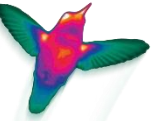




(U) LMSBF Capstone Project Concept 2026



Background



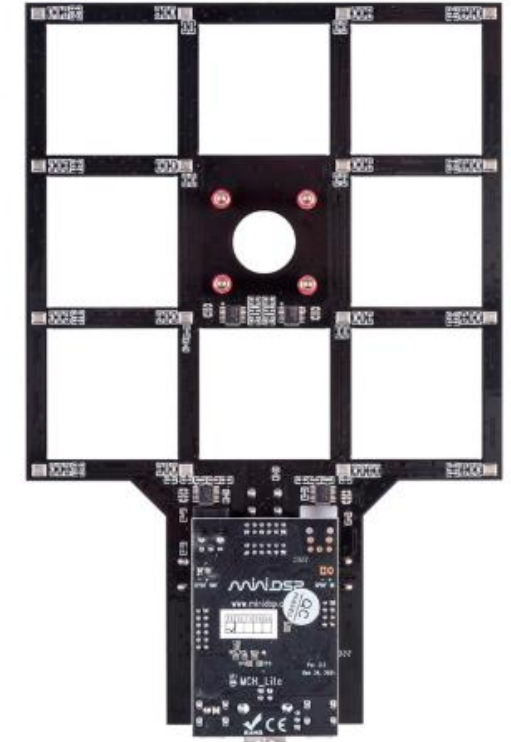
- Imaging systems are not limited to visible, infrared, or radio frequency receivers. Nearly any transmitting media can be used to generate images with enough receiving elements and a way to reconstruct and output data
- Recent developments of home automation assistants have been developing acoustic microphone arrays to gather listen and gather data more intelligently in peoples' homes to collect more information than just the sounds and frequencies emitted
- Acoustic cameras can be developed by utilizing an array of acoustic microphones coupled with data converters and audio processing to pinpoint sound sources in space and determine information about that sound signal
- LMSBF has a long history of developing Infrared imaging sensors and many of the design concepts in this project are parallel to other camera design principles to learn readout integrated circuit concepts and camera electronics concepts

Acoustic Camera Project Description



- **Problem Statement:** Create a custom CMOS ASIC to acoustically detect the location of the sound in space using an acoustic camera array
- **General Project Outline**
 - Test the ASIC design in an FPGA to prove out design ahead of tapeout
 - Design and tapeout of audio processing CMOS ASIC to receive digital data from microphone streams
 - Process the information from the microphone array to determine the location of sound
 - Display the video output with the location of the sound in the video
- **(Stretch Goal) Display the frequency content information of the sound at the detected point in space**
- **Acoustic Camera circuit card assembly consisting of**
 - Microphone array
 - Signal conditioners and A/D converters,
 - Audio processing ASIC
- **Integrated ASIC onto circuit card assembly with required support circuits: ADC's power supplies, and interfaces**

Example Acoustic Camera



Key Skills for the Project



- **System Architecture**
 - Create and Design ASIC Requirements, Concept, and Schedule
- **VHDL and FPGA Generation**
 - Rapid prototyping of detection algorithms that will be implemented on the ASIC
 - Use FFT and acoustic signal processing to create detection algorithms
- **IC Design and Simulation**
 - Digital ASIC design in TSMC 65nm or similar CMOS node
 - RTL Code and Synthesis layout and validation of blocks
- **IC Layout & Tapeout to Foundry**
 - Plan and complete a floorplan for the ASIC
 - Create and validate IC layout with DRV/LVS tools
 - Tapeout ASIC design to a foundry for a MPW (Multi-Project Wafer) Run
- **Printed Circuit Design & Layout**
 - Interface between a PCB and ASIC
 - Video output and data protocols
- **Hardware Assembly & Debugging**

Industry Collaboration



- Project team to develop and present project scope and plan for LMSBF mentors to review and approve
- Project team to develop ASIC design requirements and concept for review by LMSBF mentors
- LMSBF mentoring during project to provide feedback, track progress, and teach students about ASIC design process and methodology
- Mentors from LMSBF will work collaboratively with student design team to create a camera ASIC design to be used in a demonstration by the end of the project
- US citizenship required for participating students

