Progress Report
Local Guidance System (LGS)

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1. Introduction

LocalSonic's Local Guidance System (LGS) is a turn-by-turn navigation system for indoor use to aid the visually impaired. Pressing a button on the user device (NavU), a component of the LGS, will make the NavU emit a combination of radio and ultrasonic waves. These ultrasonic waves will be received by nearby beacons with ultrasonic sensors, which will relay the LGS user's distance from the beacon to the NavU. The NavU will then inform the LGS user of their physical position in relation to the closest landmarks inside the building via audio. The LGS has been successfully put to test under various circumstances and it is now in its final stage of development and testing.

This report documents schedule, expenditures, and planning for the Local Guidance System (LGS).

The development of the proof of concept model of the LGS focused around the following components:

- Hardware development aimed to provide a stable digital signal response from received ultrasonic signals at the beacons and detectable ultrasonic wave emission from the NavU.
- Firmware development on the Raspberry Pi microcontroller to achieve signal reading/analysis and radio communication between microcontrollers.

2. Progress and Remediation Summary

2.1. Hardware Progress

Throughout the semester, our hardware team has been working to design and implement circuits for the (NavU) and the receiver nodes for the beacon. The main components of our NavU design include several op-amps that amplify an output signal to ultrasonic emitters. The main components for the hardware design of the receiver node includes a two stage op-amp setup, an ultrasonic receiver, voltage regulator, high pass filter, and diodes which feed into a Raspberry Pi microcontroller. Portable power sources were also bought to power these components.

These hardware circuits were first developed on solderless breadboards and have since been soldered onto prototype boards. Several test attempts were made during last month and each component has been tested to meet all the functional specifications of a previously written document *Functional Specification – Local Guidance System (LGS).*

The final step in the hardware process would be to mount the components in hardware enclosures and modify enclosures to allow ultrasonic emitter and receivers to project ultrasound without obstruction from the enclosure.

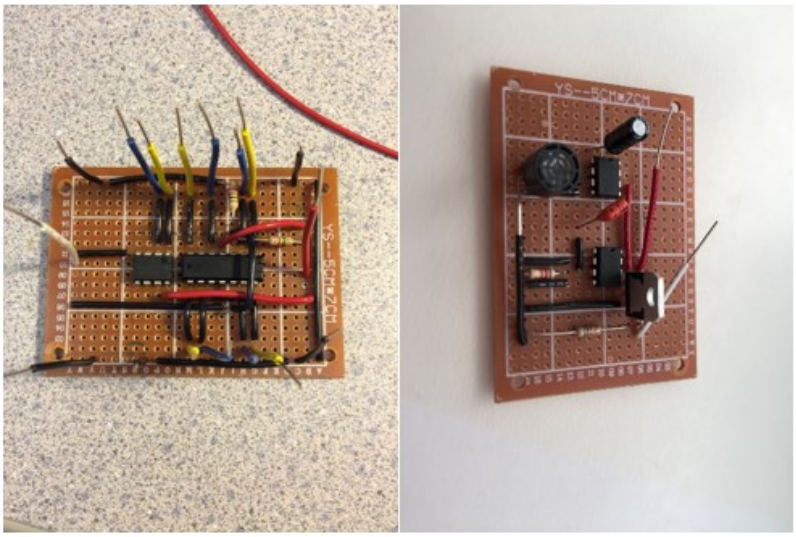

Figure 1: Hardware Ultrasonic Emitter and Receiver Circuit

2.2. Hardware Remediation

Compared to our initial hardware schedule, we are in the correct phase (design and testing) but have lost one week of time. The delay was due to one of the microcontrollers failing and multiple changes in design to resolve issues with the digital signal. We expected problems to arise during development, thus extra components were acquired so that minor changes could be easily accommodated. The final stage for hardware development and testing only involves modifying purchased enclosures and mounting the circuit boards inside.

2.3. Firmware Progress

The firmware team has been working on developing communication between microcontrollers using radio from the Nordic nRF24L01+ radio chips. We have developed and tested digital signal output for ultrasonic emitters and reading input from ultrasonic emitters, which have both been successful. Audio feedback for the user is almost finished, with only the proper sound clips required for audio feedback to be finished.

2.4. Firmware Remediation

We are currently behind on firmware development and testing by two weeks. Much of this was due to massive delay in delivery of faulty components from several orders. The parts have now all arrived, however. Proper triangulation of direction and relative distance of the user needs to be implemented on the microcontroller, although pseudo code has been written. Sound clips used for audio feedback also need to be recorded. We plan to have all firmware developed and tested by December 6th.

3. Finances

So far, we have purchased most of the essential parts required for the testing and development of our project. As shown by the expenses in Table 1, our total actual cost came in at $670, which has been paid solely by the members of LocalSonic. The large difference between expected and actual hardware cost was due to design changes in hardware and multiple backed up orders to accommodate long shipping times.

Item	Estimated cost	Actual Cost	Difference
Microcontrollers	$80	$120	$40
Ultrasonic transmitter/receivers	$250	$200	$-50
Hardware components	$30	$200	$170
Radio components	$50	$80	$30
Batteries	$20	$20	$0
Enclosures	$20	$50	$30
Wearable accessory	$10	$0	$-10
Total Cost	**$460**	**$670**	**$210**

Table 1: Expense Breakdown

4. Summary

In conclusion, the overall expenditure was not close to our original budget. We have made considerable progress during the term, but still have some way to go as we are trying to wrap up our final product before the demo. The overall development is behind our schedule due to design changes and late component deliveries. However, with our remediation strategies and extra time put into development, we will have a functional product to show on the demo day.