6.111 Project Checklist

Auditory Localization

Francis Wang and Keshav Gupta

Commitment

- I2S interface
  - Generate clocking signals for the I2S microphone receive I2S data
- AXI4-Stream interface input
  - Generate control signals to feed data into the AXI4-Stream interface
- AXI4-Stream interface output
  - Generate control signals to receive data from the AXI4-Stream interface
- UART transmitter
  - Generate UART signals at a data rate of 1000 KBaud
- UART packetizer
  - Generate delay profile data packets according to our agreed upon protocol
- UART receiver
  - Receive UART signals at a data rate of 1000 KBaud
- UART depacketizer
  - Receive delay profile data packets according to our agreed upon protocol
- NTSC receiver
  - Receive and decode NTSC camera data
- VGA transmitter
  - Generate signals for display on VGA monitor
- Delay peak detection
  - Identify and extract delay profile peaks from background noise

Goals

- Implement upstream signal processing hub
  - Sample contiguous segments of audio data and feed it into the signal processing core
- Implement downstream signal processing hub
  - Receive delay profiles from the signal processing core and transmit it over UART
- Functional block design implementation of the GCC-PHAT algorithm
  - Chain together the appropriate FFT and CORDIC IP cores to implement the GCC-PHAT algorithm, potentially with downsampling, reduced bus widths and/or reduced packet sizes

- Adequate auditory localization
    - Demonstrate a localization error of less than 25% of the field of view of the camera
- Mapping of signal peaks to screen coordinates
    - Convert peaks in the delay profiles into screen coordinates
- Overlay of detected peaks on video output
    - Display the inferred direction of the sound source as a dot/circle on the VGA display

Stretch goals

- High precision data processing
    - Use a bus width of at least 12 bits for the signal processing core
- Large packet sizes
    - Use FFT modules with a length of at least 1024 samples per frame
- High frequency data output
    - Generate delay profiles at a frequency of at least 30 FPS
- Accurate auditory localization
    - Demonstrate a localization error of less than 10% of the field of view of the camera
- Bug squashing game
    - Demonstrate a game where there are bugs crawling on the screen and clapping at the location of the bugs will “kill” them