Identification and Significance of Innovation

The International Space Station (ISS) needs to keep quiet to maintain a healthy and habitable environment in which crewmembers can perform long-term and uninterrupted scientific research under microgravity conditions. Acoustic survey is now performed once every two months using hand-held devices at about 60 locations on the ISS. It takes a significant amount of precious crew time and this sporadic nature in both space and time makes the current monitoring program unsatisfactory. NASA has defined a need for an automated, continuous acoustic monitoring system that is efficient in power consumption (long battery life), accurate, highly integrated, wireless connected, scalable, small and lightweight. WeVoice Inc. proposed to develop a ZigBee-based wireless sensor network for acoustic monitoring to meet the challenges. In Phase I, the feasibility of the proposed new acoustic monitoring system was validated. During Phase II, a prototype system that can offer real-time demonstration was successfully developed and it has been delivered to NASA for testing.

Technical Objectives and Work Plan

The technical objectives encompass the following:

1) Fixed the problems identified during Phase I and improve the sensor design to meet the technical requirements.
2) Build an MEMS microphone array that implements the novel ideal conceived in Phase I and assess its performance with test data to determine whether it can be used in this project.
3) Measure the typical power consumption of the sensor and determine the type of battery to use.
4) Miniaturize the sensor design and build nice enclosures for the sensors (both sound level meters and noise dosimeters).
5) Implement and test the signal processing algorithms for acoustic monitoring and analysis developed in Phase I on the constructed hardware systems.
6) Write a software program with a nice graphical user-friendly interface that runs on a host computer (either a laptop or a touchpad) to control the ZigBee-based Acoustic Monitoring (ZAM) system and display results.
7) Make an in-situ calibration plan for the sensors.
8) Demonstrate the ZAM prototype system in an NASA ground facility (JSC ANCL).

Task 1: Improve the data collection subsystem
Task 2: Design and fabricate an MEMS microphone array and test its performance
Task 3: Implement the developed signal processing algorithms for acoustic monitoring and analysis in C and port them to the ZEDs
Task 4: Measure the power consumption of the ZED and determine the type of battery to use
Task 5: Miniaturize the ZED design and create a simplified version for noise dosimeter
Task 6: Build a set of ZAM devices
Task 7: Design and build enclosures for the ZEDs

Task 8: Develop a software program for ZigBee network management and port it to the ZC
Task 9: Develop a software program that collects data from the ZC and visualizes them on a host computer
Task 10: System integration and optimization
Task 11: Make an in-situ calibration plan for the ZAM system
Task 12: Demonstrate the ZAM system in NASA JSC ANCL
Task 13: Draft and release the first ZAM prototype
Task 14: System delivery and documentation

NASA and Non-NASA Applications

NASA Applications: 1) Acoustic monitoring on the ISS, and 2) Noise survey on future NASA manned or unmanned spacecraft

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NON-PROPRIETARY DATA