FAMU/FSU College of Engineering

Department of Electrical and Computer Engineering

Preliminary Detailed Design

Team 301 – FPL Pole Health Detection

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Introduction

The purpose of this project is to automate and simplify the utility pole inspection process of Florida Power and Light (FPL). Through this project, the team intends to improve safety and reliability, reduce the amount of resources needed to perform a pole inspection, and increase overall inspection efficiency. The team will be working with mechanical engineers to produce a pole climbing robot with health sensing capabilities. The robot will be able to climb the entire length of the utility pole and non-invasively test the internal structural integrity of the pole. Additionally, the robot will be wirelessly powered and have the ability operated by a single person. The control system for the robot will have a method to display important information to the user and the complete system will weigh less than 50 pounds.

Selected Concept

The selected concept features a triangular shaped robot, a ground penetrating radar (GPR) sensor system, a lithium-ion power source, and an IOS app controller. The ME team will be primarily focusing on the design and construction of the robot while the ECE team will be primarily focusing on the design of the sensor, controller, and power system. The GPR system allows for a non-invasive testing of internal voids or weak spots in the utility pole. This sensor will produce a waveform image that can be used to detect these weaknesses in a pole. The IOS app provides a simple way for the user to control the robot and have access to any important information concerning the robot or utility pole. It can be downloaded on any IOS device and will connect to the robot via Bluetooth. A lithium-ion battery will be used to power both the robot and the sensor. We plan to use a wireless power tool battery in this design because of this battery's ability to be replaced and the linemen's use of this type of battery already.

Preliminary Design

Complete Design:

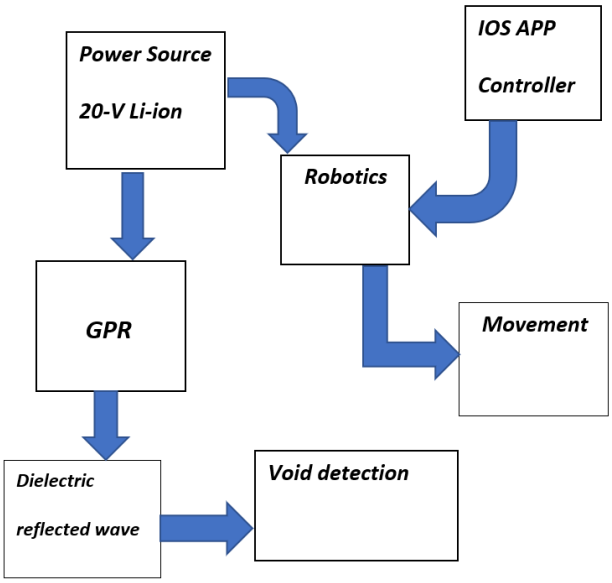

Figure 1: Block diagram of entire system

Sensor:

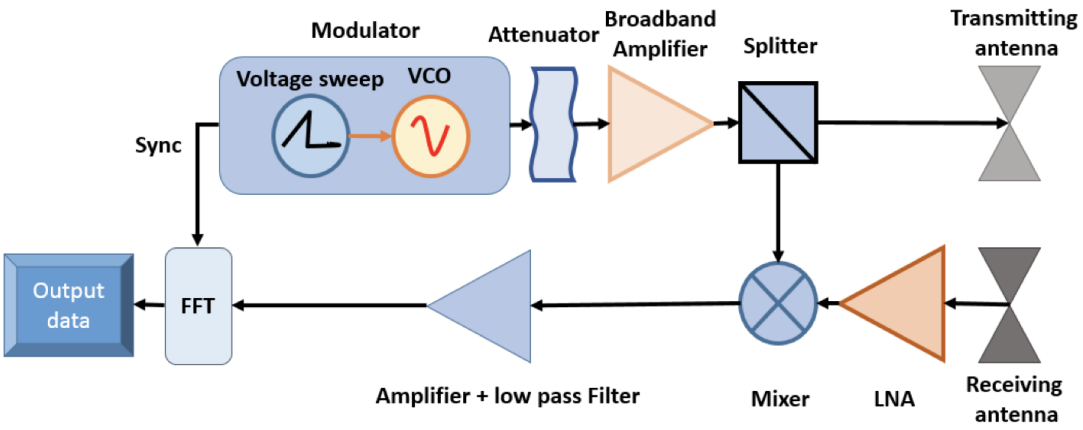

Figure 2: Basic block diagram of sensor

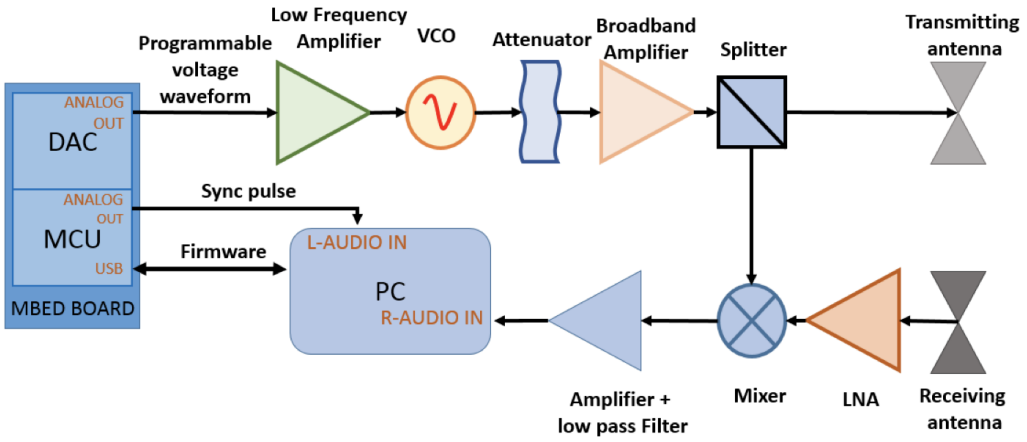

Figure 3: Sensor block diagram with controller connections

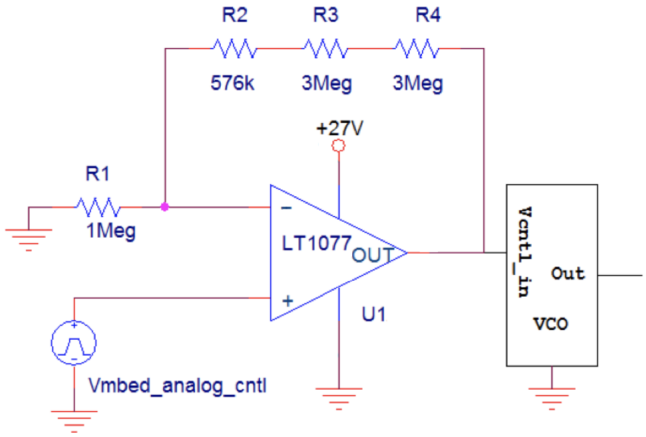

Figure 4: Low frequency amplifier

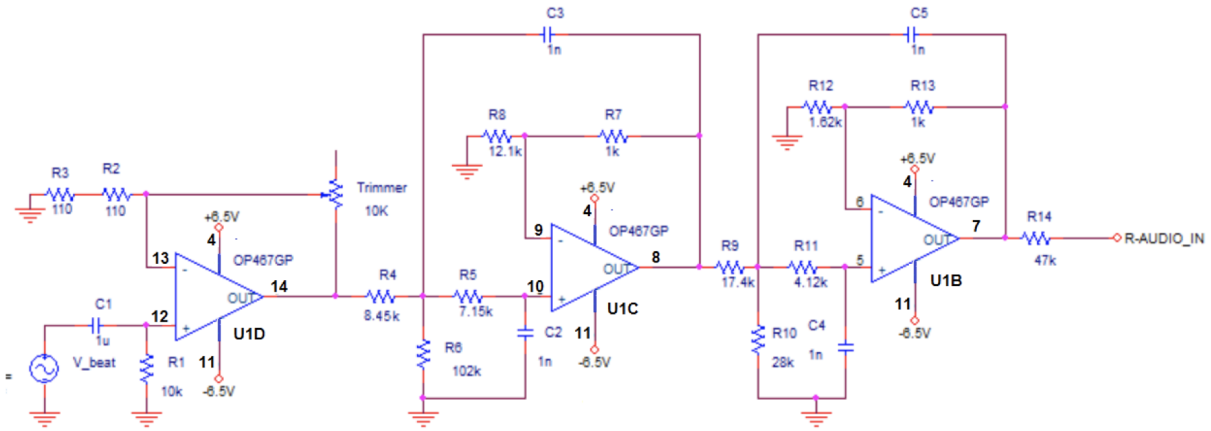

Figure 5: Low pass filter and amplifier subsystem

Data Processing Pseudocode:

Input GPR data
Dechirp
Find beat frequency
Estimate range of beat frequency
Calculate range of offset due to range-Doppler coupling

Controller:

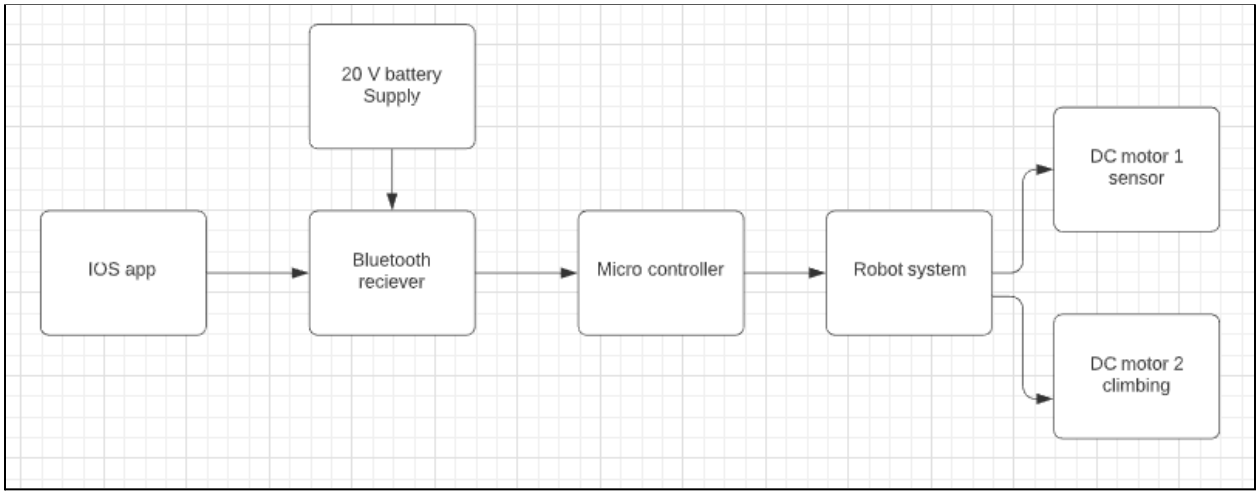

Figure 6: Controller system

Table 1: IOS app functions

Displayed Information	Controls
• GPR output data • Battery life • Connection status	• Robot movement • Sensor functionality • Tension adjustment • Emergency kill switch

Power Supply:

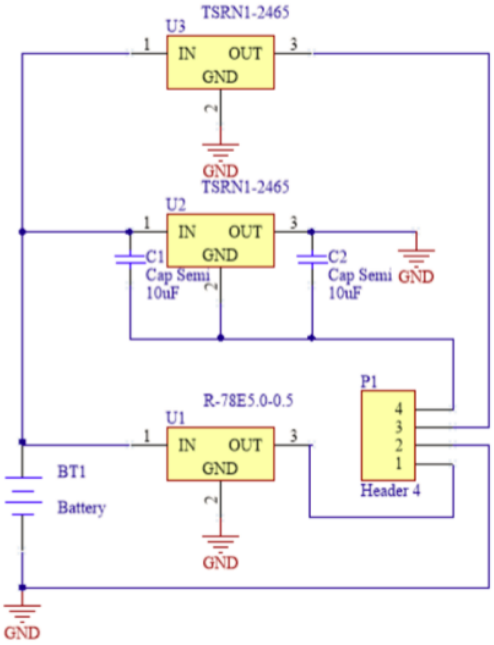

Figure 7: Power supply subsystem; BT1 - Dewalt XR 20V Li-ion; U1,U2,U3 - Switching regulators 91-93% efficiency

Figure 8: Proposed power source

Summary

The team, in collaboration with a mechanical engineering team, will be constructing a pole climbing robot with health sensing abilities. The ECE team will be primarily responsible for the sensor, controller, and power supply while the ME team will be primarily responsible for the climbing robot. The team will be constructing a GPR system consisting of transmitting and receiving antennas, controller connections, and two constructed amplifiers.