Test Plan
Local Guidance System (LGS)

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Test Plan

In order to ensure the system is functioning properly, LocalSonic has developed a series of tests. Each individual component of the system will be tested separately first before it is integrated. Hence, the team divides this testing plan into two parts: individual component testing and integration testing. The detailed testing process will be shown in the following section.

1.1. Individual Component Testing

1.1.1. Hardware

In the hardware testing part, the team will focus on the response or the output of each component. The test goal, test method, and expect result will be shown under each main component.

Ultrasonic Emitter/Receiver Pair

In order for the correct operation of this system, the ultrasonic emitter and receiver pair should be able to communicate. If the emitter is given an input the receiver should be able to replicate that input, with some signal degradation.

- Using a 40kHz sine wave generated by the function generator as the input of the emitter, the receiver should be able to pick up this signal at a range of 2-4m and an angle of 80°. Both input and output will be viewed on an oscilloscope to confirm these test cases.

Receiver Amplifier Circuit

For correct operation of the receiver circuit, the circuit must produce a digital logic level of '1' (3.3V) when an ultrasonic pulse is produced and a '0' (0V) when no pulse is detected. Additionally, the noise produced by the circuit must be minimal so as not to create false positives or false negatives. When an ultrasonic pulse is detected by the ultrasonic receiver, a small voltage is produced at the terminals, which should then be scaled up to 3.3V for it to be seen by the microcontroller.

- The noise will be tested by oscilloscope and DMM. The expected value of this voltage output should be low enough; ideally 0V.
- To calculate the gain of the receiver circuit, the team will compare the voltage before the circuit and the voltage after the circuit. Two individual op-amp circuits are used in this receiver circuit. The gain of the first op-amp circuit should around 200 and the gain of the second op-amp circuit should around 20.
- The power supply, function generator, oscilloscope and DMM will be used to test the circuit output. The expected output voltage is 3.3V when the receiver detects a signal from the emitter and the output voltage should about 0V when no signal is detected. The current output of the circuit should be very low; 0A ideally.

Microcontroller

The RPi will be used to test many components and though this testing we will determine whether the RPi is in working condition and if it will be able to handle all inputs required of it. Once the receiver circuit has been confirmed working by the previous test cases, the RPi will need to be tested to ensure it detects a '1' when the circuit produces 3.3V and a '0' when the circuit produces 0V.

- When the receiver circuit is connected to the microcontroller, the microcontroller should read ‘1’ when receiver circuit detects an ultrasonic pulse and ‘0’ when no signal is detected.

Emitter Circuit

The emitter circuit will be tested to ensure that the correct signal is produced to be output by the ultrasonic emitter.

- The circuit will be powered up and the output will be measured by an oscilloscope. The signal produced should have a peak to peak amplitude of 10V and a frequency of 40kHz.

Radio Transceivers

The radio transceivers must be able to transmit pings and distance data. To ensure the radios will work for this implementation, communication between microcontrollers will be tested.

- Using two RPis, one way communication will be tested. For this test to be successful a message must be sent from one RPi to the other with very low latency time (less than 1 μs). The microcontroller should read out the signal from radio transceivers and calculate the distance between them.

1.1.2. Firmware

In this system there are two firmware versions, one for the beacon and one for the NavU. Each version will have to be tested individually (if possible) and together in the integration tests.

Ping Signal

Once all hardware components have been tested, the firmware can be tested. The most critical part of this is the ping signal. This involves all components of the system.

For the test to be successful the following sequence of events must be completed:

- The NavU will send a radio signal indicating that an ultrasonic pulse is about to be sent.
- The beacon will receive this radio signal and start counting until it receives an ultrasonic pulse.
- When the beacon receives an ultrasonic pulse, the distance will be calculated using the time taken and the speed of sound
- This calculated distance will be radioed back to the NavU along with the beacon's ID

User Input/User Feedback

In order for the LGS to be usable by the visually impaired the UI should be completely touch/audio driven. A push button will activate the system and audio feedback will be provided to the user via headphones.

- In this test the system will take input from the push button and output a sound to the headphones.

Volume Buttons

- The user feedback will also be able to be volume controlled by two buttons indicating volume up and volume down.
- Simply, a tone will be played every time a volume button is pressed and this tone will increase or decrease in volume depending on which button is pressed.

1.2. Integration Testing

In the integration test, the entire system will be tested. In order for the system to be considered performing correctly the following sequence of events will occur:

- The user will push the activation button on the NavU
- The system will acknowledge that the user has pushed the button and will send out a ping signal (as defined in 4.1.2)
- The NavU will receive distance measurements from all beacons in range of the ping signal and determine the closest beacon
- The user will be notified via audio feedback which beacon they are closest to and what landmark that corresponds to
- All audio feedback generated by the system can be controlled in volume by the volume buttons