



*Accelerate Development
Reduce Time to Product
Automate Critical Tasks*

White Paper:
**Designing Resourceful Graphical User
Interfaces (GUIs) for Healthcare Applications**

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GSA Contract #: GS-35F-0561T
CAGE #: 49ZF1
D-U-N-S #:10-252-0355

INTRODUCTION

Designing a Graphical User Interface or GUI may appear simple and a side aspect of an application; in fact it is, perhaps, the most important part of the whole system. This paper will address the general concepts applicable to effective graphical user interface design; explore relevant details of GUIs and present important examples of display methods for healthcare data.

By definition, a GUI is a type of user interface which allows people to interact with a computer and/or computer-controlled devices that employ graphical icons, visual indicators or special graphical elements. An effective GUI includes text, labels or text navigation to clearly present the information and actions available to a user. The actions are usually performed through direct manipulation of the graphical elements. The functionality of an application can be programmed perfectly, but if the GUI is hard to interpret or annoying to use, then the program ultimately will be a failure and the end user will likely choose something easier or more convenient. Creating a simple, easy to use GUI is vital to the success of a software project.

Healthcare related information and data can be complex to understand and communicate; therefore, how the data are displayed and accessed is certainly one of the most critical aspects of a well designed application. Displaying the information in a fashion that efficiently and comprehensively communicates critical facts between healthcare providers and patients is a challenge for the most experienced GUI developer. Users must be able to interpret the data with limited or no assistance and a variety of user skill levels must be accommodated. The process for developing useful GUIs includes several key steps that will be described in this paper; including:

- A. Creating a GUI Design and Development Plan**
- B. Understanding the Key Elements in GUI Design**
- C. Modeling System Interactions**
- D. Designing Screen Layout and User Interaction**
- E. Effectively Presenting the Data**
- F. Reviewing and Verifying the Design**

GUI DESIGN AND DEVELOPMENT PLAN

The FDA mandates that “Each manufacturer shall establish and maintain plans that describe or reference the design and development activities and define responsibility for implementation. The plans shall identify and describe the interface with different groups or activities that provide, or result in, input to the design and development process. The plans shall be reviewed, updated, and approved as design and development evolves.” (Federal Register, Quality System Regulations 21 CFR Part 820.30) This requirement clearly indicates that Design Control is intended to be a prospective activity in the development process. Companies that incorporate a comprehensive up-front planning period into their development projects realize the benefits of on-time delivery; development cost savings and reduced risk of project failure. Proper planning is good development practice not only for FDA regulated applications but essential for any quality development project.

A key part of the Design and Development Plan (DDP) is the delineation of tasks and activities, the assignment to responsible parties and the means of communication between the parties. It is important that the plan also be a documented process with its own set of reviews and approvals. GUI design should be an integral part of the overall Design and Development Plan. Include in the plan adequate time and resources to comprehensively cover the steps necessary to complete a thorough design. This should include a design phase that outlines the objective of each GUI and incorporates the use of “story boards” and prototypes that can be reviewed by the project team prior to beginning the coding phase of the project.

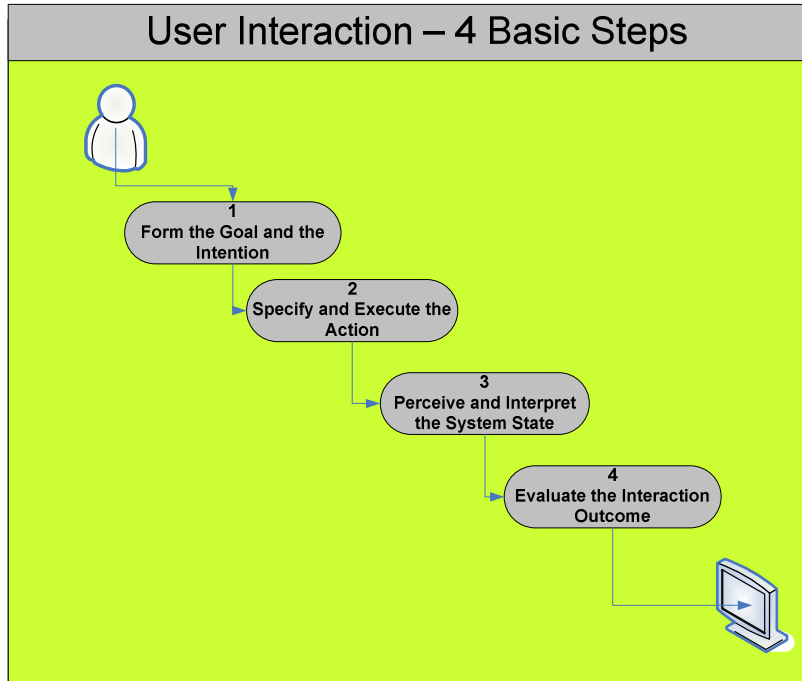
ELEMENTS IN GUI DESIGN

Creating the GUI Design must be a joint task between designers, developers and representative users. Both inexperienced users and power users should be represented. There are a number of principles that should be kept in mind when designing a user interface. These include the following:

- Know your user. It is perhaps the single most cited guideline in user interface guidelines. Yet, sometimes it is hard to make assumptions on your user population. For healthcare applications, is the user a patient, a healthcare provider or an administrator? Does the new application replace or complement a version with established GUIs already familiar to the user?
- Minimize the load on users. This implies providing informative feedback, memory aids, and other cognitive supports. It is also important to ensure that a work session can be easily interrupted for a few minutes without losing the work in progress (people are able to focus attention for a limited amount of time only).
- Preserve consistencies. There are many consistencies to be preserved in a user interface: labeling, terminology, graphic conventions, components, layout, and so on. Many guidelines, principles, and even software design systematic approaches, are oriented towards consistency.
- Ensure overall flexibility, error recovery, and customization. Flexibility is essential when dealing with people. Human beings do err; providing mechanisms to reverse performed actions allows users to explore the UI, preventing them from being trapped in an unrecoverable mistake. The interface should be customizable by the user. Flexibility consists also in providing different usage mechanisms for different classes of users. Novices could use Wizards or other simplified but lengthy means for an easy interaction, while expert users can take advantage of some form of shortcut, all in the same UI. Generally, this is accomplished by providing two distinct interaction paths; one for experienced users and a simplified set of functions for inexperienced users.
- Follow common best-practice standards. There are many standards and guidelines for interactions, abbreviations, terminology, and so on. Standards are essential for cross-application consistency and effective implementation. They ensure professional quality while reducing the design effort. (An example book of standards, “The Essential Guide to User Interface Design: An Introduction to GUI Design Principles and Techniques, 2nd Edition” – Wilbert O. Galitz)
- Elicit this assistance of experts including outside consultants that are experienced and have special skills in GUI development.

MODELING SYSTEM INTERACTION

GUI designers will better understand user requirements if they first prepare a model of the system interaction. One of the simplest approaches to modeling interactive systems is to describe the stages of actions users go through when faced with the task of using a system. As illustrated in the following chart, there are four basic steps for a typical user interaction with a generic interactive system: forming the goal and the intention, specifying and executing the action, perceive and interpret the system state, and finally semantically evaluating the interaction outcome.



SCREEN LAYOUT AND USER INTERACTION

A good GUI goes beyond simply putting pretty graphics on a screen and arranging them in a pleasing manner. The screen layout guides the user experience and should promote usability and be intuitive. Creating and organizing screens requires an experienced GUI developer who understands the users' requirements and can successfully apply current technologies in a manner consistent with design standards. Poorly designed screen layout will frustrate users and likely lead to errors as well as dissatisfaction. The GUI developer should work closely with the users to help meet their needs, desires and goals through screen design. Fundamentals to consider when designing screen layout include:

- The “Home” screen should be the focal point of the application and facilitate intuitive navigation to other screens.
- Keep the windows layout simple; do not display windows in odd areas of the screen where users may miss important information.
- Group content in categories meaningful to the user and assure features that are used frequently are readily available. Too many screens will cause confusion so limit the number of separate/hierarchical screens to a minimum. However good design is a balance; developers

should avoid the temptation to put everything on the first screen or load the toolbar with rarely used features.

- Use logical icons to describe functionality. Users will associate an icon faster than reading text to describe the functionality. For example, display a picture of a clock to indicate time.
- Choose appropriate control design. Controls are visual elements that facilitate user interaction. Examples are menu bars, pull-down menu, cascading menu, pop-up menu, push-button menu, check box, radio button, list box, drop-down list box and slider. Choosing the appropriate control for each user task will result in higher productivity, lower error rates, and higher overall user satisfaction.
- Text should be clear, concise and in the user's language. One of the most common text issues is describing errors in terms only a programmer can understand. For example, "Error-00001: unique constraint (DATA_REPORT_HEADERS_L1) violated." Use words a user will understand such as, "You can't schedule two events for the same time."
- Make the responsiveness/performance of the application fast enough so that it does not interfere with the user's work pace.
- Design for clarity and consistency. Users frequently complain that certain terms are not clear or consistent. For example; one screen may say "Data" while the next screen says "Results" and a third says "Test Data" when all three terms represent the same thing. Another common problem is inconsistently applying "OK", "Cancel", "Close" or "Exit". This lack of consistency ultimately leads to confusion and frustration for users.

PRESENTING THE DATA

Comprehensive reports and displays of data are essential for most healthcare applications since analysis of data is a fundamental task. Follow the basics of design when presenting complex data:

- Make sure the data presentation is simple, logically organized and well labeled. Avoid cluttering the screen with data that is irrelevant to the user.
- Where appropriate present information graphically, such as with charts, bar graphs or moving displays, rather than alpha-numerically. Appropriately apply "drill down" to expand the data back to numeric values for additional information.
- Clearly line up numeric values and always show clear labels with units.
- Don't use all uppercase and keep the number of fonts to a minimum.
- Group related items, drawing a box around them focuses attention. Allow customizable grouping and sorting options to support expert users.
- Make sure the results of clicking a control button are absolutely clear and give feedback on user actions.
- Use color conservatively, conventionally and consistently. Use muted neutral colors for the background. Use dark characters on a lighter background. Minimize the number of colors and make these as distinct as possible. Don't make color the sole source of information - use labels or position to clarify.
- Provide visual feedback. If operations are going to take longer than 10 seconds, provide a progress indicator.

GUI DESIGN REVIEW AND VERIFICATION

The final step in designing GUIs is review and verification from Users Groups. Specifically select both novice and expert level users. Allow the users to navigate the GUI without assistance and record the areas that impede interaction. Also provide the users a standard protocol of actions in order to make certain all areas of critical functionality are covered. Review feedback from users as well as the user's "productivity" and ease of use. Even the most experienced of GUI designers will learn from watching users navigate the application.

CONCLUSION

Creating resourceful GUIs requires upfront documentation, planning and drafting of story boards and/or prototypes that serve as the basis for the design. To start the development process for FDA regulated healthcare applications, a development plan is required to describe and define responsibilities for implementation. When it comes to great GUI design, several key points ensure that the developer concentrates on the right areas. The main idea of a GUI is to accommodate an interface with the application's user in an intuitive and simple manner. The GUI should be out of the users way until functionality from the GUI is needed at which point that functionality should be obvious and easy to locate. Creating a model of system / user interactions helps GUI designers better understand the user's view and requirements. The GUI should be responsive and provide the user immediate feedback to confirm that an action has been performed. Focusing on the fundamentals for screen layout and user interaction will assure that screens guide the user experience in an insightful and practical manner. No detail should be over looked so that multiple ways to execute each function are provided and the GUI has a feeling that it is well-put together. When presenting data for healthcare applications, it is a challenge to make the information easy to review and analyze. Keeping the presentation simple and graphical, with a clear and concise view will increase user satisfaction. Finally, soliciting feedback from users who represent a variety of system interaction skill levels is a necessary step that gives the designers confidence they have created an effective and efficient design. Overall the usability and quality of the GUIs can make or break a project's success.

ABOUT THE ASHVINS GROUP

The Ashvins Group Inc. is a team of IT consultants who design, develop, test and implement custom software and data management projects. The Ashvins Group is a Florida corporation since 2000 and classified as a Women Owned Small Business. We offer Full Life Cycle Application Development and Validation services with a specialty in healthcare, medical and clinical data management applications. Our expertise includes FDA and HIPAA compliant applications development.

The Ashvins Group applies disciplined application development industry standards combined with our unique Rapid Development Methodology (RDM) and project management practice to achieve client goals. As Development Accelerators, the Ashvins Group will enable clients to meet their critical objectives effectively while reducing time to implement and managing expenses. We utilize controlled processes and apply rigid documentation practices commensurate with healthcare industry compliance requirements and regulations. For additional information see our website at www.ashvinsgroup.com and contact us at info@ashvinsgroup.com.