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Inspect Power Lines with UAV

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Objectives

- Develop, improve, and or explore transmission and substation maintenance and operations by developing or improving one or more areas of interest with an using Unmanned Aerial Vehicle (UAV) Drone:

- Investigate the use of UAVs (Drones) for Transmission Line Inspection & Maintenance
- Improve repair times / eliminate the need for helicopter survey
- Improve Power Outage restoration times, find broken components quickly with better success
- Equip drones with HD Camera, IR Camera, Corona Camera, RFI Antenna to perform diagnostic survey of High Voltage Transmission Lines. Perform autonomous flight using maps of the system.

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Research Areas

- Protection of UAV operating near high electric fields
- Protection of T&D facilities from possible damages from UAV crashing into infrastructure
- Improve image capture capability
- Develop or improve tooling for capturing RF, IR, and / or Corona
- Develop and improve Robust & Secure flight communications
- Perform autonomous flight using maps of the system.
- Improve power supply for longer run times
- Explore if automated computer aided damage recognition is feasible and of value or not
- Explore which maintenance activities are best suited for UAV use.
- Prevent Drone attack at Electric utility Substation

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Current Solution

- Electric Utility Companies use HD, Thermal, and Corona cameras mounted to helicopters to inspect and capture images of fault power lines.

The main Disadvantage with these methods are:

- Requires a pilot and experienced engineer to operate the camera and identify damaged equipment
- The cost of renting a helicopter is from $2000-$4000 per hour
- Power lines in remote areas cannot be tested easily or quickly
- Safety concerns keep workers away from the high voltage power lines which need inspection

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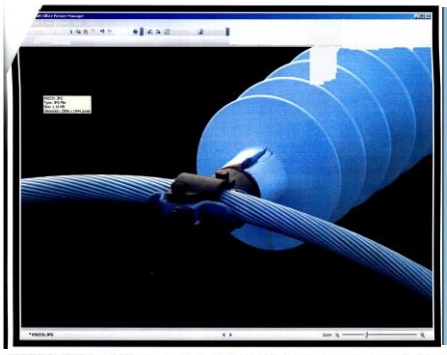
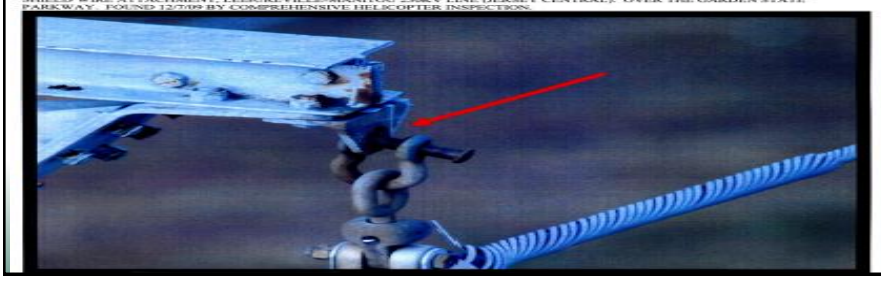


SHIELD WIRE ATTACHMENT, LEISUREVILLE-MANITOU 230KV LINE (JERSEY CENTRAL). OVER THE GARDEN STATE PARKWAY. FOUND 12/7/09 BY COMPREHENSIVE HELICOPTER INSPECTION.



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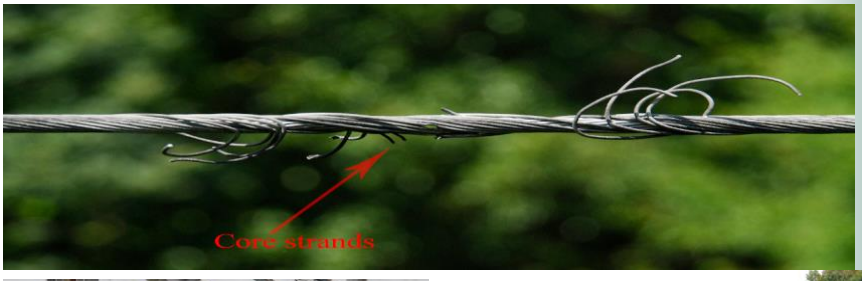

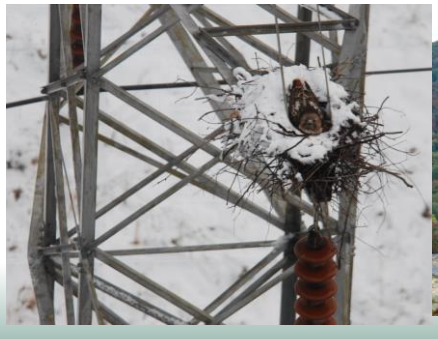

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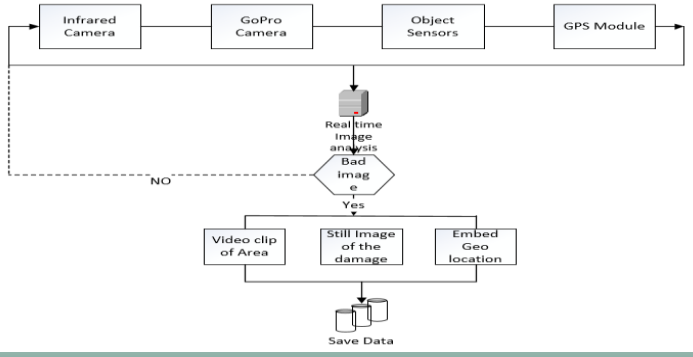
Proposed Solutions

- Design , build, and test an autonomous UAV that is capable of recording and capturing images and sends processed images back to a station with geographic data. Utilizing GPS module, a GoPro camera, object sensors and a thermal camera



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Proposed Solutions

- The LiPro battery on the drone has a limitation of only 15 minute flight time . We are going to focus on developing
  - Quick Recharging off of the Power Line
  - Develop an on-board Power Converter
  - Develop a quick charge Battery – possibly using Ultra-Capacitors
- The following slide shows high level demonstration of what we intend to do

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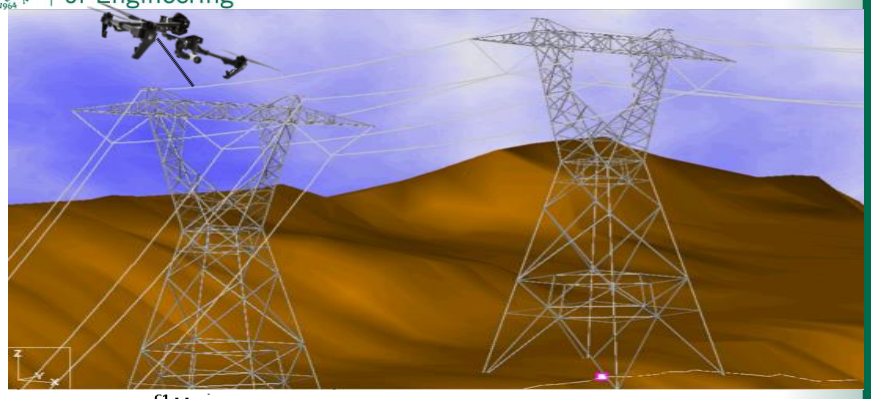

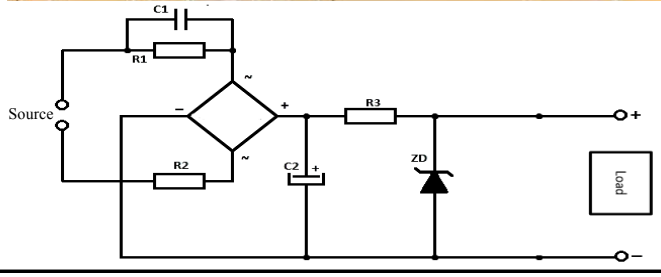

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Challenges

- Security
- Flight duration (short battery life)
- Durability (Most drones have a life time of 10000 flight)
- FAA Regulation (although there are exceptions for utilities)
- Collision
- Drone is extremely complex
- GPS Autopilot Software is extremely complex
- Instrumentation is very expensive
- Transmission Lines are long, 10 – 100 miles in length
- Budget $3000

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Market Potential

Huge market potential:

3079 Electric Utility Companies in the US.

452,699 circuit-miles of transmission in North America in 2009 (per NERC –US, Canada, Mexico, 2010)

FirstEnergy companies own approximately 12,100 miles of high-voltage transmission lines (69 kV and above),

Other markets:

Real Estate

Farming

Search & Rescue

Autonomous Mapping

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Possible Partners

- Dronewerx Company – at Lorain County Regional Airport
- NOUASA – Northern Ohio Unmanned Aerial Systems Association at Ohio Aerospace Institute
- ERPI – Electric Power Research Institute
- Transmission and Distribution World Magazine
- FLIR and DayCor camera companies

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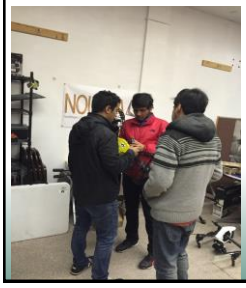
Dronewerx Company

- We visited drone works to explore the different technologies they have. We liked Their DJI drone that they sell. The drone come with a software page that enables you to different like setting the drone by itself. We can also specify the area that drone needs to fly on by just specifying the perimeter.
- The following are images we took at our visit.



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Dronewerx Company Visit

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Time Line