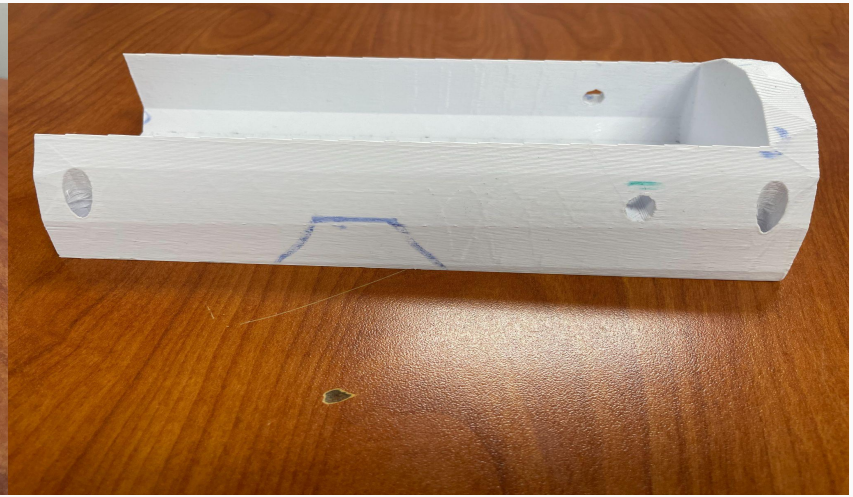
Beacon Modifications cont.



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Order/Incoming Parts

- Wiring
- Low profile break-through multi-cord grip
- 10mm RGB LED
- 10mm plastic bevel LED holder
- Tapered proof screws
- Springs
- Bolts

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Beacon Testing and Integration

- Merge incoming parts
- Verify lever rotation and LED lights
- Attach beacon to transformer

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Synthetic Data - Improvements

- Gather more assets and 3D scans to make the data set more diverse.
- Look into creating synthetic thermal images for training.
- Implement more variability in rendered environments.
- Test synthetic data to make sure accuracy is improving.

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YOLO Training and Testing

- Real image collection
- 200 Real Images/Video from FPL for testing
- Vary training dataset size
- Combinations of synthetic to real data:
  - Ex. all real, all synthetic
  - Ex. 10:1, 100:1, 1000:1 of synthetic:real
- Further optimization until 80% accuracy is reached

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Future Work - Summary

- Beacon modifications
- Data creation & collection
- Train & optimize YOLO model
- Finalize website
- Final demonstration & engineering day

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End

Any Questions?