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User Interface Design Issues for Easy and Efficient Human Computer Interaction: An Explanatory Approach

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***Abstract—User Interface (UI)* is the part of the system that acts as an intermediately between the user and system facilitating the user to interact with the system in an efficient manner. The user interface is everything the end user comes into contact with while using the system physically, perceptually, and conceptually. To the end user, the user interface is the system itself. Hence, usability of a system remains one of the most important quality attribute in determining the total quality of any software system. The challenge of user-interface design is to construct a natural dialog sequence that allows the user and computer to exchange the messages required to carry out a particular task. The user interfaces do vary from system to system and user to user. In this paper we have identified the different issues in designing efficient user interface. All these issues are discussed at length with suitable example.**

Keywords-User Interface, SDLC, Human Computer Interaction, Software Design, Software Engineering

I. USER INTERFACES: AN INTRODUCTION

Usability is the ease of use and understandability of a software application [1]. UI plays a very important role in increasing usability of an application as it is the medium of human computer interaction. Irrespective of degree to which the application supports the functional requirements, unless the application is ease, efficient and close to heart of user- the application has to face failure. Since UI gives the abstract view of the entire system to user, the success of the system greatly depends on it. Hence, designing the UI should be given adequate importance in the system design life cycle (SDLC) process.

II. ISSUES IN DESIGNING USER INTERFACE

In recent days, significant development has been observed in the field of digital electronics, system design and development. Availability of mobile devices i.e. mobile phones, net pads, laptops etc. with advanced features are gifts to the user community. Moreover, decreasing cost and better quality of these digital devices made these systems available to people at almost every level of the society. Thus the numbers of users have been increasing significantly. There are several types of systems and different types of users with distinguished ability and challenges. With ever increasing number of diversified users, the challenges in designing user interfaces for these systems have become complex and important issues. The issues in designing efficient and usable interfaces are as follows:

- User Characteristics Issues
- User interface Type Issues
- Message Construction Issues
- Graphics Design Issues
- Look and Feel Issues

- Performance Issues
- Interaction Language Issue

In the following section, we are going to discuss the user interface design issue at length.

III. USER CHARACTERISTICS ISSUES IN USER INTERFACE DESIGN

A user is the entity which is going to use the system at any point of time. The different user category includes:

- A Human being
- Other living lives
- Another Machine

In the present context we will consider human only as our target user group. Hence, the term user over this paper will distinctly means human only. The system should be designed for the intended individual or group of users. Hence, prior to start the user interface design, it important to know at details about the different characteristics of the user. Here, we are going to identify and address some of user related issues to keep in mind while designing the user interface.

The issues in this category include:

a) For whom we have to design the system- the intended user?
b) What are the physical characteristics of the users?
c) What is the degree of learning level of the user?
d) What instructional language does the user understands?

A. User Issues: For whom we have to design the system- the intended user?

If we want to design an efficient user interface, we must know for whom are we going to design the system? What their capabilities or limitations etc. are?

1) Identify the User

We must remember that all the human being over the globe is not going to use your system in general. There are different segment of the society and computers are still not a dream to many people residing at various segment of the globe. Hence, a limited number of people are only going to use the system under consideration. So, while designing the user interface, we must not consider the globe as user, but consider certain specific category of people who are only going to use it. The basic issue in designing the user interface is to identify your potential users for the system under consideration.

For example, in case of a typical ATM system the different users may include following Bank Account Holder/Customer, Bank clerk, Bank Manager, System Administrator etc.

2) User Type Issue

After identifying the various user of the system, now it is the time to classify them in to following types:

a) *Naive User:* They know very little about the system. For a typical bank ATM system, various customer of the bank are the naive user.

b) *Sophisticated User:* They are comfortable using the system. For a typical bank ATM system, Bank Clerks, Managers, Accountant etc. are the sophisticated user.

c) *Specialized User:* They are the experts in using, maintaining and administrating the system. Again, for a typical bank ATM system, System Administrator, System Maintenance Engineer etc. are the specialized user.

Depending on the type of user, the user interfaces must be designed as the degree of knowledge about the system varies among different categories of these users.

B. Physical Characteristic Issues of the User

All the users may not be equally physically able. Few may be visually challenged, some may be impaired, some may have wounded or inborn with different physical challenges. But, many of them may be the target user. Hence, during user interface designing, the physical characteristics of the user must keep in mind to provide them better usability of the system.

For example, you can't expect all your ATM system customers to be physically fit. Some customer may be visually challenged, for them the user interface must provide audio instruction sets instead of written instructions. In contrast, some may even be hear impaired. For them an audible interface may be inefficient but a visual one.

C. Educational Level Issue of the User

Different user will have different level of education. Some may be illiterate, some may have school level education or some might have acquired higher education even. As the degree of education differs, the capabilities of various use differs in several respect. Hence, the same interface could not be efficient for all. So, at user interface design activity, the education level of user must be considered.

In case of ATM system, we can't expect all the users to be literate. For, illiterate if our interface provides interactive messages in English language only, it is of no use for the users who are educated in a native language only.

D. What instructional language does the user understands?

Another important aspect is language of instruction. Here, by the word "language" we are actually denoting the words that are used in an application. While designing the application, with respect to selection of words, one must keep in mind about the target audience of the application. Ideally, a Specialized User is comfortable with technical terms, internal abbreviations, acronyms, word truncations, etc. However, for the ease of use of a Naive User an application must display common and communal language. Practically a balance of frequently used and instantly recognizable words should be used while designing the language of an application.

IV. User Interface Type Issues

Depending on how does the user access, User Interface can be broadly classified into two categories i.e. Command line or text base user Interface (CUI/TUI) and Graphic User Interface (GUI). Both the interfaces have their relative advantages, limitations and related issues as discussed below.

A. Issues related to TUI

Text based User Interface or Command Line Interface is a formerly used type of user interface. Though it was suitable for 'Specialized User' group but it lacks acceptance towards 'Naive User' group. As acceptance to a large audience is a very significant aspect of effective user interface design, the trend in user interface design has already shifted from TUI to GUI.

B. Issues related to GUI

Graphic User Interface (GUI) is commonly considered to be superior to Text based User Interface. However, GUI does not automatically mean removal of texts and commands. It is the outcome of combining three different systems - command, menu, and iconic (GUI) systems. GUI can seem to be more comfortable to the 'Naïve Users' as it uses images and graphics to represent different functionalities. However, experienced command based users or 'Specialized User' may find a performance degradation to work with a fully GUI based applications as excessive use of graphics sometimes slower down the systems.

As GUIs are the trend of the day, we shall discuss the next issues mainly taking into consideration the Graphic User Interfaces

V. Message Construction Issues in User Interface Design

The interaction between the system and user is generally occurred via message exchange. The system gives some message for action to the user; in response the user again gives some message to the system. As messages do guides the user during any operation, improper message display may misguide the user too. Hence message construction is again a vital issue in user interface design. In this section we are going to identify and discuss the different issues in message construction i.e. Message Context Design, Message Size and Message Type, Message Content design issues at length.

A. Message Context Design Issues

If we want to build up an efficient user interface then we must take into consideration in response to which current activity of the user the message will be displayed, which type of user will see the message and which type of terminologies can be used to construct the message content etc.

1) Current Activity Issue

The main motive of messages is to guide and assist the user in proper direction while he/she is using the system so that they can successfully accomplish the intended task. To achieve this it is essential that the system reactions are very relevant to the users' action. So, in response to user's certain activity/action, the interface should display proper and relevant messages which can let the user know what should be his/her next action. The instructions given through the messages should be concise, consistent and relevant to the current activity of the user. It should not be confusing and ambiguous.

2) User Type Issue

The background and experience of the user should be the determining factor during message construction. The type of language or the level of explanation in the message will surely be different for novice users and sophisticated users.

3) Terminology Issue

During message construction we should be careful about the language and terminologies being used. Language should always be polite, appropriate and user friendly. For novice users language should be simple and native so that user can easily understand the meaning. On the other hand for specialized users the language can be formal and technical terminologies can be used.

For example, in case of an ATM system if there is no cash, a typical message like Error number #70 can be understandable for system administrator, but general customers of the ATM will understand nothing from this code.

B. Message Size Issues

Message size should not be very lengthy as it can become confusing as well as annoying. On the other too short messages may not be understandable to novice users.

C. Message Type Issues

We should understand the current situation of the user and generate messages accordingly. The type of messages will solely depend upon the user's last activity. The message type may be either directive messages, error messages or a help message [5].

1) Directive Message Issue

Directive messages are those which guide the user thoroughly step by step giving instructions. The content of the messages should be concise, to the point and very relevant to the situation. Good user interface should provide directive messages from the beginning till the end at each phase until user is able to get the proper output from the system.

2) Error Message Issue

It should not be expected that user will always perfectly follow the instructions provided by the system. Sometimes user mistakenly selects the wrong option or may do not understand the directive messages correctly and gives some unexpected instructions to the system. In this situation, a system with good user interface will guide the user to proper direction by providing meaningful error messages rather than just hang up and surprise the user with some abnormal behavior. Whenever user do something unexpected, the interface should let the user know what has gone wrong and display all possible alternative solutions to overcome the wrong activity.

For example, in case of an ATM system if user enters wrong PIN number, it is not sufficient to just inform him the same by means of a message; rather we can also suggest him to enter the PIN again.

3) Help Message Issue

A good user interface should always be ready to answer whenever the user says

- I want information
- I am in trouble

Help messages should be there when the user is unable to understand the system's behavior and asking for help. Help messages should be elaborative and fulfill all type of queries of user. Even a good system can predict user's intuition and give suggestive messages even when user is not demanding for help.

VI. Display Graphics Design Issues in User Interface Design

In respect of a graphical user interface display graphics refers to the aspects of its design, including elements such as colors, shapes, layout and typefaces and the behavior of dynamic elements such as buttons, boxes and menus etc. In this section we are going to discuss some aspects which can greatly influence the appearance of a system by enhancing its graphical design.

A. Organization of Controls

"Controls" can be referred to menus, dialog boxes, onscreen buttons, and any other graphic element that the designer uses to design the interface. Related controls can be placed together so that user can easily find them. Again use of too many controls in a single window can be visually disturbing as well as can reduce the usability of the system.

For example, if the user finds zoom in command in a menu, he would like to have zoom out command in the same menu rather than searching it somewhere else in the window. Here Figure1 shows an interface with well organized controls and Figure2 shows an interface with scattered controls.

Figure 1: Well organized controls

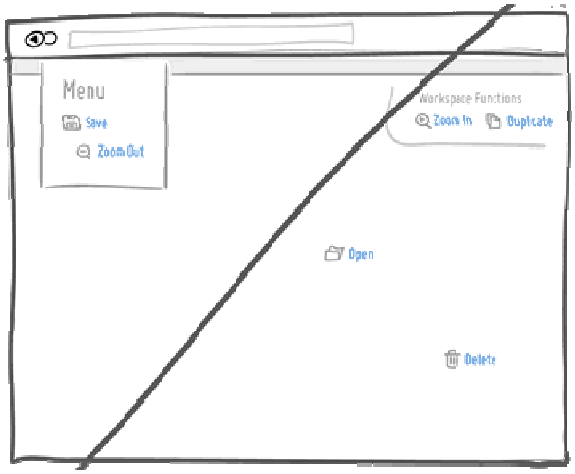

Figure 2: Scattered controls

B. Use of Color

Colors are important element in designing user interface as careful and wise use of color give the user a visual delight as well as help the designer to grab the attention of user to exceptional events. But overuse of color or use of highly contrasting color can create visual irritation. So, we should limit the number of colors used and be careful about color pairing [9].

For example, pairing of colors for Text1 leads to poor visibility whereas color pairing for Text2 provides better visibility.

Designing User Interface is simple
Text1: Poor visibility

Designing efficient User Interface is Challenging
Text2: Better visibility than Text1.

C. Visual Delight

A good visual hierarchy can be used to separate out our important elements from the less important ones. A visual hierarchy results from varying such things as alignment, proximity, color, tone, indentation, font size, element size,

padding, spacing, etc. When these visual language elements are applied correctly, they can work together to direct and pause people's attention within a page - improving general readability.

For example, the interface in figure3 helps the user to read the content step by step as proper font size, alignment and spacing are used here. Again user can easily find out the click area as a bigger and colorful click area is used in the interface, whereas the interface shown in figure4 proves itself as poor one as it fails to apply the visual language elements correctly..

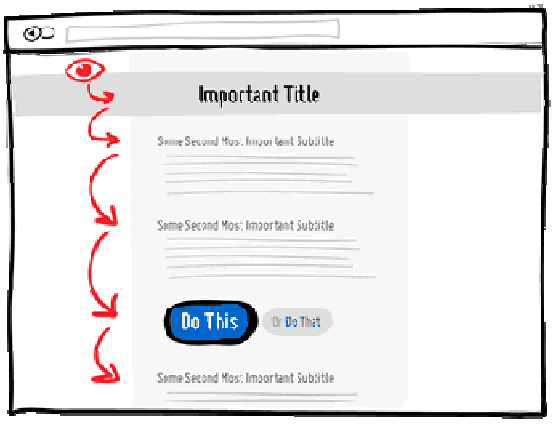

Figure 3: Visually soothing interface

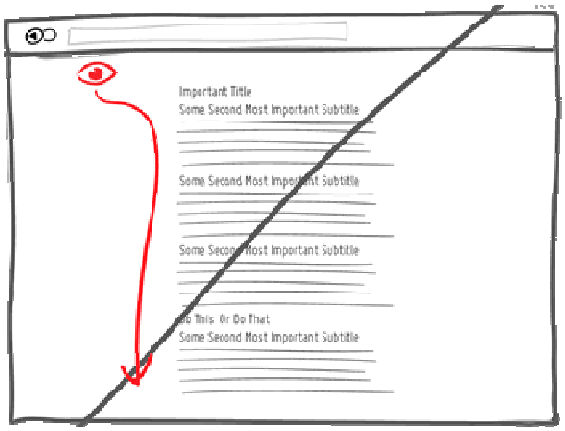

Figure 4: Visually disturbing interface

VII. Look and Feel Issues in User Interface Design

Look and feel can be described as how the overall system is being represented towards the user and what is the degree of usability of the system for the user. An interface with soothing and uniform look and feel can increase the acceptance by the user and can also help the user to translate their experience to other products with the similar look and feel. In this section we are going to discuss some ideas which can increase the usability of a user interface.

A. Recognize, instead of Recall

According to human psychology it is easier to recognize something existing, as opposed to having to recall it purely from one's own memory. Recognition relies on some kind of cues or hints which help us by touching our past experience. Recall requires us to probe the depths of our memory all on our own. We can consider giving users the ability to recognize items which they have been exposed to before, instead of expecting them to remember everything on their own. It can give user go easy on feelings.

For example, in case of a social networking site, if we want to know users favorite movies, it can be a better approach to ask the user to select from an existing list of movies rather than just asking him to type some names by recalling from his memory. Figure5 shows an interface where user needs tick the names of his favorite movies from a given list of movie names and Figure6 shows an interface where user has to remember and type the names of movies.

Figure 5: User needs to recognize

Figure 6: User needs to recall

B. Law of Default

Defaults are some predefined settings that initially help the user to identify the features of a system. It can be a smart approach to design the defaults in such a way that most of the user need not to change the default settings and can feel like the system is designed only for them. Again default values can be defined to speed up data entry. The initial or default item could be the most frequently selected item or the last item selected by that user.

C. Provision of Reconfirmation and Undo

Human are prone to doing mistakes. So, it can be a good practice to ask user for reconfirmation each time before finally executing the action initiated by the user. It can reduce user mistakes. Again it is possible that user reconfirmed the wrong action and identified the mistake after the action is done. So, in order to provide a more flexible interaction Undo options can be used, so that, user gets the last chance to recover his mistake. Use of Reconfirmation and Undo options give the user a relaxing environment. He is not always over conscious and tensed about what he supposed to do with the system.

D. Follow Convention

Sometimes it's good to follow convention rather than experimenting [6]. If the user is familiar with similar kind of system which we are developing then we can expect that he knows the basic use of the system. In this situation without experimenting much if keep the basic design similar to the existing system then he will be able to use his previous experiences to understand the new system.

E. Flexible Mode of Interaction

Using only a mouse can sometimes become time-consuming and inefficient for sophisticated and frequent users of an application. Keyboard accelerators can provide an efficient way for users to access specific menu items or controls in a window [5]. The accelerators used should be easy to access and limited to one or two keys (such as F5

or Ctrl-S). Again Keyboards have limitations in the GUI world, such as when trying to implement direct-manipulation tasks like drag and drop, pointing, and re-sizing. So, we need to provide complete and equal keyboard and mouse support for all menu and window operations.

VIII. Performance Issues in User Interface Design

Performance of any system is always desired to be high. As user interface is an important part of any system, the performance of user interface definitely affect the performance of the system [8]. An important measure of performance of the user interface is the Load time. Load time can be defined as the time it takes to render the first screen of the user interface. If the load time is too long then it can project a bad impression about the system, so the load time should be reasonable. Load time can depend upon number and type of user interface elements is used. We can balance the Load time by adopting following means:

- Minimizing the use of controls like buttons, dialog boxes menus etc
- By not using unnecessary images and using small size images
- By not using too slow animations
- By designing according to available hardware support

Though good performance is an important issue while designing user interface, we should not compromise too much with look and feel to improve the performance.

IX. Interaction Language Issue

Internationalization and Localization are means of adapting computer software to different languages, regional differences and technical requirements of a target market. The terms are frequently abbreviated to i18n (where 18 stands for the number of letters between the first "I" and last "n" in internationalization, a usage coined at DEC in the 1970s or 80s)[4] and L10n respectively, due to the length of the words.

A. Internationalization (i18n)

Internationalization is the process of designing a software application so that it can potentially be adapted to various languages and regions without engineering changes. For example, in India date is formatted as DD/MM/YYYY but US users will format a date as MM/DD/YYYY.

B. Localization (L10n)

Localization is the process of adapting internationalized software for a specific region or language by adding locale-specific components and translating text. Localization (which is potentially performed multiple times, for different locales) uses the infrastructure or flexibility provided by internationalization (which is ideally performed only once, or as an integral part of ongoing development).

To get an application to support multiple languages one should design the application to select the relevant language resource file at runtime. Resource files are translated to the required languages. This method tends to be application-specific and, at best, region-specific. The design should support date format validation, and other regional standards along with adaptability to different languages.

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X. Conclusion and Future Scope

In this article first of all we tried to discuss about the necessity and significance of designing good user interface for improved human computer interaction. Then we have pointed out some important issues which can be taken into consideration while designing good user interfaces. We have discussed each of these issues at its length and also tried to explain what measures can be taken regarding these issues to design an easy and efficient user interface. Here we have taken into consideration the conventional and contemporary interfaces only like VDUs, Touch based UIs and tried to discuss the issues by taking examples of simple user interfaces like typical ATM system, social networking sites etc.

However, current advancement in technology field will surely lead us to a whole new generation of interaction interfaces in near future. In future each of the issues identified here, can be discussed elaborately for different types of User Interfaces like gesture controlled interfaces, voice command interfaces etc

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