Team

Andrew Thompson
- Project Lead, Audio Streaming

Reed Taylor
- PCB Design, Audio Streaming

Brent Morada
- Wireless Module

Anna Lee
- Audio Processing

Jair Santiago Carranza
- Amplifier/Speaker System
Project Vision, Applications

- Crowd control system using a drone equipped with a speaker
- Relay important messages to a target audience without being physically present
Ground Control System

- Application on Raspberry Pi
- Records the user via a microphone
- Transmits the digital audio samples to the drone receiver over NRF24 wireless module

Drone Receiver Module

- Drone with mounted PCB and speaker system
- Flies 5-10 feet over target audience
- Receives digital audio samples from client, converts to analog, and outputs to speakers
Ground Control System

- Raspberry Pi connected to a 7” touch screen display
- Running our audio streaming code
- Simple user interface which allows for tap-to-record
Audio Cartridge

Module fitted to the Drone Platform to output the audio stream from the base station.

UAV (Yuneec Typhoon H: Pro Drone)

Power Supply (11.1V Vcc) ( Venom RC 25007)

3.3V Regulator (LD1117S33CTR)

Speaker (CSS-1021028N)

1.8V Regulator (LD1117S18CTR)

Microcontroller (EA LPC4088)

Amplifier Circuit (MAX9744 20W)

Audio Codec (NXP SGTL5000)

Tranceiver Module (NRF 24LR01+)

RF Communication From GCS

HP-out

Lineout

I2S (audio data)

I2C (clk & control)
Ground Control Station

Ground station used to broadcast audio streams to the drone platform

- Microphone
- MIC-in
- RF Communication to Cartridge
- Tranceiver Module (NRF 24LR01+)
- SPI
- Base Station Audio Streaming Application (Raspberry Pi)
PCB Layout
Finished PCB
Drone

- Yuneec Typhoon H Pro
  - Can carry ~ 4lbs
  - Relative operating loudness around Phantom 4
  - Enough space to fit PCB, battery and piezoelectric speaker
# Bill of Materials

<table>
<thead>
<tr>
<th>Component</th>
<th>Model/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller</td>
<td>LPC4088</td>
</tr>
<tr>
<td>Audio Codec</td>
<td>SGTL5000</td>
</tr>
<tr>
<td>Ground Control System</td>
<td>Raspberry Pi B+ with Touch Screen</td>
</tr>
<tr>
<td>Main Crystal</td>
<td>SG-210STF (12 MHz)</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Adaptors, Capacitors, Resistors, and Regulators</td>
</tr>
<tr>
<td>Speaker</td>
<td>CSS-1021028N (107 dB)</td>
</tr>
<tr>
<td>Amplifier</td>
<td>MAX9744 (20W stereo)</td>
</tr>
<tr>
<td>Power Supply</td>
<td>Venom RC 25007 (11.1 V)</td>
</tr>
<tr>
<td>Drone</td>
<td>Yuneec Typhoon H Pro Hexacopter</td>
</tr>
</tbody>
</table>
Prototyping Progress

- **Audio Streaming**
  - Successful audio streaming from ground control system (Raspberry Pi) to LPC4088 development board over NRF24 wireless module
  - Sampling data at 12 kHz and sending 64 samples (32 bytes) at a time over NRF24 wireless module
  - Samples are sent from LPC4088 to codec on dev board through buffer (4 bytes)
Prototyping Progress

- **Wireless Communication (NRF24)**
  - Successful implementation of the NRF24L01+ Drivers in C for the LPC4088
    - Adapted from TMRh20’s RF24 driver, utilizing facilities specific to the LPC4088
    - Performed range testing, successful audio streaming for the entire length of HFH hallway
Prototyping Progress

- **Audio Processing (SGTL5000 Codec)**
  - Currently writing bare metal driver in C to work with LPC4088 for I2C and I2S bus interfaces, currently finishing up input/output routing
  - Found and edited necessary libraries for driver, adapted files from preceding codec on dev board
Prototyping Progress

- **Speaker and Amplifier System**
  - Speaker system is now fully assembled and has been tested with the LPC4088
  - Peak 107 dB output
  - Much louder than our initial test speaker, should be easily audible over the drone flight noise
Moving Forward

- Purchase second spin of PCB with minor updates
  - Pull up ISP pin, change SPI interface, etc.
- Send second PCB spin for assembly
- Create housing for components to attach to drone
- Finish codec drivers to run program on PCB
- End-to-end testing with code on PCB
Thanks to:

● Yogananda Isukapalli
  ○ Capstone Instructor
● Brandon Pon
  ○ TA
● Carrie Segal
  ○ TA

Team Sponsor

● Phil Tokumaru
  ○ AeroVironment Project Advisor
Q & A