Contents

1 References

This test plan refers to the following documents:

1) PDS.pdf, v1.0, 11/4/2019: The product design requirements specification for Team 18's Theremizer project.
2) Functional Decomposition of Theremizer.pdf, v1.0, 11/14/2019: The functional decomposition of Team 18's Theremizer project.
3) Rubric for Test Plan and Test Cases, source: Dr. Faust's capstone page, link: http://web.cecs.pdx.edu/ faustm/capstone/forms/TestPlanRubric.pdf, date accessed: 11/29/2019
4) Lecture 8 of Engineering Practices: "Testing and Documentation", source: Dr. Faust's ECE 411 page, link: http://web.cecs.pdx.edu/ faustm/ece411/lectures/Lecture8TestingAndDocumentation.pdf, date accessed: 11/29/2019

2 Objectives

Successful testing of Theremizer entails validation of correct PCB manufacture and circuit build, functional characterization and test for all individual functional blocks as per the functional decomposition, correct functionality of integrated blocks, and verifying overall system performance to the specifications called for by design.

2.1 Acceptance Test: Theremizer

Individual acceptance tests will be put in place for having a functioning theremin output, faithful reproduction of both unmodulated audio input and theremized audio input, filter controls for cutoff frequency and resonance, and meeting the engineering requirements of at least 1V user controllable output amplitude, at most 600 Ω output impedance, and at least 10 kΩ input impedance. A unit that successfully meets all of these specifications will constitute one working Theremizer.

2.2 Functional Test

To verify each functional block, the following functional blocks must meet these parameters:

- All regulated power domains available (9V,5V,+/-15V).

- Audio preamplifier offers user controllable gain from 0 input volume to at least 30dB input gain.
- Local oscillator offers at least 1KHz frequency change with antenna proximity and a resting oscillation frequency above 200KHz.
- RF oscillator is tuneable to same frequency as local oscillator.
- Envelope modulator successfully mixes RF oscillator and audio input to a modulation index of at least 0.2.
- Final mixer stage outputs baseband audio and offers theremin output of at least 1KHz frequency sweep.
- Microprocessor provides control voltage within expected limits to the low pass filter.
- Low pass filter has useful resonance and cutoff frequency control.
- Output amplifier offers user controllable output gain from 0 volume to at least 3dB above the filter output.

2.3 Integration Test

Successful integration of all of the functional modules can be seen by the following tests:

- RF oscillator and audio input are successfully mixed in envelope modulator.
- Envelope modulated RF and local oscillator are successfully mixed in frequency mixer stage.
- Low pass filter responds to microprocessor control voltages.

2.4 Performance Test

To characterize the performance of the Theremizer, the following parameters will be looked at:

- Frequency range of theremin
- Range of useful tonal distance from theremin
- Maximum input audio only output amplitude

- Maximum theremin output amplitude
- Maximum theremized audio output amplitudes
- Minimum distance from EM interference sources to maintain operation
- Resonance frequency range for resonance control
- Frequency response of Theremizer at full range cutoff settings
- Tuning stability over both time and power cycles

3 Resources

3.1 Personnel

Thorough testing of Theremizer will require strong test and measurement skills and the ability to interpret those results, physical circuit debugging skills, and hardware programming/debugging skills. The necessary personnel will be the 4 group members, engineers 1-4, all of whom have senior student level ECE skillsets:

Engineers 1 and 2: Shall focus on physical validation of the circuit and performance/functionality of the analog modules. They will need a strong background in circuit assembly, analog circuit behavior, and schematic reference.

Engineers 3 and 4: Shall focus on the validation of the hardware programming and microcontroller behavior and debugging any problems in communications with the microcontroller. They will require a strong background in computer engineering, the fundamentals of USB communications, and the Arduino code system including C/C++ compiling/linking and the Arduino IDE.

3.2 Test Equipment

We will need the following equipment and their respective connectors and tools:

- Oscilloscope
- Function generator
- Multimeter

- Spectrum analyzer
- DC power supply

The test equipment can be found in the different engineering labs in the PSU College of Engineering.

3.3 Other Equipment

We will also need the original prototype for reference and comparison, programming equipment for the microcontroller, and the means to listen to the audio output. We will need the following:

- Original analog circuit PCB Prototype
- and USB programming cable
- Arduino IDE
- Atmel Studio
- Windows 10
- USB drivers
- Audio Amplifier with speakers

The audio amplifier with the speakers will be provided by Jeff Roman.