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System Features

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Atmospheric Data Analysis Officer Interfaces

System Feature: Ocean Temperature Interface Window

Introduction/Purpose of feature

The Atmospheric Data Analysis Officer (ADAO) needs to be able to monitor the ocean temperature around the world, so emergency services can have the necessary equipment ready for landing. Furthermore, the ADAO need to inform the astronauts what kind of weather conditions they should expect when landing, e.g. wind velocity, likelihood of storms, tidal reports, etc.

A network of weather satellite, which is simulated by the International Space Station Server (ISSS), collects data to make the simulation.

Stimulus/Response sequence

As part of the ADAO's role to monitor the weather on earth, the ADAO needs to inform the Mission Director of any change in ocean temperatures that could affect the mission, especially concerning landing.

Associated functional requirements

1. The data coming from the ISSS needs to be refreshed on the order of once a minute.

Functional requirements

1. Display a labeled, dynamic map of the world.
2. Ocean temperatures for selected locations around the world need to be displayed to the user on the map.
3. The temperatures need to change accordingly to the data received from the ISSS with temperatures ranging from 0 to 45 degrees.

System Feature: Weather Interface Window

Introduction/Purpose of feature

The ADAO needs to monitor weather data from around the world, especially extreme phenomenon such as cyclones, which could interfere with the communication of data between the International Space Station and the Mission Control on earth.

A network of weather satellites, simulated by the ISSS, collects data to be displayed symbolically to the ADAO.

Stimulus/Response sequence

The ADAO should inform the Mission Director of any civilian risks due to hazardous weather conditions, in addition to advising the Mission Director on the landing conditions and the necessary timing for space shuttle decent.

Associated functional requirements

1. The data coming from the ISSS need to be refreshed on the order of a minute – up to 5 minutes, or down to 30 seconds, depending on divergence of data.

Functional requirements

1. Map of the world is an essential graphical interface.
2. Cyclones need to be displayed on the map, using graphics to indicate the location of the cyclone, which is based on data received from the ISSS.

System Feature: Photo Database Interface Window

Introduction/Purpose of feature

During the mission a number of images are collected. The images will be coming from the experiments that will take place during the mission or other images uploaded to the database, such as weather maps, images of the sun, satellite deployment, etc.

The ADAO will need to have access to this database during the mission and will be able to look through all the images stored and have them displayed within the program.

Stimulus/Response sequence

The Photo Database allows the ADAO to visually monitor many aspects of the mission. This allows the ADAO to assist the Mission Director in decision making.

Associated functional requirements

1. The storage of images and their availability to the ADAO is to be handled by the ISSS, with images transmitted to the ADAO client on request (given appropriate permission from the simulation or supervisor).

Functional requirements

1. System needs to load the images from the database.
2. System needs to display the images on the screen.
3. The ADAO need to be able to browse through the images available in the database and have then displayed on the screen individually.

System Feature: Magnetosphere Interface Window

Introduction/Purpose of feature

The Earth's magnetosphere protects it from ionizing radiation from solar winds and flares. In LEO (Low-Earth Orbit), where the ISS is located, the magnetosphere is fairly stable in strength. Nonetheless, exemplary events such as a solar flare will produce measurable chances in magnetosphere strength, which may be used as advanced warning of increasing radiation levels or communications disruptions.

Stimulus/Response sequence

The ADAO is required to monitor the magnetosphere strength and report to the Mission Director any anomalies that may effect the mission, considering primarily the maintenance of astronaut safety and station-to-base communications.

Associated functional requirements

1. The ADAO client window is to interact with the ISSS to update the magnetosphere strength for selected locations.

Functional requirements

1. A graphical image to display the Earth's magnetosphere.
2. Magnetosphere strength for selected locations is to be displayed on the Earth's magnetosphere image.
3. Also a graph is required to display the history of the magnetosphere measurements.

System Feature: Ozone Interface Window

Introduction/Purpose of feature

Ozone (O_3) is a blue, highly reactive oxidizing agent which is an extremely poisonous gas. It is created primarily by electrical activity in an oxygen atmosphere – e.g. lightning on earth, or perhaps faulty electrical equipment on the ISS. Medium concentrations can cause nausea and throat irritation. High concentrations can be lethal. In isolated and confined spaces such as the International Space Station the quality of the air needs to be monitored continuously. Therefore ozone levels need to be regularly tested, and appropriate measures taken if they exceed safe limits.

Stimulus/Response sequence

The Ozone levels should be monitored and harmful levels should be reported to the astronauts, so they can (temporarily) evacuate the effected areas.

Associated functional requirements

1. The ISSS is to generate test data for the ozone measurements and communicate this data to the ADAO client.

Functional requirements

1. A schematic of the International Space Station
2. A legend to identify the current ozone levels in different areas of the International Space Station.

System Feature: Ionising Radiation Interface Window

Introduction/Purpose of feature

During the mission the ionising radiation levels will be changing outside the station, due to variations in the solar winds and as a result of significant solar events, such as solar flares or coronal mass ejection. The radiation level outside the station is proportional to the radiation levels inside the station, particularly in modules with portals. High radiation levels pose a significant danger to the astronauts, leading to long-term illness or even short-term acute effects, such as nausea. It is therefore the ADAO's responsibility to warn if the radiation level increases to an extreme level, allowing astronauts to take appropriate action (such as relocating to modules with higher radiation shielding).

The data will come from sensors outside the space station, which will be simulated by the ISSS.

Stimulus/Response sequence

When the radiation level rises above 70 RAD, a warning alarm will sound. The ADAO then needs to warn the Mission Director using the warning button on the screen.

Associated functional requirements

1. An alarm should trigger (audibly and visually) when the radiation level exceeds 70 RADs.
2. The data coming from the ISSS need to be refreshed on the order of seconds – possibly as quickly as twice a second.

Functional requirements

1. A graph of the radiation level should be displayed on screen and show the radiation level as recorded over the last 2 minutes (at a minimum).
2. An image of the International Space Station needs to be displayed, with appropriate highlights to symbolically convey the radiation level to the operator.

Station Electrical Power Systems Officers Interfaces

System Feature: Device Controls Interface Window

Introduction/Purpose of feature

In the event of the International Space Station loosing power, the Station Electrical Power Systems Officer (PHALCON) is able to turn off non-critical systems to save power. Power losses could occur for a variety of reasons, including:

- Accidental damage
- Excessive power usage
- The space station orbiting the night-side of the Earth (eliminating any power generation from the solar panels)
- Current leakage
- Electromagnetic interference (caused by solar flares, etc).

The collective power production and consumption is shown to the PHALCON's window so it is possible to monitor when the net power flow approaches a loss – at which point the PHALCON needs to rectify the problem(s).

The data used for this is generated from the ISSS.

Stimulus/Response sequence

If the available power decreases, PHALCON may be forced to turn off some of the non-critical systems. He is able to turn off the heating, lighting (all lighting or just switch to emergency lighting), or thermal operations (e.g. heat exchangers). After PHALCON has selected a subsystem to turn off, more power will be available to the remaining operational systems.

Associated functional requirements

1. When turning off one of the non-critical systems, the net power flow should increase appropriately.
2. The data coming from the ISSS need to be refreshed on the order of every second – more frequent updates may be necessary as a result of the impulsive behaviour of the electrical systems.

Functional requirements

1. A status-bar is required to display the current heating level and heater power consumption (within the space station).
2. It should be possible to increase or decrease the heating, which should update the status-bar showing the current heating power consumption.
3. Power to the thermal operations can be increase or decrease.
4. It is necessary to be able to switch between normal and emergency lighting.

System Feature: Communications Antenna Interface Window

Introduction/Purpose of feature

One of the most important responsibilities of the PHALCON is to maintain communication between the International Space Station and Mission Control. Factors like weather on Earth and the location of the space station can influence the signal strength. PHALCON needs to monitor the signal strength and take the appropriate actions to make sure that the communication systems are working correctly.

The data used is generated by the ISSS.

Stimulus/Response sequence

In order to maintain communications with the space station, PHALCON needs to make sure that the signal strength does not drop below 70%, at which point data corruption or loss begins to occur. PHALCON has several tools by which to control signal strength:

- Increase antenna power to increase the signal strength (keeping in mind the effect of this increased power usage)
- Turn off either the Data Interface or Communication Interface and that way gain more power.
- Use Auxiliary power to offset the effect of increasing antenna power. After this option is exercised the batteries needs to be recharged, to prevent them becoming exhausted (and consequently unavailable).

Associated functional requirements

1. An alarm must sound if the signal strength drops below 70% strength.
2. If power is increased in order to increase signal strength the total power available should decrease.
3. If either the Data Interface or Communications Interface is turned off the total power available should be increased.
4. If Auxiliary Power is used the total power available should be increased. Furthermore, the batteries used should be depleted by an appropriate level, and require recharging.

Functional requirements

1. It is essential to provide toggle on/off switches for the Data Interface, Communication Interface and Auxiliary Power.
2. A status bar is needed to indicate the signal strength.
3. Another status bar is required to display the electrical power consumed by the communication antenna system.

System Feature: Experimental Racks Interface Window

Introduction/Purpose of feature

The International Space Station provides a unique opportunity to conduct research into physical phenomenon. A wide range of experiments is performed on the space station. These experiments are powered by racks. It is critical that the laboratory does not loose power during an experiment, which leads to erroneous results. Therefore power must be maintain during an experiment.

Stimulus/Response sequence

PHALCON is to maintain power to the experimental racks during an experiment. Although it may be necessary to inform the astronauts that an experiment needs to be halted or ended due to limited power supply. eg The space station could orbit the night-side of the Earth, resulting in no solar power.

Associated functional requirements

1. This interface should graphically show each experimental rack individually, in order to change their parameters.

Functional requirements

For each rack:

1. Display a Power consumption meter.
2. The ability to increase or decrease the power consumption.
3. A thermometer to measure the temperature.
4. A thermostat to adjust the temperature.
5. A toggle switch to turn on and off the experimental rack.

System Feature: Solar Panels Interface Window

Introduction/Purpose of feature
The Solar Panels is the main source of power for the International Space Station. The maintenance is a highly critical for the mission success. Although the supply power is not constant as it depends on the orbit of the space station. Therefore the solar panels are connected to auxiliary batteries which are recharging during solar exposure and discharging otherwise.

Stimulus/Response sequence
PHALCON is responsible for distributing the generated power. The excess generation (that is power not allocated to the experimental racks, communication antenna, etc.) is to charge the auxiliary batteries. If power is disrupted due to solar flares or other unforeseeable events the power must be re-distributed to emergency operations only. The Mission Director must be informed of any action taken to rectify the situation.

Associated functional requirements

1. All data must be generated by the server and communicated with the PHALCON client.

Functional requirements

1. A current measurement of the amount of power which is generated
2. A graph of the power received from the solar panels.
3. An image of the space station orbiting around the sun

System Feature: Fuel Cells Interface Window

Introduction/Purpose of feature
The solar panels is the main power source for the space station, however the generation suffers from large fluxuation. To counter-balance the power variation fuel cells are used. At the start of the mission the fuel cells are replenish with the shuttle supplies.

Stimulus/Response sequence
PHALCON is to maintain power to all the necessary devices. A fuel cell may freeze or overheat and in such cases become unavailable. It is PHALCON responsibility to adjust the power consumption to handle the situation.

Associated functional requirements
The required information must be generated by the ISSS and sent to the PHALCON client.

Functional requirements

1. A power output meter for the solar panels
2. A combine oxygen and hydrogen meter to display how much fuel is left
3. A visual array of the fuel cells banks.