

FPL Robotic Pole Inspection Collar

Team 505

“Team Southern Pine”

ME Team Introductions



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EE Team Introductions



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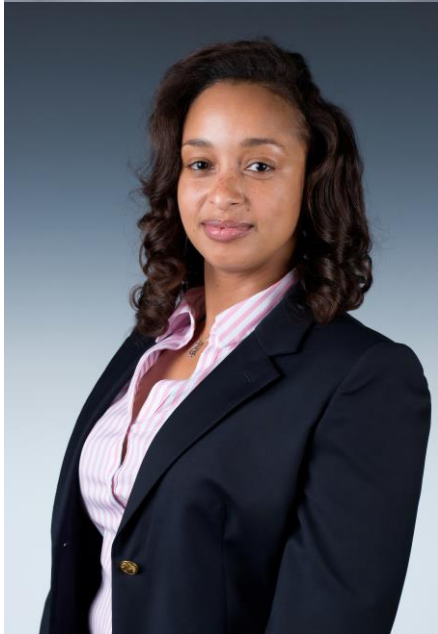


Leonardo Vazquez
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Sponsor's and Advisor's



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Objective

The objective is to design a mechanism that can climb a wooden utility pole and check its structural integrity

Project Background

- Florida Power and Light (FPL) is a power utility company serving 5 million customer accounts
- FPL's linemen work on power poles, some of which cannot be reached by bucket truck
- Pole safety inspection is a subjective process that is prone to error
- FPL works continuously to ensure safety of its workers and consistently develops new safety procedures

Motivation

In summer 2020, a lineman for FPL was climbing a pole in a resident's backyard

The pole suffered from rot at the base and cracked with the lineman at the top of the pole

The lineman came crashing down on top of a glass table



Sourced from

<https://www.seattletimes.com/seattle-news/new-video-shows-tukwila-power-poles-snapping-like-matchsticks/>

Key Goals

- Design a lightweight robot that can be easy to mount on a wooden pole
- Design a reliable robotic testing sensor
- Design a robotic system that can be modular
- Design an interface that will display the status of the pole's health

FPL Test Standards

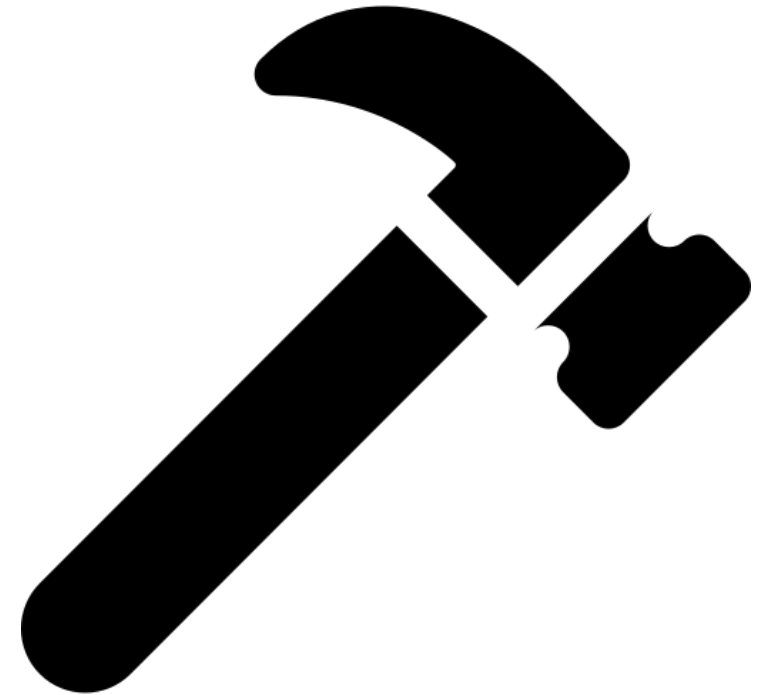
Step	Action
1	Determine ownership, height, class, and year of pole. Information can be found on the brand/birthmark information that is on the pole. In addition, Bell South poles have the metal strip on it.
2	Conduct visual inspection of pole. Identify cracks Identify woodpecker holes Identify deterioration
	Test for quality of wood. Hit pole with a hammer at several locations As high as you can reach comfortably Waist high Near ground Determine state of wood through sound made when hit (crisp sound for new wood & hollow sound for rotten wood)



4	Test for deterioration at the ground. Excavate six inches around pole. Penetrate pole with a screwdriver Determine if pole is rotten at ground
5	Repeat steps 1-4 for two adjacent poles.
6	Identify underground risers Type (primary, secondary, telephone, CATV, Streetlight, traffic signal) Number and size of riser shield or conduit on pole. Physical location (Quadrant)
7	Write recommendations as to the installation or removal of pole. Evaluate outer state of pole Evaluate inner state of pole Recognize foreign utilities attached to pole Record relevant information on field notes.

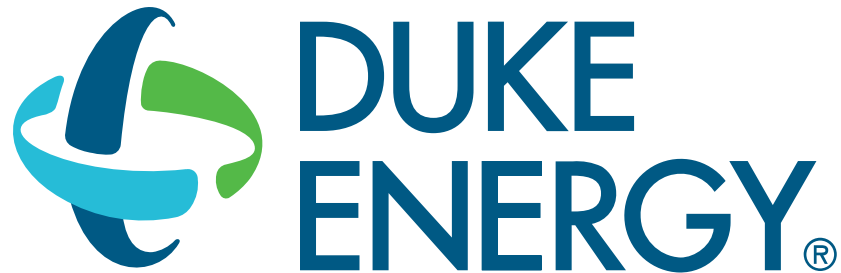
OSHA Test Standards

Hammer test: Rap the pole sharply with a hammer weighing about 1.4 kg (3 pounds), starting near the ground line and continuing upwards circumferentially around the pole to a height of approximately 1.8 meters (6 feet). The hammer will produce a clear sound and rebound sharply when striking sound wood. Decay pockets will be indicated by a dull sound or a less pronounced hammer rebound.



Markets

Primary Markets:



Secondary Market:



Customer Needs



The customer needs were established by asking questions to people of interest to gather information



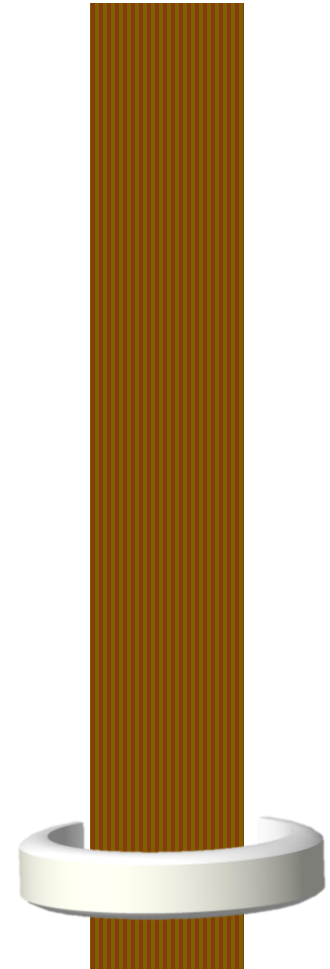
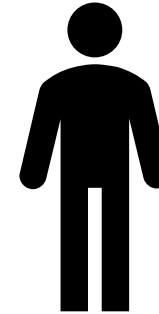
There were interviews with

Our FPL sponsors

An International Brotherhood of
Electrical Workers Representative

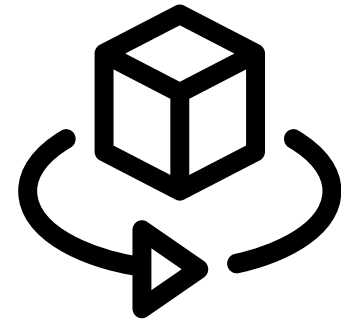
Customer Needs

- Robot needs to climb the pole
- Replace and standardize the hammer test with sensor or mechanism while meeting OSHA standards of inspection
- The sensors can determine the integrity of the wood
- The data needs to be interfaced to the linemen
- Be of convenient size and weight for carrying



Functional Decomposition

Climbing



Rotate



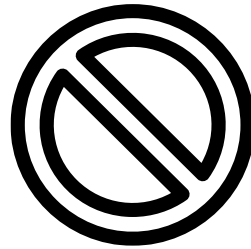
Traverse vertically



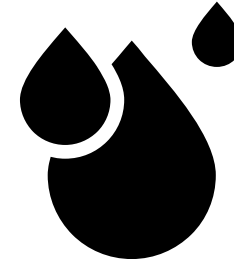
Stability

Functional Decomposition

Detection



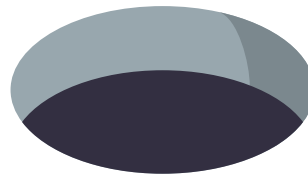
Voids



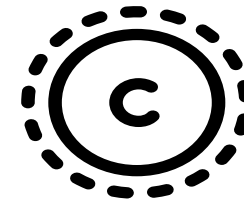
Water



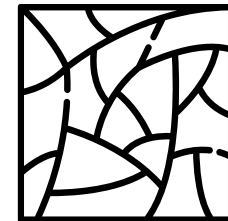
Rot



Analyze Holes

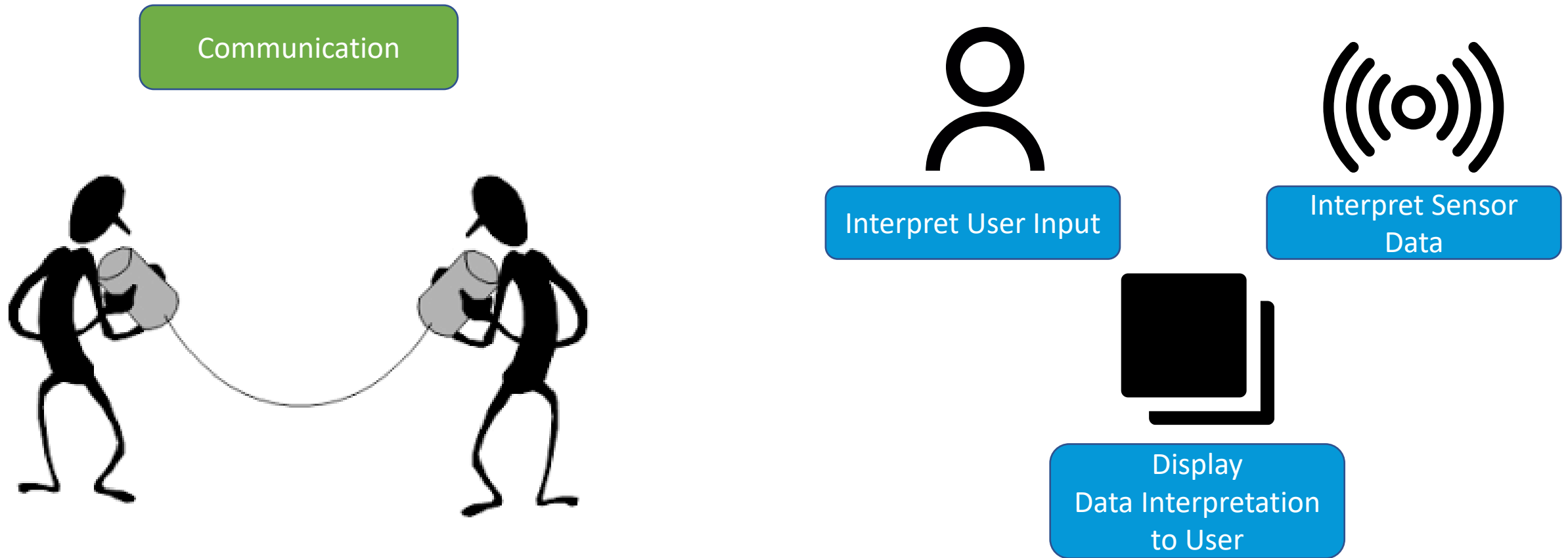


Determine
Circumference



Analyze Cracks

Functional Decomposition



Rapid Prototyping

- To develop our climbing mechanism we are preparing a prototype out of cardboard
- This prototype will be used to identify possible problems early on
- Constructing an early prototype will provide key insights to the dynamics of climbing on a wooden pole

Future Work



Assemble
prototype 1 and
check
functionality



Improve climbing



Develop new
concepts



Select concept



Develop
prototype 2 and
check
functionality

Questions



Sources

- <https://www.slunglow.org/event/new-show-cap-pie/>
- https://journalnow.com/archive/so-metal-the-world-of-metal-detecting-is-changing-and-north-carolina-is-home-to/article_7bb241c8-ecac-11e6-a1f4-7f1a74729de1.html
- <https://www.onlinewebfonts.com/icon/546768>
- <https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.269AppD>
- <https://www.seattletimes.com/seattle-news/new-video-shows-tukwila-power-poles-snapping-like-matchsticks/>
- <https://www.flaticon.com>

Appendix

- The following slides have supporting information



Customer Needs

Question	Statement	Interpreted Need
“What does the device have to incorporate in its test of the wood?”	“The device needs to incorporate a few steps of the OSHA wooden pole test, especially the hammer test. This would allow for less injury and more assessment of the utility asset.”	The device adheres to OSHA standards of inspection.
“What should the device do with its findings?”	“The linemen should be able to control the robot with its test or have it report back the findings of the pole's condition.”	The device can interface with the linemen and deliver data directly to them.
“At which height is the pole generally rotten?”	“The rot is usually found at ground level.”	The device can operate on the lower portion of the pole.

Customer Needs

Question	Statement	Interpreted Need
“What is the intended mobility of the device?”	“The device needs to be able to ascend and descend the pole to perform its examination and test.”	The device can climb a wooden utility pole.
“What does the device need to test for?”	“It needs to test for rotten wood or voids in the wooden pole. This can seriously affect the structural integrity of the pole and is a huge safety issue.”	The sensors can determine the integrity of the wood.
“At what height or location is the pole bored?”	“Anywhere suspicious including above reach Height.”	The device can examine the pole at various heights beyond operator reach.

Customer Needs

Question	Statement	Interpreted Need
“What is optimal for size and weight?”	“It can fit on the back of the utility truck and weighs under 30 lbs.”	The device is convenient to transport.
“What is the most common class of pole encountered?”	“The most common are class II and class III poles.”	The device works on poles of class II and III.
“What is the most common height of poles?”	“I would say 30’, 35’, and 40’. That should cover a good range of installs for this initial project while also focusing more on the types of poles that are usually encountered in the “rear of” and inaccessible locations where the crew will be required to physically climb instead of being able to use a bucket truck.”	The device works with a set range of diameters (Derived from height to diameter relations)

Customer needs

Question	Statement	Interpreted Need
“What would make the mechanism most effective in the field?”	“If the device tests with OSHA regulation or incorporates that into the design. This allows easy adoption and incorporation into a utility workers toolset.”	The device adheres to OSHA standards of inspection.
“What would you say would make the robot more appealing to use to you personally?”	“It would be helpful if it could determine its life if it is OSHA regulated, hip worn tool that is similar to a hammer, rechargeable. It would be best if it was user friendly.”	The device is convenient to use and portable.

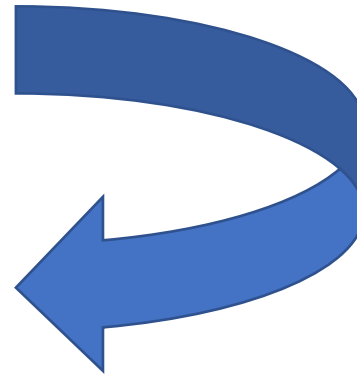
Project Management



Most Important Points

1. The quick brown fox jumps over the lazy dog.
2. The quick brown fox jumps over the lazy dog.
3. The quick brown fox jumps over the lazy dog.
4. The quick brown fox jumps over the lazy dog.
5. The quick brown fox jumps over the lazy dog.
6. The quick brown fox jumps over the lazy dog.

Lessons Learned



Reference

Questions (be sure to design your own)



Backup Slides

