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Recommended Practice

Human-Computer Interfaces for Space System Operations

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Recommended Practice for Human-Computer Interfaces for Space System Operations

Sponsor

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Abstract

This AIAA Recommended Practice establishes a set of criteria and guidelines for the design of interactive displays that will facilitate the standardization of human-machine tasks related to space system operations. This document is consistent with other standards publications related to human-computer interfaces and allows for project specific extensions. The focus is on the operational details of human-computer interfaces, rather than the structural design of displays.

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1.0 Introduction

The purpose of this document is to promulgate a foundation set of guidelines and criteria for the design of interactive displays that will facilitate the standardization of human/machine tasks related to space system operations. In the context of this document space system operations includes any activity related to the command, control, and monitoring of on orbit objects; along with supporting terrestrial, transport, and communication facilities. There are many standards, guidelines, and project requirements documents related to Human Computer Interface (HCI). While they are of great value, none provides a simple, approved by consensus, foundation for space system operations. The reasons are many but the common ones are that they are too generalized, too complex, or tailored to a specific project or organization. This document is intended to be consistent with other documents related to HCI, allow for project specific extensions, yet be sufficiently simple to achieve industry approval by consensus. As such, it should facilitate standardization for space system operations.

Accordingly, the focus of this document is on the operational details of the HCI as opposed to the structural design of displays that can be found in other more broad-based standards. The intent is to structure basic layout, terminology, and symbology principles so that their general standards herein will be germane to space system operations.

Section 2 presents the specific guidelines and standards for space system operations; and Section 3 lists the basic documentation on which this document is founded.

2.0 Space System Standards

The guidelines and criteria in this section pertain to the satellite command and control specifics of HCI assuming adherence to an underlying windowing standard such as that of X Windows.

2.1 Definitions

The following terms are used throughout this document:

Direct Manipulation Device A device such as a mouse or track ball that allows the operator to manipulate the cursor, and interact with objects.

Icon A graphic representation of a function or action that can be invoked by the user. For example, an icon may represent a satellite subsystem and the function invoked provides detailed information about the subsystem.

Screen A single display surface.

Select The identification of objects upon which an action is to be taken and/or the initiation of an action.

Space system. A combination of space and ground based elements used to achieve a common goal.

Window An area of a screen (usually rectangular) that provides the operator with the functional means to communicate with an application program and through which an application program communicates with the operator. There is no absolute relationship between windows and zones; however, a zone will typically be comprised of one or more windows.

Workstation One or more display surfaces, direct manipulation devices, keyboards and other HCI mechanisms that support one operator position.

Zone A partitioned area of a screen that is utilized for an operational function.

2.2 Guidelines and Criteria

This section delineates guidelines and standards for space system operations HCI.

2.2.1 Usage of Windows

2.2.1.1 Guidelines

Industry windowing environments provide considerable flexibility in a system's ability to maneuver and size displayed windows. This capability when carefully planned and executed broadens the HCI display capabilities for space operations. However, the space system designer must be careful to prevent arbitrary user reconfiguration of the display in a manner that would jeopardize operations by covering critical data on the display.

For real time operational displays, there should be a mechanism to prevent arbitrary reconfiguration of the display by all but specifically authorized operators. Pre-planned tiling techniques can provide flexibility in configuring the content of a display without risk of one window covering critical data display in another. Appendix 1.7 depicts tiling options that could be employed.

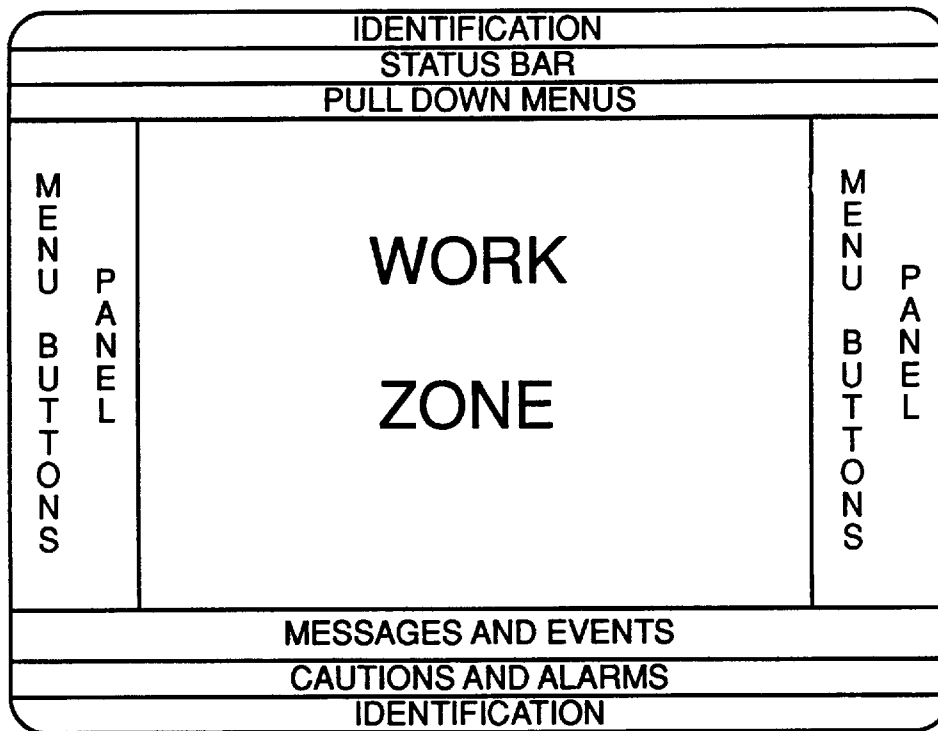
2.2.2 Overall Screen Layout

2.2.2.1 Guidelines

Screens should have a consistent format across all applications within a system so that an operator can expect standard functions to be in the same location. Figure 2.2-1 depicts an example of partitioning of display screens into zones where each zone represents a specific operational function. In this partitioning there is a general work zone in the center of the screen and other fixed communications zones are organized around it. The fixed zones are optional, but, if used, should be placed in accordance with the partitioning depicted. Importantly, since the fixed zones perform critical status and control functions, they should be placed so that expansions such as pull down menus protrude into the general work zone and do not cover other critical control and status zones. The zones are briefly described in Table 2.2-1 below. In addition, Appendix 1.6 presents

Table 2.2-1 Zone Descriptions

ZONE	DESCRIPTION
Identification Zone	Primary function is to indicate security classification of the screen. Other identifying information such as time, and operator position identification may be included provided it is clearly distinct from the classification.
Status Zone	An annunciator bar or panel that provides a high level indication of system/subsystem status via color or shape dynamics. Also provides an ability to select specific system/subsystem items for more detailed viewing.
Alarm Zone	Contains the information for visually indicating conditions that could place mission assets or personnel at risk or impact mission performance.
Message and Events Zone	Displays messages that are tutorial in nature and do not demand operator recognition or action for system operation.
Menus Zones	May be in the form of pull down menu bars or menu panels. Menu panels may also be annunciators.
Work Zone	General area for displaying mission data and conducting dialogues with the operator. Tiling should be considered as a means of reducing the inadvertent coverage of critical information.

Figure 2.2-1 - Screen Partitioning

several suggested detail formats for the respective zones. While the zones vary in size and placement, they have a high degree of commonality in the way information is presented and in operator interaction mechanism. This commonality should be preserved across screens.

2.2.2.2 Criteria

The display screen shall be partitioned into zones appropriate to the operation activity being performed and shall not change during the performance of the activity. In addition, non-work zones shall be positioned so that they are never covered by other display information.

2.2.3 Alarms

2.2.3.1 Guidelines

Alarms are indications of conditions that require or may require operator action to correct or prevent mission degradation or a

threat to life or assets. Importantly, they are distinguished from messages that provide tutorial or event information that simply informs the operator.

The criteria for labeling a condition an alarm is that, at a minimum, an operator response is required. The response may be acknowledgement and possible further follow-up action.

Easily accessible aids should be provided to the operator for alarm resolution. Such aids should, at a minimum provide an expanded description of the alarm, potential impacts, and candidate corrective actions. Expansion into intelligence based resolution support is highly desirable.

Sample Alarm Zone formats are presented in Appendix A-1.5.

2.2.3.2 Criteria

Alarms shall be categorized according to the