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The Problem

- Psychological stress from prolonged space missions
- Need a device that may quickly relieve this stress
- A reduction in stress helps a crew member better focus on the task at hand
- Safety of autonomics is of utmost importance

Motivation

- Why this is a good project
- Incorporate designs from multiple disciplines
- Provide experience in integrating user, mechanical, and software interfaces
- Requires the design and testing of an induction heating system

Psychological Effects of Sleeplessness

- Autonanias currently spend on average 4 hours per day, which could be years
- Given the extended duration of future missions and the isolated, confined and extreme environments there are:
  - Possibilities that adverse cognitive or behavioral conditions will occur affecting crew health and performance
  - Mental disorders that could develop should adverse behavioral conditions be undetected and unattended
- Behavioral Health and Performance (BHP) research addresses the risk of adverse behavioral conditions and psychiatric disorders developing during or following a long duration mission.
- BHP also develops countermeasures for maintaining behavioral health and enhancing performance during long duration isolated, confined, and highly autonomous missions.

An ODS could aid as a countermeasure

Functional Flow Diagram

Error Handling

- ODS dispensing the wrong scent
- Incorrect blending of the aroma
- The HCL not stimulating the hardware correctly
- Activation with an empty cartridge

Constraints

- Cost – we cannot exceed given budget
- Schedule – individual teams may have issues meeting
- Technical – expressed as minimum deliverables by Sponsor
- Activation with an empty cartridge

Safety Concerns

- Touch temperature test on the housing cannot exceed TEP(7)
- Physiological reaction with Fragrances
- Malfunctioning of the device causing premature activation
- Interferring with existing systems

Skills Learned

- Interdisciplinary Cooperation
- This Project will incorporate skills including: Mechanical and Electrical Design, Psychological Testing, as well as Development of Chemical Substances.
- Learning to see challenges as an opportunity for growth rather than focusing on the negative points of a situation.
- Working within a given budget
- Collaborating with team members during high stress situations

References

- Ref[2]: Dr. Larry Larson (Technical Sponsor)
- Ref[3]: "Psychology and Smell." Fifth Sense.
- Ref[4]: "Midterm Report Devices Behavioral Health and Performance (BHP) research addresses the risk of adverse behavioral conditions and psychiatric disorders developing during or following a long duration mission."
- Ref[7]: "Midterm Report Devices Behavioral Health and Performance (BHP) research addresses the risk of adverse behavioral conditions and psychiatric disorders developing during or following a long duration mission.
- Ref[9]: "Midterm Report Devices Behavioral Health and Performance (BHP) research addresses the risk of adverse behavioral conditions and psychiatric disorders developing during or following a long duration mission.

Environmental Boundary Conditions

- The ODS is designed for use under normal working conditions on the surface of the Earth.
- This proof of concept does not take into account the amount of radiation (due to both solar flares and galactic cosmic rays) and possible implications of micro-gravity brought about by the extra-terrestrial environment.
- The presence of micro-gravity will inhibit the aromatic dispersion because heat will not necessarily travel upwards.
- These extra-terrestrial conditions must be considered if implemented in an extra-terrestrial environment.

Induction Heating System

- A solid state RF power supply sends an AC current through an inductor (often a copper coil), and the part to be heated is placed inside the inductor.
- When a metal part is placed within the inductor and enters the magnetic field, circulating eddy currents are induced within the part.
- These currents flow against the resistivity of the metal, generating precise and localized heat (the joule effect).
- Heat is also produced through hysteresis (internal friction)
  - Based on a magnetic material resisting a change in the magnetic fields
  - This internal friction generates heat
- Since heat is transferred to the product via electromagnetic waves, the part never comes in direct contact with any flame.
- The inductor itself does not get hot and there is no product contamination.
- When properly set up, the process becomes very repeatable and controllable.

Performance

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Part Condition</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Supply</td>
<td>12 V ± 1%</td>
<td>10</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td>Power Source</td>
<td>12 V ± 1%</td>
<td>10</td>
<td>14</td>
<td>12</td>
</tr>
</tbody>
</table>

Software

- The user will interact with the system by tuning the device, entering data on the keypad. The ODS will prompt the user for a response and then release an aroma to the user.

Astronauts currently spend on average 6 months in space, however in the future it could be years.

References

- Dr. Larry Larson (Technical Sponsor)
- "Psychology and Smell." Fifth Sense.
- "High Frequency Induction Heating." (http://www.richieburnett.co.uk/indheat.html
- "Midterm Report Devices Behavioral Health and Performance (BHP) research addresses the risk of adverse behavioral conditions and psychiatric disorders developing during or following a long duration mission.

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