8.8 HUMAN FACTORS METHODS IN THE DESIGN OF THE GRAPHICAL USER INTERFACE FOR THE OPEN SYSTEMS RADAR PRODUCT GENERATION (ORPG) COMPONENT OF THE WSR-88D

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1. INTRODUCTION

A concerted effort is underway to develop and deploy an Open Systems solution to components of the WSR-88D. A detailed discussion of this effort is presented by Saffle and Johnson, 1997. The Open Systems solution consists of off-the-shelf POSIX (IEEE, 1995) compliant hardware and operating systems along with new software developed in ANSI C and existing algorithms written in FORTRAN.

The first part of the WSR-88D system being redesigned is the Radar Product Generator (RPG). The primary function of the RPG is to generate and distribute products for various users. It also provides control of the RDA as well as valuable status of the entire system. All of the RPG control operations are performed at the Unit Control Position (UCP), defined as the human-computer interface to the RPG. This paper will discuss some of the shortcomings of the current UCP and the solution being used in the Open Systems RPG (ORPG) with special emphasis on tasks and users' needs.

2. CURRENT UCP IMPLEMENTATION

In the current UCP implementation, users build command strings to control various system operations or retrieve the state of various components using a hierarchial text menu structure. A sample screen is presented as Figure 1. The UCP also provides for the display of various status information. All of these functions are performed at a stand-alone alphanumeric terminal with a monochrome display and single keyboard. Although highly functional from a system capability, these menus are very cryptic and difficult to use from an operator perspective. Many routine tasks are not being performed effectively due to a poor interface.

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                        RPG MAIN MENU                    PAGE 1 OF 1
COMMAND:
FEEDBACK:                                                OPER A/R 21

Select Menu Item

(AD)aptation Data, {PASSWORD#1}          (E)nvironmental Winds Edit Screen *
(AR)chive                                (RD)A Control
(G)eneration and Distribution Control *  (RE)dundant Control
(Selection of Product Parameters         (ST)atus
                                         (T)ime Display
                                         (U)nit Control
                                         (V)olume Coverage Pattern *
                                         (H)elp

NOTE: * Enters edit screen at this point.


05/22/90 10:12:52 NO STATUS CHANGE
05/22/90 10:07:00 The RPG System is in OPERATE MODE
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Figure 1. Sample Existing UCP main menu

Much of the lack of usability cannot be blamed on poor design. It represents the level of technology which existed at the time the WSR-88D system was developed. The traditional approach to system design excluded modern human performance engineering methods. As such, many features were designed from a software implementation perspective (by a computer scientist) rather than from a user perspective (by a human factors engineer). Menu selections were organized on a highly functional level. For example, most of the RDA control functions are organized in a collective set of menus. From a user standpoint, menu groups may be more effective if routine tasks were not buried under several layers of menus just to fit it into a specific category.

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For the novice user, being able to use the UCP to perform a specific task can be frustrating. This increases the importance of training on the current UCP. The amount of time required to adequately train a user to effectively use the UCP can be considerable. With today's tight budgets, training is limited to only a few days. Also, many of the individuals being trained to use the UCP are not the ones who actually use it in the operational environment. It has been suggested that many users will forget most of the commands required to perform specific tasks. In a highly stressful situation (i.e., severe weather), UCP functions that could enhance the operational performance of the radar are not being performed due to the complex, non-intuitive design of the interface coupled with the lack of use or familiarity of the UCP. Therefore, it is desirable to have highly intuitive selections in order to reduce the burden on human memory needed to use the UCP.

3. GRAPHICAL SOLUTION

Many of the problems discussed in the previous section can be addressed using a Graphical User Interface (GUI) implementation of the UCP. A GUI has a major advantage over the current UCP in that considerably more information can be effectively presented to the user. Menus and status displays can be made visually appealing, and more effective. Using a mouse to initiate responses is generally more effective than having the user transfer attention between the screen and the keyboard. Furthermore, complex tasks can be simplified using a graphical rather than textual approach. However, a GUI solution does not guarantee success over its predecessor. Understanding the user within the context of tasks becomes a key element in successful GUI design. There may be advantages in maintaining an established "look and feel" with other popular software packages to be consistent and effective.

Ideally, the first logical step in rehosting the UCP would be to study current UCP users and determine their needs. These are normally the first steps in traditional human factors design. Unfortunately, the limited time and scope of the project put severe limits on what can be done. It would be a mistake to not perform some sort of task analysis and user profiling as the resulting user interface could be as ineffective as its predecessor. Therefore, task analysis and user profiling are being done in parallel with design and prototyping work.

Over the past few years, considerable knowledge has been amassed by personnel in the NEXRAD Operational Support Facility (OSF) regarding the usability of the current UCP. A group of individuals, each with a specific expertise in the current RPG, has been organized into a GUI UCP development team. Through contacts with current WSR-88D users, these individuals are well aware of the strengths and weaknesses of the current system. It is the responsibility of this team to recommend solutions to various aspects of the current UCP. Since no one individual can be considered an expert on all functions of the RPG (it would be undesirable to make the design effort the work of a single individual), at least one member of the team is strongly associated in one of the following WSR-88D aspects: algorithms and adaptable parameters, training, overall system functionality, daily user needs, and human factors. In addition, a software engineer from the National Severe Storms Laboratory (NSSL) is responsible for prototyping and integrating menus and displays and finding solutions to problems related to the UCP. Regular team meetings are held to discuss problems and recommend solutions. As prototypes are developed, they are demonstrated to the GUI team and possible solutions discussed, keeping in mind the needs of the end user and established principles of user interface design. Forms of prototype testing and a refined understanding of user tasks and users are being formulated as a prospect to be inserted into the GUI development process. The revised prototypes are then demonstrated and discussed at a following meeting. Team refinements to the prototypes have led to obvious and substantial improvements in the user interface over time.

It is anticipated that regular demonstrations of the GUI will continue to be provided to students attending WSR-88D operations training at the OSF. Comments are encouraged during and after these demonstrations (either directly or via E-mail). User feedback from future users attending classes at the OSF will add to the usability of the new design.

4. EXAMPLES

The following are examples of parts of the UCP which have been enhanced through the use of a GUI interface.

4.1 Defining Clutter Suppression Regions

An important UCP function which is ideally suited for a GUI is defining clutter suppression regions. The capability to define up to 15 clutter suppression regions allows the user to reduce the amount of contamination in RPG generated products by non-meteorological targets. The current clutter suppression editor provides a tabular listing of various clutter region variables (Figure 2). The interface is very

CLUTTER SUPPRESSION REGIONS PAGE 1 OF 2
COMMAND: AD,PASSWD1,CL,C,11,
FEEDBACK: OPER A/R 21
(M)odify, {LINE#} (DE)lete, {LINE#} (DO)wnload
(E)nd (C)ancel

Region	Start Range	Stop Range	Start Azimuth	Stop Azimuth	Elev Seg Number	Operator Sel Code	Channel ID	Width S
1	2	510	0	360	1	1	3	2
2	2	510	0	360	2	1	3	2
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0

Figure 2. Sample Clutter Region Edit Screen

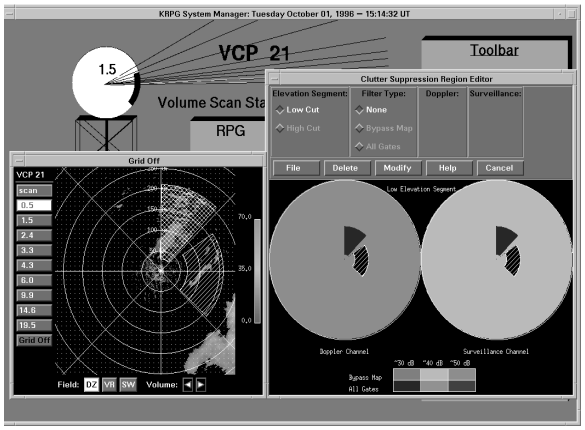
complex and difficult to use. Some of the entries in this table are coded which means the user must interpret what these codes are before placing entries into this table. In addition, no actual

radar data are provided as a basis for defining these regions. The user must first look at a radar data display on the PUP, note the regions suitable for clutter suppression filtering, then return to the UCP and enter the appropriate values in the table.

In the ORPG UCP, a radar display window is provided from which the user can interactively define clutter regions using only the mouse. Another window is provided to display the clutter map as it is defined by the user. Color and texture is provided in the display to associate clutter region boundaries and filter type. Colors chosen to signify different filter types were based on guidelines suggested by Kroemer, 1994. Colors are widely separated from one another by wavelength, making each type easily distinguishable. As each region is defined, a composite map is presented identifying regions where overlap is occurring and which filter type has priority. A sample display of the ORPG Clutter Region Edit Screen is presented as Figure 3.

Figure 3. Sample ORPG Clutter Region Edit Screen

4.2 Status



Another very important function of the UCP is to display the status of various WSR-88D system components. If a major component of the system fails, it is important the user get the information as quickly as possible in order to correct the problem. In the current UCP, status is provided as black and white text only. Major components with serious error conditions are displayed in inverse video. Actual status messages must be read from a long list of messages. Finding the desired status message can be time consuming.

A GUI approach to display status information is very desirable. Shapes can be used to identify system components. Color can be used to convey the state of these components. Visually, this can make it much simpler for the user to interpret. Alarm conditions can be quickly conveyed by flashing a particular component or through the use of color. Textual information about a problem with a component can be presented in pop-up windows after the user selects the component with the mouse.

5. SUMMARY

Work on converting the Unit Control Position (UCP) component of the WSR-88D Radar Product Generator (RPG) is progressing. Rapid prototyping of various key UCP functions with guidance from a Graphical User Interface (GUI) design team is proving to be very successful. The goal of the GUI design team is to make the new Open Systems RPG user interface as easy to use and as intuitive as possible using well-established human factors principles as a guide (Mayhew, 1992).

6. ACKNOWLEDGEMENTS

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7. REFERENCES

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