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Higher-Clarity Speaker System

Project plan

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 stand-alone speaker system that will be wireless, of a high clarity, and able to be connected to with standard microphone options.

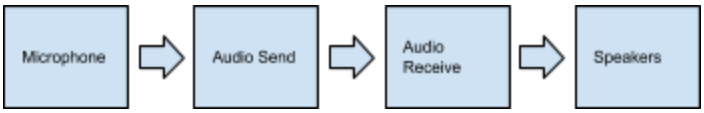
3 Design

Include any possible methods and/or solutions for approaching the project at hand. You may want to include diagrams such as flowcharts to, block diagrams, or other types to visualize these concepts.

3.1 Previous work/literature

Traditionally with radio communication, the system is hardware based with a built transmitter and a corresponding receiver. There aren't and retail radio systems that have a software setup.

3.2 Proposed System Block diagram



3.3 Assessment of Proposed methods

While doing our preliminary research, a few options stuck out immediately as the most viable ones for us. The first area, is in the audio send and receive units, here is where most of our work will happen. The units will need to be quick, robust, and able to handle many simple instructions many times. We have looked at the Arduino Uno, Raspberry Pi, and the MSP430 Launchpad. We have chosen the MSP430, as it is both readily available to us, as well as the cheapest option. The next issue is how the information will be sent. Here, we are looking at Bluetooth, Infrared, and WiFi. Infrared was an option suggested by the client, though after research it seems that it would be the hardest solution to implement due to the low data rates and visibility of infrared. So, we decided to use radio wave under the permitted frequency to transmit the data from the transmitter (microphone) to the receiver (speakers). Our revised method of transfer is through a radio software called GNURadio. This is creating a software implementation to our project creating a more unique solution. In this software, we can pick and choose frequencies depending on what is an open channel at the location being used.

3.4 Validation

There will be two main options for validating our design. The first of these is through calculations and analysis of our system. These will ensure that, at least from the design table, we have a viable and working solution. The second test will be after building the speaker system, in which the speaker system will be tested for an audience and seeing how they rate the quality and clarity of the speaker to their untrained ears. If the average person doesn't notice a more clear and consistent output from the speakers, then the project goals were not fully met. The system will also be tested to make sure that unintentional noise, for example echoing.

4 Project Requirements/Specifications

4.1 FUNCTIONAL

The LaunchPad development board features:

14-/20-pin DIP (N) socket

Built-in flash emulation for debugging and programming

Included MSP430G2xx device features:

MSP430G2553IN20 – 16kB Flash, 512B RAM, interruptible GPIOs (capacitive sense-capable), 16-bit timers, 8ch 10-bit ADC, Comparator, Serial Communication (USCI – I2C, SPI & UART) & more

MSP430G2452IN20 – 8kB Flash, 256B RAM, interruptible GPIOs (capacitive sense-capable), 16-bit timers, 8ch 10-bit ADC, Comparator, Serial Communication (USI – I2C & SPI) & more

This is the basis for the creation of the rest of our design. We currently don't know of any way to measure speech clarity, as perception varies from person to person. We also need to do more research on our data transfer ability, before we decide if we can use current speakers, or need to create our own.

4.2 NON-FUNCTIONAL

The speaker output needs to be clear, no matter where your table is placed in the convention hall.

The data transfer must be fast enough that the presenter can not hear a lag. If the lag is noticeable it can become very difficult to speak.

The entire system must be scalable so that as the number of tables increase, more speakers can be paired.

There can't be a noticeable lag from speaker to speaker, this will reduce clarity for tables close together.

The total price for the system and at least two speakers needs to stay below our budget, roughly $500.

5 Challenges

We originally had planned to use the Raspberry Pi 3 model B. The cost to get 4 of these would be around 800 dollars. By switching to the Texas Instruments Launch Pad we can invest in multiple, to allow each of us to work independently at times.

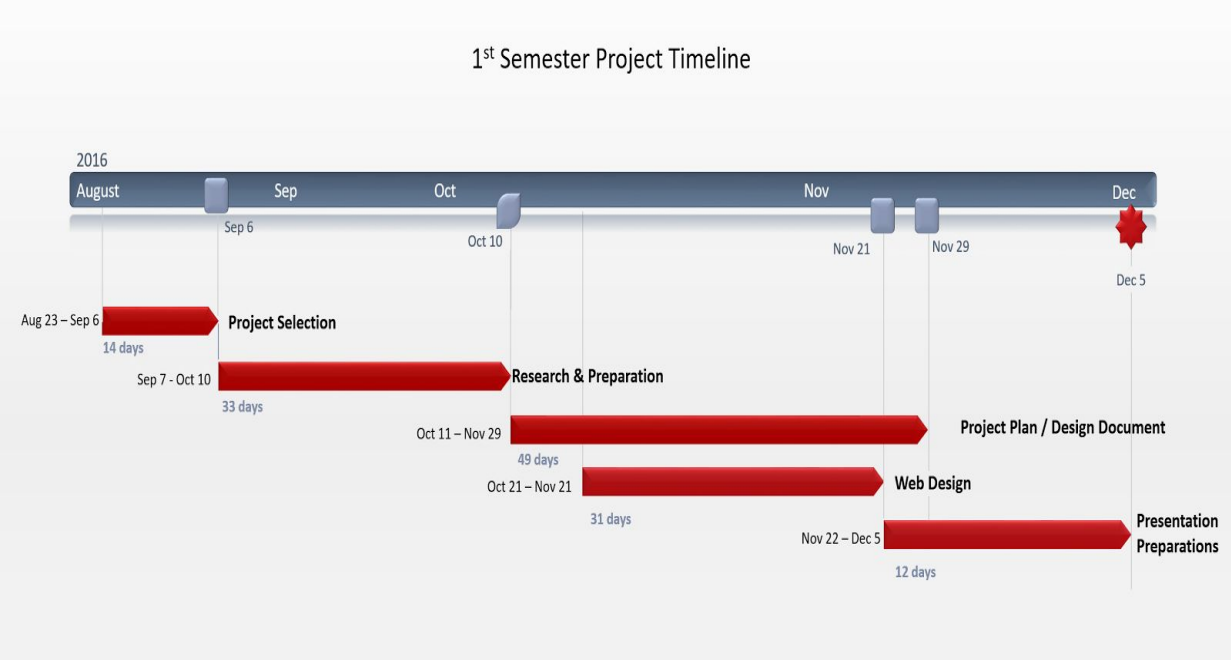
The functionality of the Raspberry Pi was a bit higher, so we will either have to invest in some chips to add functionality to the launch pad, or design many of our own components.

Even with the ability to pair a single speaker with clear output, we could still experience issues as we add more speakers. If the lag from speaker to speaker is great enough, we may find we have to redesign our system. Professor Tuttle is worried this is an issue we may not be able to overcome.

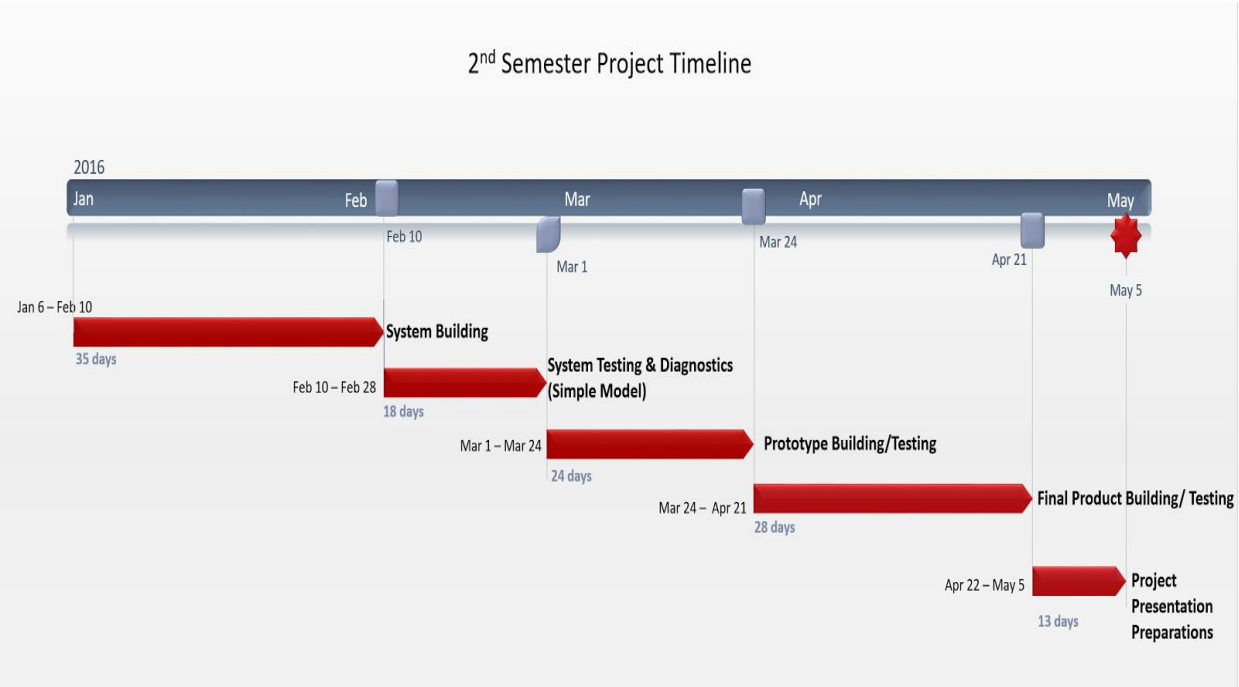
Professor Tuttle also suggested possibly creating a simple antenna for beginning our design, but this was a concern of our client early on. (radio signal regulations)

6 Timeline

6.1 First Semester



6.2 Second Semester



7 Conclusions

The high clarity speaker system that we will be developing will encompass audio quality, fast and accurate data transfer, and compensating synchronization. Our goals are to create a high quality speaker system with multiple speaker outputs as well as ensuring no data loss upon transfer while trying to eliminate desynchronization.

Building our own speakers will create less dependency on what is currently out there for sound quality as well. Designing speakers on our own would support our own calculations for creating quality in clarity. We are using the TI Launch Pad to test our data transfer in a smaller scale to ensure our process is functioning correctly. GNURadio is our method for radio transfer. It will eliminate the hardware aspect of radio transmitter and receiver. Going from microphone to speaker can be done on the Launch Pad to test and support our process for creating our high clarity system. Our biggest obstacle is getting familiar with the radio software and apply it to our microcontrollers.

8 References

Similar Projects

- http://www.instructables.com/id/Raspberry-Pi-Multi-Room-Audio-MobileTabletPC-Contr/
- http://www.instructables.com/id/DIY-Bluetooth-Speaker-PartyBar/
- http://lifehacker.com/5940829/this-diy-wireless-receiver-controls-virtually-any-stereo-system-with-any-smartphone
- http://garagelab.com/profiles/blogs/tutorial-arduino-ir-sender-and-receiver
- http://www.instructables.com/id/How-to-control-your-TV-with-an-Arduino/
- http://www.instructables.com/id/Add-Simple-Bluetooth-to-Arduino/
- http://www.instructables.com/id/PC-Speakers-Into-Bluetooth-Speakers/
- http://gnuradio.org/

9 Appendices

If you have any large graphs, tables, or similar that does not directly pertain to the problem but helps support it, include that here. You may also include your Gantt chart over here.