



## BACKGROUND

Plans call for human *cislunar operations and lunar surface access*, to prepare for eventual Mars missions. NASA will also develop new opportunities in lunar orbit that provide the foundation and act as a gateway for human exploration deeper into the solar system. Current human spaceflight is complex and requires as many as fifty people to support the International Space Station (ISS) Mission Control Center (MCC) in Houston, Texas. These flight controllers in the front and back rooms of the MCC, serve as an extra pair of eyes overseeing the numerous station systems. Deep space missions - to the moon, Mars, and beyond - will be more complex and place challenging mission constraints on the crew. As the round-trip communication delays increase in deep space exploration, more onboard systems autonomy and functionality is needed to maintain and control the vehicle. These mission constraints will change the Earth-based ground control approach and will demand efficient and effective human-computer interfaces (HCI) to control a highly complex vehicle or habitat system. One approach to consider is the use of machine learning in an HCI application to help reduce the use of the interface by a crew member having difficulty, perhaps due to health issues. The system monitors the user's use of the display and controls system and note crew usage patterns (key touches, etc.) that could potentially detect user's display and control performance. The system should be able to see a trend in usage degradation and provide caution and warning messages due to sub-performance display and control usage (based on known optimal usage from the user). For critical events such as a fire, the system should be able to correct user errors that could lead to a hazard by initiating automatically the correct system command. To better understand the use of new HCI systems applications concepts, a means of developing and demonstrating said capabilities is needed.

## PROBLEM/DESCRIPTION

Develop a proof-of-concept (POC) MHIS that adapts displays and control crew usage to the situation and the user over time. To constrain the problem, use the following situation as the starting point to develop the POC system:

- A Habitat, the crew uses a D&C system for:
  - o Selecting/viewing critical habitat parameters such as temperature. Pressure, Co2, etc. and turning on/off systems as needed.
  - o Handle an emergency such as fire and having to close off several valves and activating fire suppression systems.
  - o Bringing up a standby system such as aux power.

The system should be able to detect what crewperson it is and retrieve their personality file that contains information about their use of the display. As the crew uses the display, the system can detect sub-performance (more than two key/switch errors) based on previous optimal performance operation and issue warning—both audio and visual such as warning about usage performance. For a said emergency situation, the system should be able to correct a critical mistake and activate it automatically like fire suppression because the fire is intense. Key to this project will be spending time developing the concept of operations and scenarios that will drive the design. Again, this is a POC, and therefore scenarios are very much open such as selecting from oil/gas industry a scenario for developing the system. The key point is helping NASA understand what it would take to develop an MHIS.

## DELIVERABLES

Hardware, Software for the system, User/operations manual that includes block diagrams and flowcharts, schematics, bill of materials, any known issues/bugs, lessons learned.

## DESIGN TEAM PROFILE





TOPIC # - TDC - 61 – S22

**MACHINE-LEARNING HUMAN-COMPUTER INTERFACE SYSTEM  
(MHIS)**

<b>NASA MENTOR:</b>	George Salazar
<b>LEVEL:</b>	Upper Division Students [JR/SR]
<b>MAJOR / DISCIPLINES:</b>	EE/CE/CS
<b>TEAMS:</b>	Mentor may accept more than one team
<b>DURATION:</b>	Two-Semester Project

Design Project Topic Offered By:  
NASA JSC, Human Interface Branch

