USE OF SONIFICATION FOR SPACECRAFT SITUATIONAL AWARENESS APPLICATIONS

BACKGROUND
Due to the round trip communications delay time, NASA’s deep space missions will be challenged with providing the crew with timely notification of vehicle/habitat system issues. Moreover, it is expected that these vehicles and habitats will be highly-complex with many systems and possible modes of failure which could overwhelm the crew with caution and warning messages in off-nominal situations. In the case of the crew area going dark (no displays), the only means of vehicle status is auditory. Hence, new methods of notifying the crew on the status of the vehicle need to be investigated.

PROBLEM DESCRIPTION
Develop a sonification annunciation system that provides a sonification of caution and warning messages based on the current definition of the International Space Station Caution and Warning (C&W):

**Emergency** - there are three types of emergency: Toxic Atmosphere, Rapid Depress, and Fire. These are events that cause a life-threatening condition for the crew and thus require immediate action by all crew members. The tone is a repeating beep of a single frequency.

**Warning** - a hardware or software failure that requires immediate corrective action by at least one person to avoid major impact to the mission or potential loss of the vehicle or crew. The tone is repeating beeps of two different frequencies (sounds like a French police siren).

**Caution** - a condition that is not time critical in nature and identifies impact which, if left uncorrected, may become a Warning. The tone is a single continuous tone.

**Advisory** - messages that provide information about systems status and processes. There is no aural tone for an advisory.

The system is to simulate a limited set of vehicle sensors and annunciate the appropriate sonification output. The system should have a user interface to permit modification of the sonification outputs as well as silencing/acknowledging the alarms.

**Constraints:**
- Use commercial components (This is a proof of concept prototype)
- Each sonification annunciation should be able to be inhibited/silenced.
- Annunciation output sound pressure level should be a max of 80 dBSpl measured at 1 foot.
- Annunciation output should be adjustable in increments of 3 dB from 0-80 dBSpl.

**Deliverables:** Schematics, block diagrams, software, operational description of the system. Bill of materials,

**DESIGN TEAM PROFILE**

<table>
<thead>
<tr>
<th>NASA MENTOR:</th>
<th>George Salazar</th>
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<tbody>
<tr>
<td>LEVEL:</td>
<td>Upper Division [JR/SR];</td>
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<tr>
<td>MAJOR / DISCIPLINES:</td>
<td>EE, CE</td>
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<tr>
<td>AREA OF RESEARCH:</td>
<td>Audio/sonification and spacecraft systems</td>
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<tr>
<td>TEAMS:</td>
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<td>DURATION:</td>
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