

Virtual 3D Audio

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Project Background

- Communication devices for helicopters
- Current helicopter headsets don't typically allow for positional audio
- Positional audio would make it easier to communicate when several people are in the helicopter
- Emulating 3D audio with a stereo headset would allow for positional audio

New Developments

- Current helicopter headsets are typically stereo or mono
- Should be a general solution that can be applied to pre existing headsets
- Will allow for positional audio from non specialized headsets

Project Description

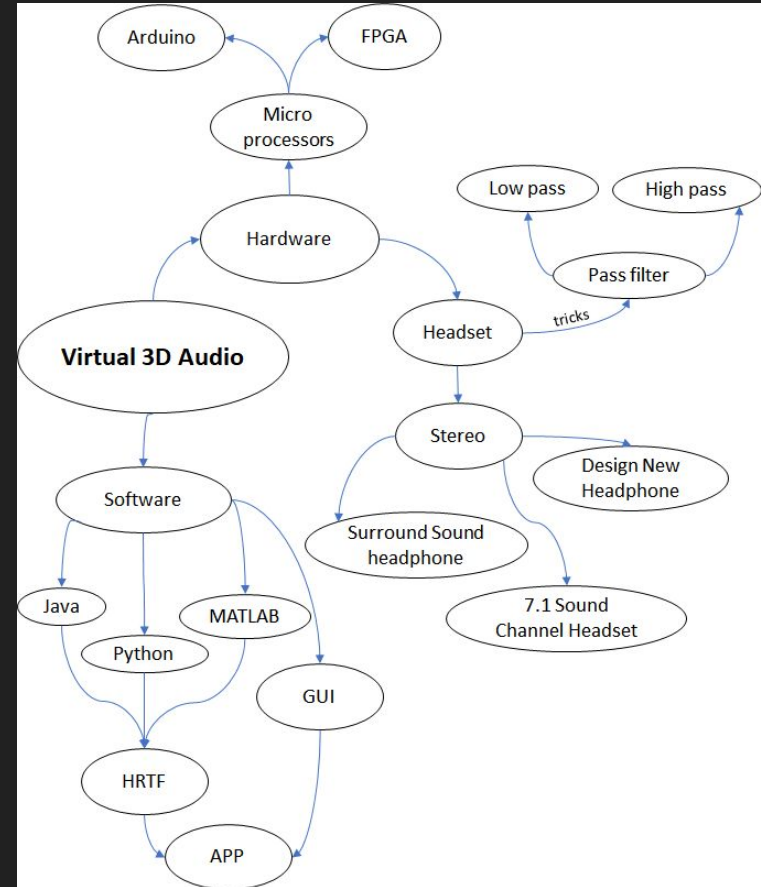
- Device should have ability to simulate audio coming from any position relative to head in 3d plane
- Should be emulated using a stereo headset
- Must operate based on user input from a GUI
- Must be easily useable by anybody, including those without a technical background

Final Design

- User selects a point via X, Y, Z coordinates, which is then displayed on GUI
- Coordinate data, along with model selection are sent to audio processing module when 'play' button engaged
- Module will begin recording microphone input, and outputting filtered audio through the headphones

Brainstorming

- Fast Fourier Transform
- IIR Filter
- Head Related Transfer Functions

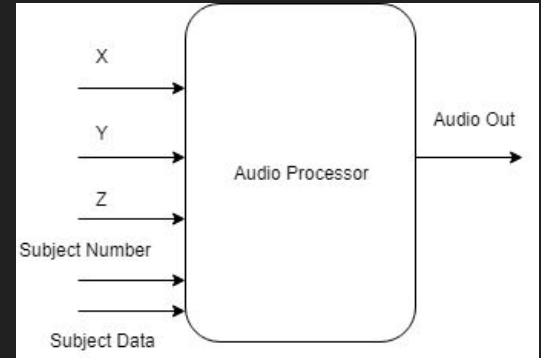


Head Related Transfer Functions Background

- Record response in ear resulting from impulse played in specific location
- Can use response in ear versus initial sound to calculate transfer function
- This transfer function can be used with any sound to emulate that position
- Accuracy depends on physiology of user

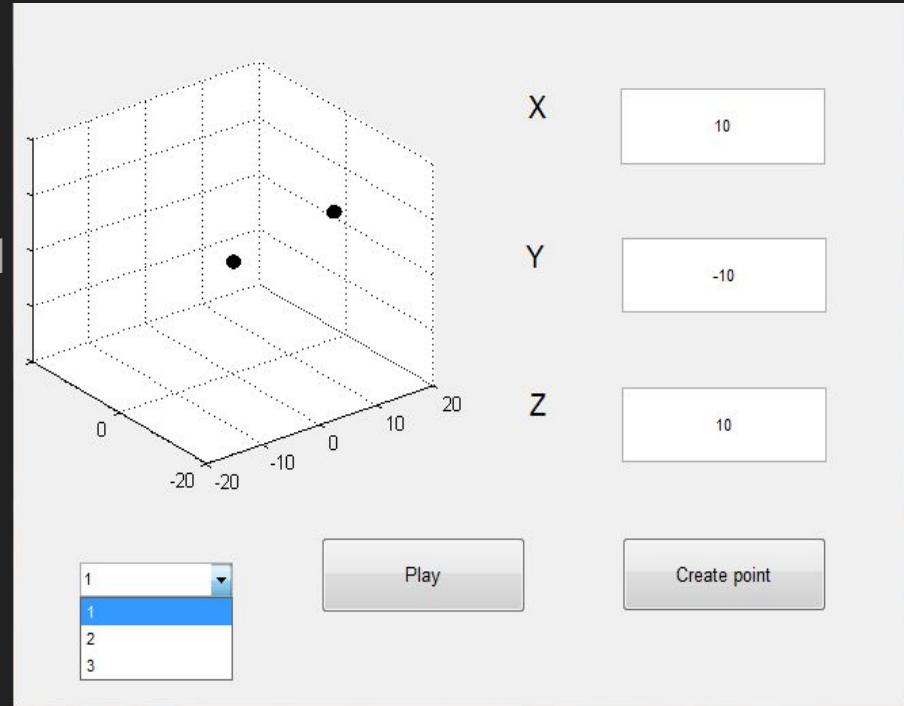
Subsystem 1 - Audio Processing

- Created via MATLAB
- Allows for selection between several data sets
- Allows for real-time processing of audio inputted through microphone
- Includes ability to synthesize via X, Y and Z coordinates



Subsystem 2 - GUI

- Can allow users to input three dimensional coordinates (x,y,z)
- Create point button: plot the input and the original points
- Play button: record sound in the surrounding environment for 5 seconds, and play the processed audio



Integration

- Access the HRTF database through the GUI.
- GUI was created by MATLAB app designer.
- Put GUI and HRTF database in the same folder, and the GUI would call the function and run the audio process

Final Product

- User selects point via X, Y, Z coordinates
- GUI also allows ability to choose between different subjects data sets
- This information is passed into audio processing block
- Data for the location is convolved with microphone input for given duration

Future Developments

- Convert MATLAB code to C for easier portability to hardware
- Implement hardware solution which allows for multiple users
- Calculate position of sound relative to user in real time, depending on movement of users head

Summary

- Attempting to increase ability to communicate in helicopters
- Must emulate 3d audio based on easy to use GUI input
- Implemented 3d emulation using Head Related Transfer Functions
- Implemented via MATLAB
- Using HRTF database created by UC Davis
- Worked around issue of inaccuracy via allowing for selection between different models
- Future plans include hardware implementation as well as accounting for head movement