IPRO 344
Improving Energy-Efficiency and Offering Quality Audio in Mobile Devices and Intercoms

Objective

- To investigate the potential improvements that Class D amplifiers offer for intercom systems
- To analyze the electro-acoustic aspects of a two-way communications channel
- To simulate and evaluate a drive-thru facility
- To develop guidelines for an acceptable drive-thru system

Team Introduction

Web Team
Mike Carrozza(L)
Alex Barnett
Min Soo Kang

Presentation Team
Nastasja Terry(L)
Mike Carrozza
Mohammad Raza

Coordination Team
Chia-Hao Tu(L)

Minutes Team
Nastasja Terry
Kevin Gullikson

Poster Team
Kevin Gullikson(L)
Li Li
Min Soo Kang
Chia-Hao Tu

Microphone Team
Mohammad Raza(L)
Li Li
Alex Barnett
Chia-Hao Tu
Mike Carrozza

Tools/ Media Team
Li Li(L)
Mohammad Raza

Purchasing Team
Harry Lee(L)
Roozbeh Shegarfi

Documentation Team
Minsoo Kang(L)
Harry Lee
Roozbeh Shegarfi

Kiosk Team
Roozbeh Shegarfi(L)
Nastasja Terry
Kevin Gullikson
Alex Barnett
Harry Lee

Research Team
Alex Barnett(L)
Min Soo Kang
Mike Carrozza

Tasks to be Accomplished

- Investigate microphones that most accurately capture customers' voices in outdoor environment.
- Implement a pre-amplifier.
- Design a kiosk for the prototype
- Evaluate the audio quality of the system.
- Develop a prototype of improved sound quality drive-thru system.

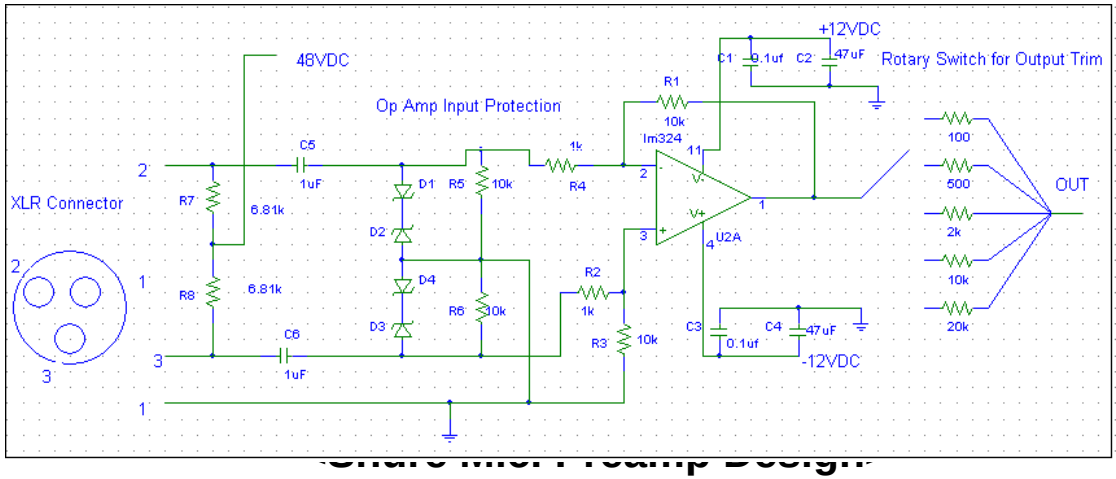
Progress

- **Microphone**
  - MX-100 series from Shure Inc.
  - High Quality Microphone Assembly
    - Built-in preamp
    - Reduction of the impact of any electromagnetic interference on the cable length
    - A higher quality element with a relatively flat frequency response from 20hz to 20kHz

<Shure MX-183>

Progress

- **Preamplifier Design for Shure Microphone**
  - Phantom power circuit isolated with capacitors
  - Op amp protected from spikes with Zener diodes
  - Difference amplifier achieves 20dB of gain
  - Output trim allows adjustment of input levels to class D amplifier.
  - Trim comprised of stepped attenuator for precision and repeatability



Progress

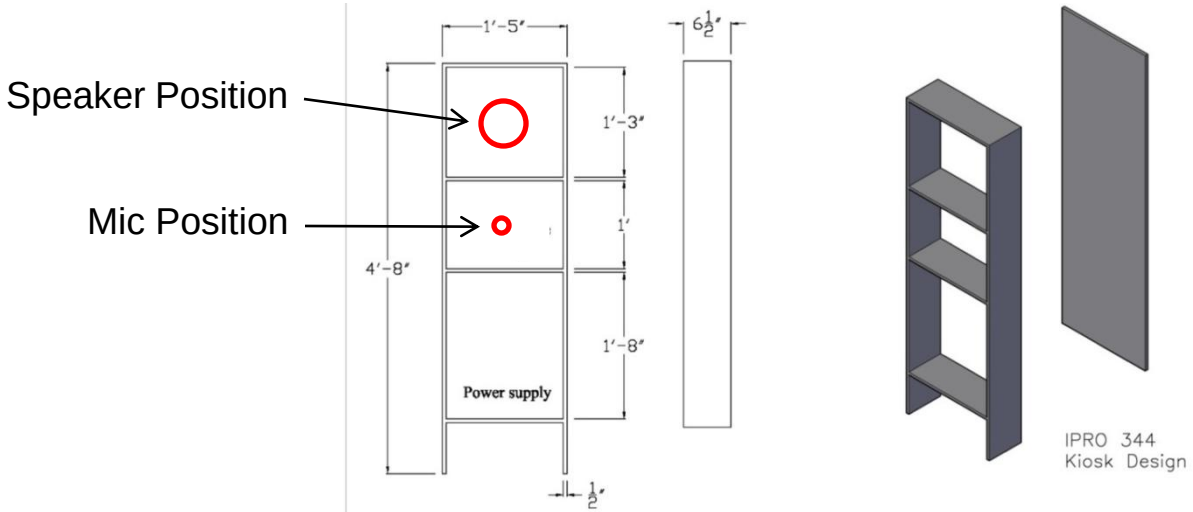
- **Speaker**
  - Outdoor/ Weather-Proof
  - Compatibility with the class D amplifier
  - Benefits
    - Sensitivity : Above 90 dB/watt
      - Made of butyl rubber/ Withstand an outdoor environment
      - Offer more watts per speaker per dollar

<Polk Atrium 45>

<Polk Audio db 401>

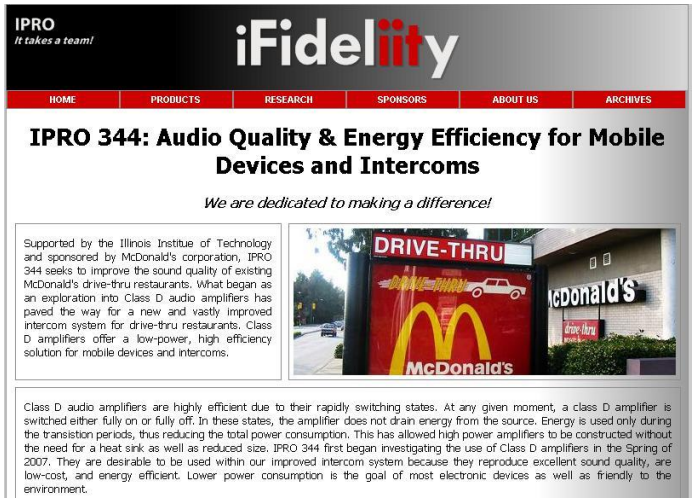
Progress

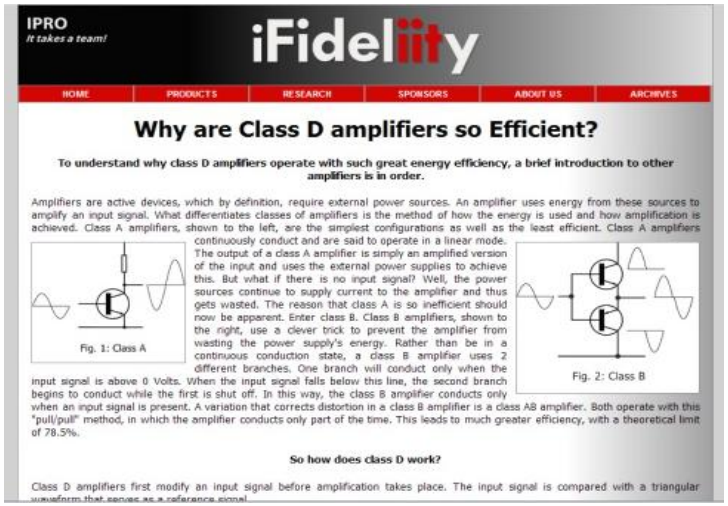
- **Kiosk**
  - Material & Shape : Wood & Cubic
  - Design : - Isolating the Interior of the Kiosk in order to Prevent Sound Feed Back from Speaker to Microphone
    - Mimic the acoustic properties of an actual drive through kiosk.
    - Careful positioning of speaker and microphone to prevent from tipping over



Progress

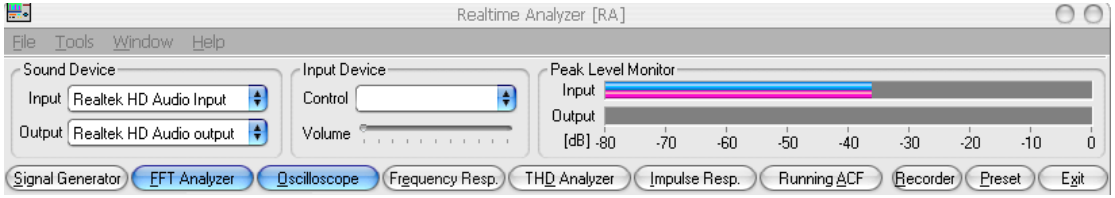
- **IPRO 344 Web Page**
  - Topics : Overall Purpose, Products, Prototypical results and progress, Research and Background, Members





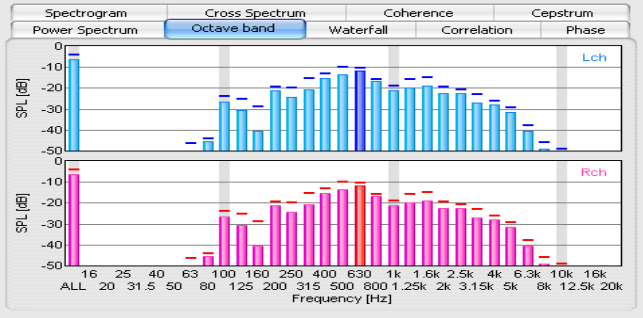
Progress

- **Sound Analysis Tools**
  - Acoustic Analyzing System 5E
    - Offer the FFT analyzer with 9 options
    - Using the real time spectrum analyzer, environmental noise and human voice can be analyzed

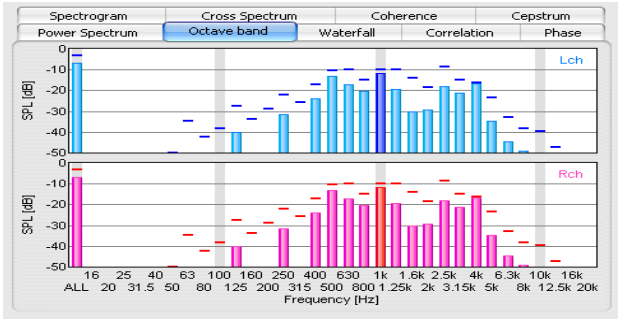


<FFT Analyzer>

- When speaking in front of the Microphone,



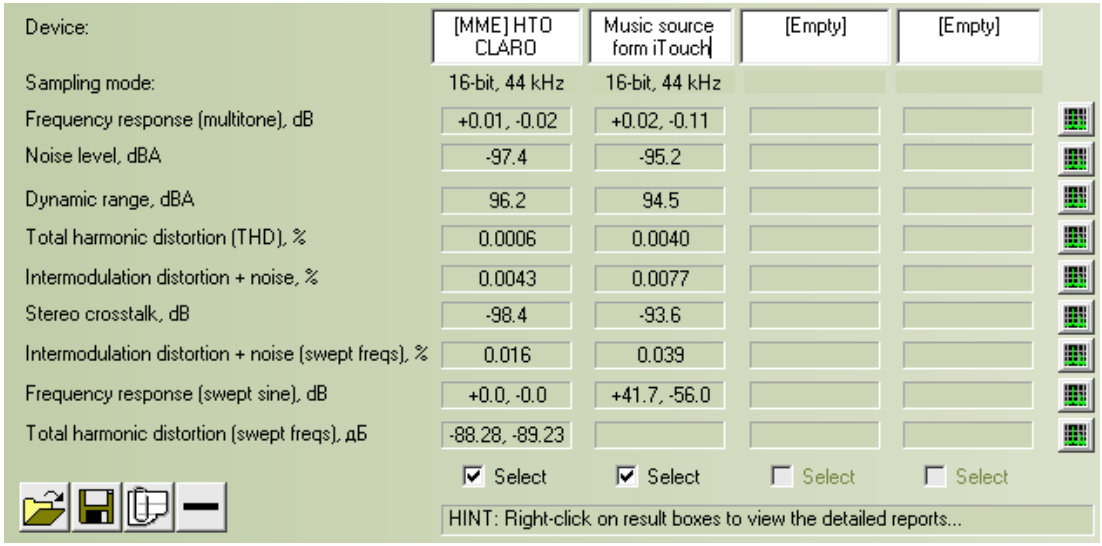
<Human Speech without Music>



<Human Speech with Music>

Progress

- **Sound Analysis Tools**
  - RightMark Audio Analyzer 6.1.2
    - Test the electronic noise produced by the amplifier system
    - Self-test of the soundcard and audio signal



Device:	[MME] HTO CLARO	Music source form iTouch	[Empty]	[Empty]
Sampling mode:	16-bit, 44 kHz	16-bit, 44 kHz		
Frequency response (multitone), dB	+0.01, -0.02	+0.02, -0.11		
Noise level, dBA	-97.4	-95.2		
Dynamic range, dBA	96.2	94.5		
Total harmonic distortion (THD), %	0.0006	0.0040		
Intermodulation distortion + noise, %	0.0043	0.0077		
Stereo crosstalk, dB	-98.4	-93.6		
Intermodulation distortion + noise (swept freqs), %	0.016	0.039		
Frequency response (swept sine), dB	+0.0, -0.0	+41.7, -56.0		
Total harmonic distortion (swept freqs), дБ	-88.28, -89.23			
	Select	Select	Select	Select

HINT: Right-click on result boxes to view the detailed reports...

<the Result of Self-Test >

Challenges

- **Microphone**
  - Encounter unexpected problem as we go along the implementing process
- **Speaker**
  - Search for durable high quality outdoor speakers to produce sounds like actual human voice
- **Kiosk**
  - Exact location of microphone and speaker, best distance between microphone and speaker is not known
  - Feedback noise from the microphone can not be eliminated
- **Tools/ Media**
  - Outdoor noise is variant and complicated to analyze
  - Difficult to represent sound quality using numerical data
- **Web Page**
  - Making website cross browser compatible

To Do

- **Microphone**
  - Build high quality preamplifier to drive the power amplifier
- **Kiosk**
  - Build the kiosk
  - Test the microphone in different places to find the best place for the microphone
- **Tools/ Media**
  - Continue searching for software tools to measure the outdoor noise
  - Try to write a MATLAB program to do above
- **Web Page**
  - Complete content for any unfinished pages
  - Continually update with progress of prototype and testing
- **Poster**
  - Find a creative and eye-catching way to display information

To Do

- **Purchasing**
  - collect all required equipments
- **Documentation**
  - Prepare for the final report and presentation
  - Support post team and web team
- **Research**
  - Gather journal articles & publications that can assist others in designing the project
- **Coordination**
  - Make Gantt chart and manage the flow of tasks
- **Minutes**
  - Make a record of everyday progress
- **Presentation**
  - Present the midterm and final presentation

THANK YOU