FAMU-FSU College of Engineering

Pole Health Detection Sensor

Florida Power and Light

Team 301

Overview

- Project Scope
- Design Requirements
- Concept Generation
- Concept Selection
- Selected Design
- Next Steps
- Summary

Project Scope

- Motivation:
  - Improve safety and reliability
  - Reduce resources needed to inspect poles
  - Increase inspection efficiency
- Goal:
  - Automate and simplify pole health inspection process

Design Requirements

1.1 - Detect voids in southern pine wood utility pole

2.1 - Climb to the entire length of pole

2.2 - Keep tension while climbing

3.1 - Weigh less than 50 pounds

3.2 - Operated by a single person

4.1 - Rechargeable battery

4.2 - Display important information to user

4.3 - Kill button

Concept Generation

- Tools:
  - Morphological Chart
  - Biomimicry
- Goals:
  - Produce 100 concepts
  - 5 medium fidelity concepts
  - 3 high fidelity concepts

Medium Fidelity Concepts

	Concept 1	***Concept 2***	***Concept 3***	***Concept 4***	***Concept 5***
Sensor	Audio	Ground Penetrating Radar (GPR)	Sonar Tomography	Ultrasound	Electrical Resistance Tomography
Controller	Button Controller	IOS App	IOS App	Laptop Computer	Gaming Controller
Power	Li-ion Battery	Li-ion Battery	Li-ion Battery	Ni-Cd Battery	Ni-Cd Battery

High Fidelity Concepts

	Concept 1	***Concept 2***	***Concept 3***
Sensor	GPR	Electrical Resistance Tomography	Sonar Tomography
Controller	IOS App	Button Controller	IOS App
Power	Li-ion Battery	Ni-Cd Battery	Li-ion Battery

Concept Selection

- Tools:
  - Pugh Chart
  - Analytical Hierarchy Process
- Goal
  - Determine final design from high fidelity concepts

Pugh Charts

Sensor:

Criteria	Weight	***GPR (Reference)***	***Electrical Resistance Tomography***	***Sonar Tomography***
Cost	2	-	+1	-1
Size & Weight	2	-	0	0
Invasiveness	4	-	-1	-1
Power Consumption	4	-	-1	+1
Adaptability	3	-	-1	-1
Score		-	-9	-5
Continue?		Yes	Combine?	Combine?

Pugh Charts

Controller:

Criteria	Weight	*IOS App (Reference)*	*Button Controller*
Cost	2	-	-1
Size & Weight	2	-	-1
Power Consumption	3	-	-1
Operation Distance	4	-	0
Ease of Use	4	-	0
Score		-	-7
Continue?		Yes	No

Pugh Charts

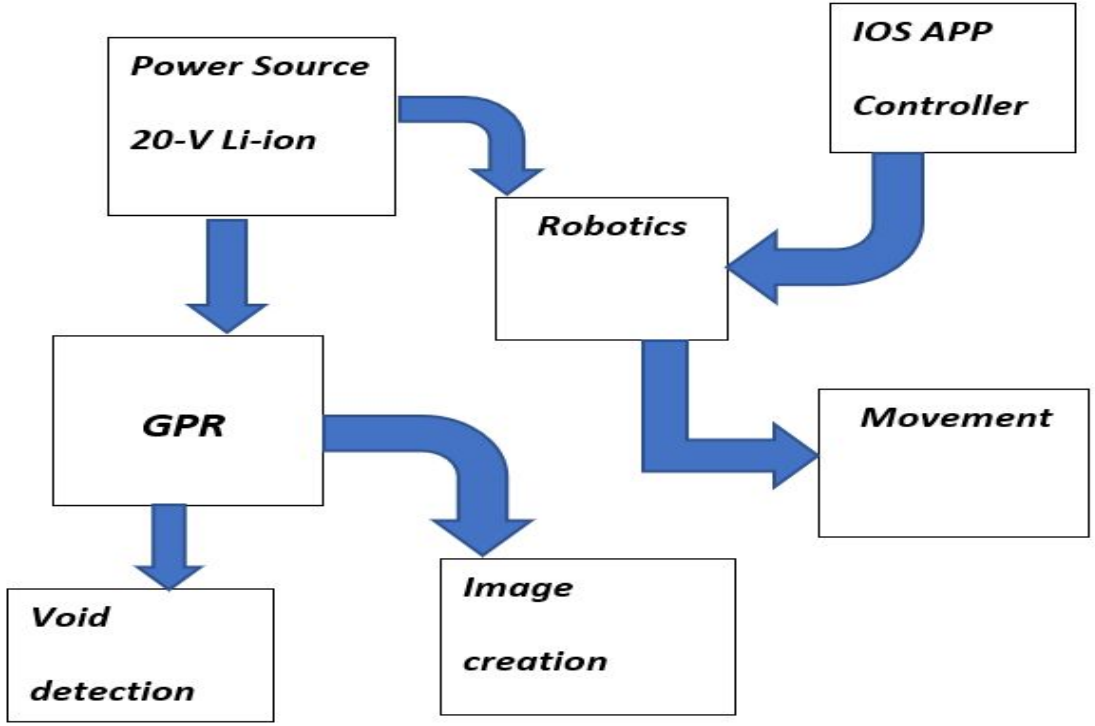
Power:

Criteria	Weight	*Li-ion (Reference)*	*Ni-Cd*
Cost	1	-	+1
Charge Duration	4	-	-1
Power Density (Wh/liter)	4	-	-1
Size/Weight	3	-	-1
Time to full charge	3	-	-1
Score		-	-13
Continue?		Yes	No

Analytical Hierarchy Process

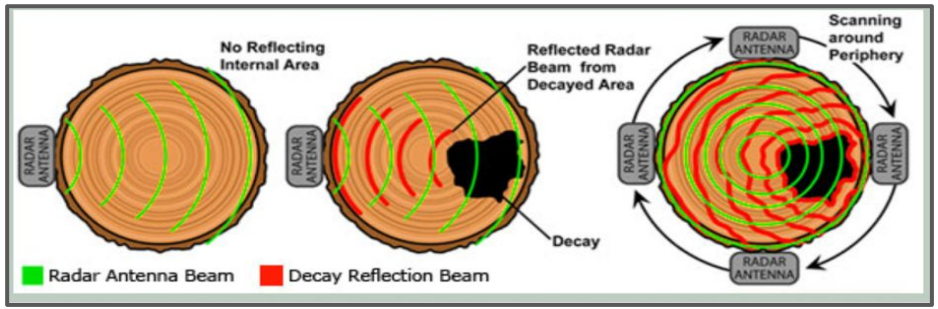
Criteria	Weight	*GPR, IOS App, Li-ion Battery*	*ER Tomography, Button Controller, Ni-Cd Battery*	*Sonar Tomography, IOS App, Li-ion Battery*
Cost	2	3	4	2
Size & Weight	1	3	2	2
Invasiveness	4	5	2	2
Power Consumption	4	3	2	4
Ease of Use	3	5	3	3
Effectiveness	3	4	2	2
Score		68	41	45

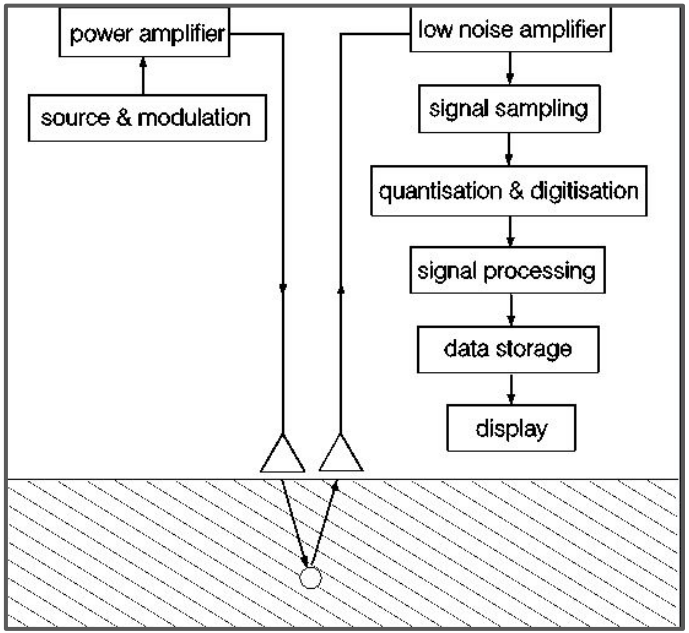
Selected Design



Ground Penetrating Radar

- Used detect underground utilities
- Relies on high frequency radio waves
- Different items have different permittivities





IOS App

- Available on iPhone/iPad
- Connect via Bluetooth
- Control robot movement and sensing abilities
- Display important information

Li-ion Battery

- Battery used for cordless power tools
- Easy to remove and charge
- Already used in the field

Next Steps

1. Order Parts
2. Begin Building Prototype
3. Test and Revise Prototype

Summary

- Automating and simplifying the pole inspection process
- Working with ME Team to build pole climbing robot with health sensing capabilities
- Selected Design: GPR, IOS app, Li-ion battery

Questions?