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Higher-Clarity Speaker System

Design Document

Contents

1 Introduction

1.1 Project statement

The goal for this project is building a wireless speaker system that will produce a high clarity sound output. The speaker system should give an optimum sound clarity in a large room, especially places like a convention facility.

1.2 Purpose

It has been common to find at a number of facilities that the speaker systems produce less than optimal sound clarity. This poor sound output quality makes it so that the audience can't hear what the person with the microphone is saying, and the issue could be worsened with audience members that don't have great hearing capabilities. Sometimes, this is due to the poor speaker placement, but we want to tackle the problem on a more technical side and look at the actual hardware being used. The usage of speakers is a very common way to convey messages to large audiences, whether that be indoors or out. Hopefully, the project will help to make these messages clearer and more easily understood.

1.3 Goals

Goals for this project include:

- Stand alone speaker system
- Higher clarity when compared to the current systems installed at ISU
- Scalable in order to fit the needs of different sized rooms
- Easy to use, will not distract from the presentation
- Minimal delay between audio send and receive

2 Deliverables

For this project, the deliverable will be a multiple speakers system that able to be connected via wireless, able to produce a high sound clarity, and able to be connected to with standard microphone options.

3 Design

3.1 System specifications

The project will be divided by two, which is the transmitter part and the receiver part . The transmitter will consist of an RF antenna module, Tiva TI launchpad microcontroller, and microphone. The microcontroller's role should be able to create a network for the receiver to connect and able to transmit the audio signal through the network. The microphone's role is to capture the analog audio signal and convert it to digital signal to be transmitted. The receiver consists of the speakers and the receiver wireless module that will be connected to them. The module's role will establishing a connection with an existing network created from the transmitter part.

3.1.1 Non-functional

- **Reliability:** The speaker system should have a very reliable wireless connection, which means that the connection between transmitter and receivers should have zero interference from other noise radio wave, and also zero lost connection error.

- **Usability:** The speaker system should be user friendly to anyone that uses it, which means that the process of establishing and connecting the network between the microphone and the speakers should be straightforward.

- **Scalability:** The speaker system should has a flexible range of scalability in terms of amplifying the audio output while maintain the desired level of audio clarity.

3.1.2 Functional

- The system must send and receive a stream of audio data and signals.
- The system must be able to convert the the analog data receive and convert the digital data back to analog signal.
- The system must have a certain filters that able to change the audio signals.

3.2 PROPOSED DESIGN/METHOD

The system will comprise of two parts, which is the transmitter and receiver part. For the transmitter part, a Tiva TI Launchpad will be used in communicating with the microphone and transmitting data. The Launchpad should be able to receive the audio data from the microphone and able to transmit the data via radio signal with the RF antenna module installed to the microcontroller. For the receiver part, another Launchpad will be used and be programmed to connect and receive the data transmitted from the radio signal. Then, the speakers connected to the receiver microcontroller will be outputting the audio data. Lastly, GNURadio will be use in running and implementing the software code.

3.3 DESIGN ANALYSIS

At this point in our design, we have started to read into the functionality of a signal processing software known as GNU radio. There are tutorials online that explain some basic functionality using python.

We have decided that testing will be broken into two groups right now. If we can get the software to process signals and output over common computer speakers, then we feel confident that we can make this also work over a simple radio antenna.

The second group of testing is to build a receiver that can take in common radio frequencies. We feel that once we can get this end of our product working then the intermediary step of communication will come next.

Once we have these components working, the physical design will start to take shape. We will still need to decide exactly how we want to connect the microphone. One idea has been to use some sort of phone app possibly using android. Where we have to connect the microphone to the system will decide how it is utilized. If we have to connect the microphone to the Launchpad then we'll also have to figure out some sort of battery pack to allow a movement.

This is why early testing is important to us. If we want to end up with a quality finished product we know we have a lot to learn.

4 Testing/Development

4.1 INTERFACE SPECIFICATIONS

There will need to be some hardware/software interfacing pieces to our project. There will be software code that is running our radio, via GNURadio, which will then need to work with an antenna to connect to our other speakers and transmit the speaker's message.

4.2 HARDWARE/SOFTWARE

We are currently working with two main parts in doing testing for this project. The first is the launchpad, a microcontroller that we are using due to it being far cheaper than other common options like the Arduino Uno. Then we are using GNURadio and it's companion packages, GRC, to develop a software radio for the project.

4.2 PROCESS

We have decided our current version of design mainly through research. There is a lot to be learned as none of us have ever done anything similar to this. To create this design we have spent a lot of time learning about different technologies, and through meetings with Professor Tuttle have gotten to our current concept.

Current testing procedures have been outlined in **Section 3.3**.

5 Results

The current design is the result of a lot of trial and error in what we think we can create in a realistic amount of time and at a realistic cost.

We initially wanted to use a Raspberry Pi and a bluetooth transmitter to sync to some simple bluetooth speakers. the cost of a single Raspberry Pi with a bluetooth antenna would not allow us to scale realistically. Not to mention each additional speaker would have to come at market cost which isn't very realistic.

After some more research, and meeting with Professor Tuttle we began to look into software radio and building a simple FM antenna and receiver. We have now split the project into two groups with Nick and Quinn focusing on the software, and Arifi and Andrew working on designing a receiver.

6 Conclusions

As stated above the bulk of our project this semester has been based in learning about different technologies that we can utilize, and figuring out how to piece these together into a design that is efficient and economical.

After meeting with our client initially we were basing most of our design on bluetooth communication. Dr. Banitt was worried about using radio frequencies, and had presented possibly using another technology such as infrared. After coming to our first design we met with Professor Tuttle who helped push us into something that would be a bit more realistic for us.

The second design formed through meeting with Professor Tuttle led to our current testing phase. Once we have finished our current testing phase we will have a good idea of the physical design of our product. The communication intermediaries between each component will be decided once we have the capability to send and receive signals.

7 References

http://gnuradio.org/redmine/