FAMU/FSU College of Engineering

Department of Electrical and Computer Engineering

<u>Operation Manual</u>

Team 301 – FPL Pole Health Detection
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Project Overview

The FPL Pole Health Detection Sensor was developed to improve the overall safety and efficiency of Florida Power and Light's (FPL) pole inspection process. The linemen current uses an 18-step process to test the structural integrity of their utility poles. The hammer test involves the user striking the pole and listening to changes in pitch. This method of testing is inaccurate due to the varying degree of hearing from person to person and has caused injury because of its inaccuracy.

The Pole Health Detection Sensor uses ground penetrating radar (GPR) to determine the structural integrity of the utility pole. This technique relies on the varying dielectric constants of solid wood and compromised wood. The GPR sensor produces a waveform, determining whether the utility pole has any internal defects. This technology provides linemen with a non-invasive and accurate way to determine the health of their utility poles. To build the GPR sensor, we followed instructions found in the COST Action TU1208 "Guide to building a GPR radar for educational use" presentation.

Modules

Low Frequency Amplifier (Amp1)

The subcomponent, Amp1, is responsible for providing a voltage gain. This circuit results in an amplification of Av = 7.576. It consists of four resistors of varying values and an operational amplifier.

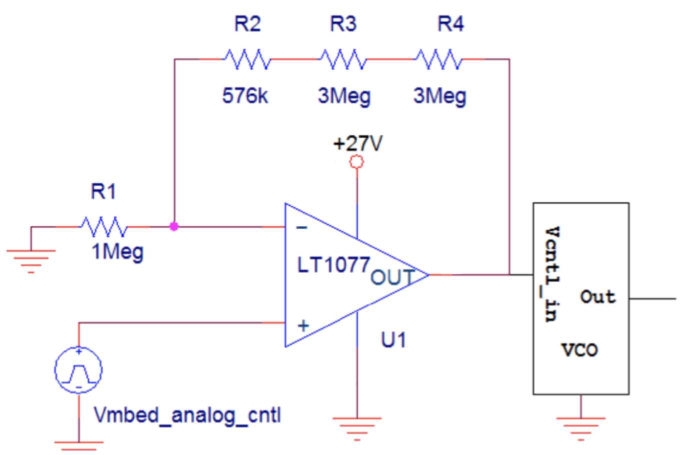

Figure 1: Amp1 Subsystem

Amplifier & Low Pass Filter (Amp2)

The subcomponent, Amp2, consists of several resistors and capacitors of varying values, three operational amplifiers (only one OP467 is used in hardware), a trimmer, and a coaxial terminal. The amplification is set by the trimmer and the filter modules are used to determine the maximum bandwidth frequency. For this design, the maximum bandwidth frequency is set to 15 kHz.

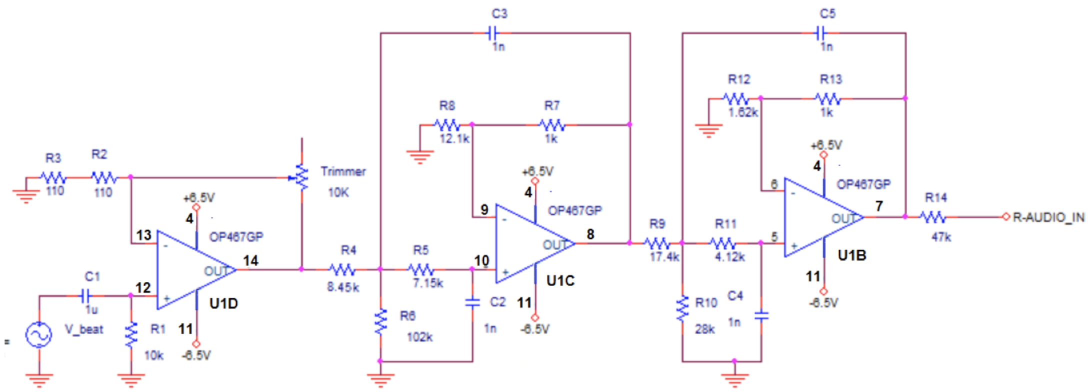

Figure 2: Amp2 Subsystem

Power Supply (DC-DC Converters)

The power supply subsystem consists of three switching regulators, and two capacitors. This system inputs 12V DC and produces four levels of output DC voltage, 5V, 6.5V, -6.5V, and GND.

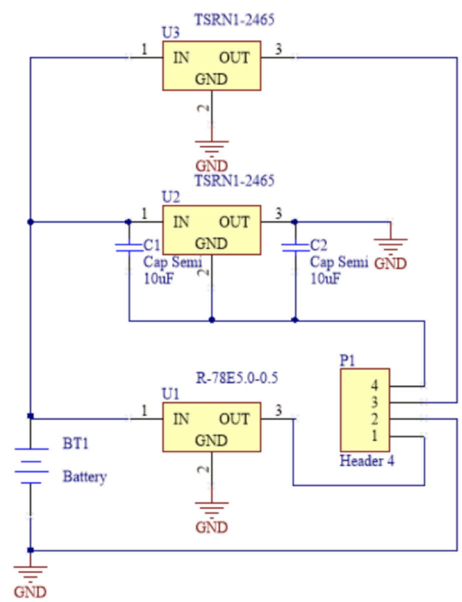

Figure 3: DC-DC Converter

Integration

The subcomponents are constructed as shown in Fig 4. Detailed instructions, along with all needed parts, can be found in the COST Action TU1208 “Guide to building a GPR radar for educational use” presentation.

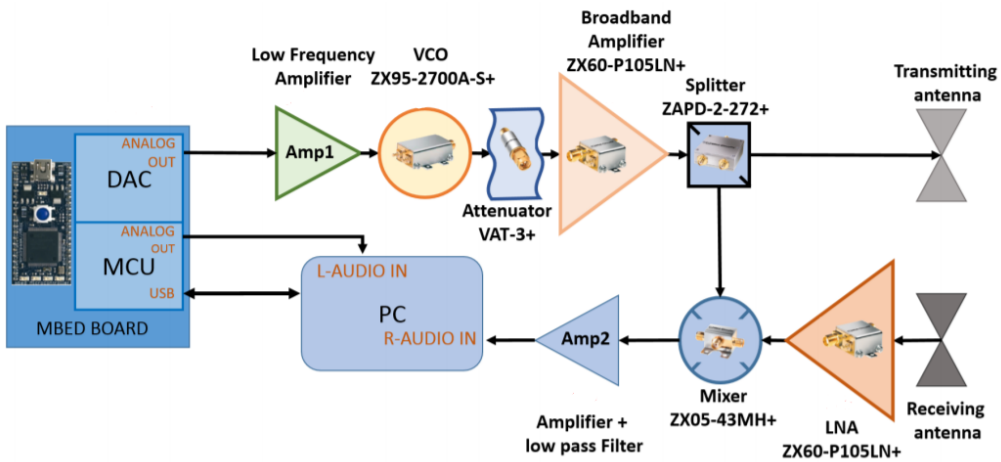

Figure 4: Block diagram of GPR sensor

Operation

The sensor is operated using the program scripts provided in the COST Action TU1208 "Guide to building a GPR radar for educational use" presentation. These include the following programs:

Python_GUI_4_Sliders.py
Calc_DAC_with_Predistortion.py
Mbed_Python_Control_LPC1768_2_main.txt
Mbed_Python_Control_LPC1768_2.bin

These programs produce the interface shown in Fig 5 and the output menu shown in Fig 6.

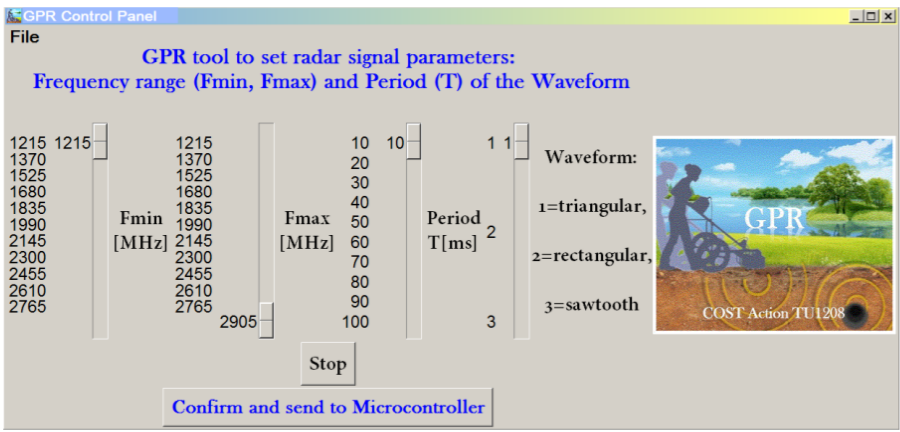

Figure 5: GPR user interface

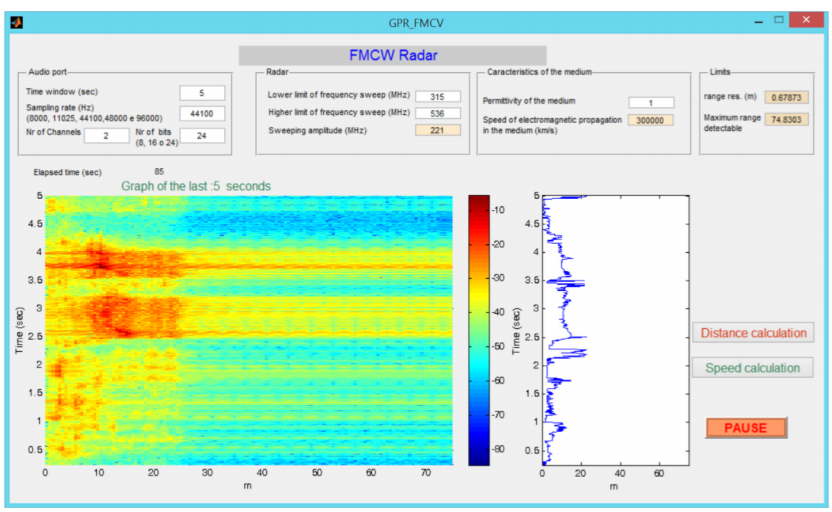

Figure 6: GPR output

Troubleshooting

If the robot is malfunctioning:

1. Check to see if the battery is charged.
2. Check if the phone app is connected.
3. Check to see if there are any loose connections.
4. Make sure the robot is not attached too tightly or loosely.
5. Reset microcontrollers.

If the sensor is malfunctioning:

1. Check for loose connections.
2. Check outputs for all components individually
3. Make sure power input is working
4. Reset microcontrollers.

In case of an emergency, immediately power off the device using the kill switch. If possible, remove the battery after being powered off. Report situation to supervisor.