



**CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY**

Name(s) Robert C. Henning	Project Number 35587
Project Title The Exchange Improving Unit: An Auditory Device for Directional Filtering	
Abstract Objectives/Goals There is a fundamental limitation inherent in standard hearing aid devices- due to the fact that they amplify all ambient noise, use in noisy environments is both irritating and isolating. The purpose of this project was to develop a device that would enable users to actively filter signals, directionally, to be more comfortable with more situations. Methods/Materials This was developed by beamforming the harmonic components of the signal received from four microphones and rejecting components that originated from undesirable directions. The real-time processing was performed by an FPGA calculating phase shifts through an FFT and attenuating frequencies based on a localization and parameter-analysis algorithm that was refined through testing. Results The results indicate that this system is a viable solution to assist hearing aid users for conversational, meeting, and other spoken sources. The restrictions in the dynamic potential currently limit the quality of music and similar sounds, especially in increasingly louder environments. Conclusions/Discussion The benefits of this system over others, such as shotgun-microphone based aids is that this device can work with multiple voices, as in a group setting, and only needs to be set-up once in a new configuration of sources. Although this device still has extensive refinement needed for future production, the essential technological components were proven to function at ideal levels.	
Summary Statement This project helps hearing aid users by removing sound from undesirable directions in noisy, public environments.	
Help Received Emailed a local professor while learning basic concepts; all research was done independently and at home.	