

# User interface usability studies on different operating systems

WANG You-ying, SHEN Ye, YANG Yang, MA Jie, MA En-ping, SHI Xun-zhi  
(Sydney Institute of Language and Commerce, Shanghai University, Shanghai 201800, China)

**Abstract** - This article abstractly introduces the relevant technologies about user interface software testing, and focuses on mobile terminals' design requirements for user interface and usability guidelines for further exploration. On this basis, using intelligent we apply manual testing methods in aspects of user-friendliness, information platform of Urban Construction Group as the example, content and table, form, navigation and interface aesthetics and coordination testing for analyzing the web applications' interface usability on Windows, Android and ios operating systems. According to outcomes of our experiment, the UI usability of the program conform to design requirement and turn out effective

**Key words** - User Interface, Mobile Terminal, Types of Operating Systems, Usability

## 1. Introduction

Software testing plays increasingly significant roles in contemporary computer software areas for the reason of helping with checking and locating potential mistakes of software design and development to a largest extent to ensure the quality of software. With the continuous increase in software scale and system complexity and the innovation in development methods, studies on software testing has become more difficult and complex as an important issue in computer science area. Graphical User Interface (GUI), which is the end of underlying application codes, responds to events triggered by users as they click the mouse and selecting the menu. It is an indispensable part of human-computer interaction for the advantage of perspicuity and ease of operation. Nowadays, software developers usually use more codes, which even constitute 60% of total amount of codes of whole program, to achieve the GUI of application [1]. GUI testing has been paid more attention to for ensuring the robustness of GUI functionality. Considering for compatibility and stability of software on different operating systems, this article studies the performance of GUI of web application on current prevalent operating systems: windows, android and ios, to summarize similarities and differences and give some advice for improvements of quality of software and programs.

## 2. Features of UI and related problems

### 2.1 features of UI and current problems

User Interface (UI) is a kind of computer operating user interface, as well as a development basement of many software systems. There are some of principle features. Three of its representative characteristics are as following. Firstly, it is

easy to operate, and has gradually become a generally used pattern for software interaction [2]. Secondly, UI is based on the event-driven model, which is one of its most obvious characteristics. It is typical of UI to trigger corresponding handler through a user inputting an event. Additionally, unpredictability is another characteristic of UI. Due to randomness of user input, program usually runs with great randomness.

There are many problems existing in UI design. First of all, it aggravates the workload of system development. Although it provides users with hierarchical, graphical and visual operation, which has brought lots of benefits to average users, larger amount of codes and testing tasks occur as well. In addition, UI design may cause usability problems. If it fails to conform to users' operating habits, for example, shortcuts are unscientific and pages cannot upgrade information in time, inefficient UI design may cause a series of problems, such as redundancy of user input, unneeded repeat of program operation and unclear help or prompting messages [3].

### 2.2 Methodology of UI testing

Manual testing and automatic testing are two main UI testing methods. Manual testing based on generated design and test cases relies on testers' manual input and comparison between actual and expected outcomes. The UI testing based on event flow graph is only a manual testing tool without automation and codes [2]. However, automated testing contains two aspects. The one is choosing exactly suitable automated testing tool through recording or capturing scripts and then play backing it to copy user's operation. The process can be repeated as needed. The other is writing automated testing scripts using traditional programming language such as Java, C++ and Visual Basic to simulate users' operation.

Because there is no exactly perfect tools which totally satisfy testing need of all different programs. In fact, the most common automated testing methods are the combination of the tools and script writing to make up for disadvantages of automated tools with customized scripts [3]. It can achieve to taking advantage of the flexibility of automated testing. Here are some typical automated testing methods. (1) WinRunner. It is an enterprise-level functionality testing tool through capturing, detecting and repeating human-computer interaction operation [3]. (2) FEST-Swing. It provides software developers and testers a series of application programming interface (API), reducing the testing difficulty and increasing efficiency [4]. (3) FSM model. It can cover codes by creating test model with algorithmic language when testing is starting

[5]. As is indicated in the figure, automated testing of UI has following five key steps [5].



Fig.1 process of automated testing

### 3. UI for Mobile Terminal

#### 3.1 GUI Platform Requirements

The mobile terminal is an embedded system that its GUI platform should meet the general specification focusing on embedded systems. Most of embedded GUI are working as application modules which has configurability, good portability, scalability and is cropped that meet demands for different operating systems and hardware. These characters are closely related to architecture level of the embedded system. In summary, GUI system consists of display, window and user models which decide the basic display way for graphics on the screen, windows display effect on the screen and interaction's main features with respect [6].

Mobile Terminal's GUI platform meets following requirements due to limited resources available for embedded mobile terminal [7]:

1) *Small memory occupations*: Mobile Terminal system generally has small memory; therefore it could not occupy too many memory resources as GUI table system does.

2) *Customizability*: Embedded system's mobile terminal usually has various business needs according to targeted markets positioning differences. For example, some kinds of systems require for partial graphic display functionality, while others need complete GUI assistance.

3) *Providing simple and convenient GUI user program developing interface*: It offers improved graphical interface for application program development.

4) *Quick and easy operating interface*: Mobile terminals like mobile phones, MP4 and tablet PCs limited by cost, energy and mobility have weaker computing ability and smaller memory and screen and low resolution and a finite number of interfaces which could not meet the demand to access input and output devices. Therefore, mobile terminal interface contains characteristics of flexibility, reliability and easy operation, etc.

#### 3.2 GUI Usability Standards

Usability is the major quality of mobile terminal's UI. There are mainly three standards:

1) *System performance*: it is about computer or handheld device's performance, frame rate and detention measurement in dealing with graphic system.

2) *Task performance*: it is about the performance quality in applications for specific tasks. Speed and accuracy are important metric parameters [8].

3) *Pervasive aesthetics*: the standard tends to measure user's subjective aesthetic experience and perceptions of

program utility. It takes up questionnaire and interview to get users' feedback for measuring user performance.

#### 3.3 Tested Prototype Introduction

Shanghai urban construction group's intelligent engineering information management system (<http://cm.sucg.com.cn>) sets group terminal and project terminal to satisfy the management requirements for group overview and program management. As for the structure of hard ware, it bases on mobile network's topological architecture which is available for control and maintains whole system store, calculation and daily operation through giant servers. As for software structure, the system develops on MS.NET platform by three-layer architecture (data layer, logical layer and user show layer). Key technologies for structure building are AJAX asynchronous server access technology, data exchange based on XML technology and database access based on ADO.NET technology.

### 4. Testing scheme

#### 4.1 testing methods

The testing method explained in this paper starts from designing testing cases, followed by operating, observing, recording and analyzing outcomes. It includes a sequence of manual testing such as user-friendliness, content and table, form, navigation and interface aesthetics and coordination, testing. With performance of application on windows, android and ios observed and recorded, the property and nature of UI can be verified overall. The operating system and platform chosen by this experiment are respectively windows7 (laptop), android4.0.4 (smart phone) and ios5.1.1 (iPad)

#### 4.2 testing process

##### (1) User-friendliness testing

According to definition from Software Engineering and Product Quality, user-friendliness is ability of attractive software product that can be understood, learnt and used by users [9]. It is an intuitive quality indicator of application which is used to assess whether software is effective, easy to learn and memorize. In the area of UI, the user-friendliness is directly reflected in human-computer interaction. Table 1 shows a common test case for user-friendliness testing.

TABLE I Test Case of User-Friendliness Testing

No.	1	2	3	4
Test Item	Friendliness of UI	Easy to learn	Easy to operate	Abundant on-line assistance
Description	How about simplicity	whether need extra ability for learning.	Whether difficult for operating	Accuracy and all sidedness of on-line assistance for web program
Test Outcome	Windows	succinct	There is navigation and users have related industry background; easy to learn	Easy to operate
	Android			
	ios			

The testing results indicate that, the Urban Construction Intelligent Information Platform performs without significant difference in different operating system. Overall, UI of the web program is laconic and friendly to users, while it has some shortages in offering timely and effective assistance due to its characteristics of being based on internet.

*(2) Context and table testing*

Context testing is used to check reliability, accuracy and relativity of information offered by application, while table

testing, as a supplement of context testing, focuses on checking whether the tables are set right. Related test case is as Table 2.

The test table presents that the context design of the program is simple, without protection and correction processing of input error, especially in Android system. However, in table design of the program is relatively reasonable. The table is flexible and can demonstrate information clearly.

TABLE 2 Test Case of Context and Table Testing

No	Test Item	Test Criteria	Test Outcome		
			Windows	Android	ios
1	Element accuracy	No typos; be logical	No typos; pages link to each other logically	Same as Windows	Same as Windows
2	Input protection	Data check	no input error protection and correction in pages	Same as Windows	Same as Windows
3	repetitiveness	be used again	Context and pictures can be repeated	Same as Windows	Same as Windows
4	Table width	Wide enough to avoid multiple line	Table is enough wide to show words clearly ; rare multiple-line sentence.	Table width is limited, many multiple-line sentences	Same as Windows

*(3) Navigation testing*

Navigation describes how customers operate on a page and it works on different user interfaces including buttons, dialog box, list tables, windows or different link pages.

As can be seen from testing result, the navigation design of intelligent information platform of urban construction is

easily operated on Windows, Android and ios system. The navigation is put on the top of pages, which is easy for users to visually catch. Users can also distinguish by different size of buttons according to different level of operation. The steps to reach the destination are within three steps and it is very efficient.

TABLE 3 Test Cases of Navigation Testing

No	Test Item	Test criteria	Test outcome		
			Windows	Android	ios
1	Operation of the navigation buttons	Have links	Each button has corresponding links	Same as Windows	Same as Windows
2	Link between navigation, page structure and menu	Style are unified	Style, color and font of linked page that is related to navigation are unified.	Same as windows	Same as Windows
3	Navigation-oriented	Easy to operate	style is simple and succinct , buttons navigation has clear means; strong orientation	Same as Windows	Same as Windows
4	Efficiency of navigation	Reach to targeted page within least operation	Relatively high efficiency; can reach to target using fewer steps; may cannot work	Same as windows	Same as Windows

*(4) Form testing*

Application and user interface is presented in the forms of user interface which is composed of forms and internal widgets. As a result, UI testing takes two parts into consideration: forms and widgets within forms. Ordinary forms contain title bar, menu bar, tool bar, status bar and internal widget. Table 4 shows related test case for Urban Construction System in details.

Testing result shows that the form design of intelligent information plat form of urban construction meets the functional requirements. However, there are drawbacks when comparing with design of other modules. In the platform of Windows, Android and ios, form widgets of some pages have too complicated operation due to the large number of widgets, which also lead to the unbalanced layout and destroy the aesthetic sense of pages.

TABLE 4 Test Cases of Form Testing

No	Test Item	Test criteria	Test outcome		
			Windows	Android	ios
1	From size and space layout are reasonable;	Reasonable	Forms have suitable size and space layout	Same as Windows	Same as Windows
2	As form zooms, whether the size of controls change	Reasonable	The size of controls in form will change at reasonable proportion as form zooms	Form cannot zoom,; not strong practicality	Same as Windows
3	following operations perform right when current form is not closed	Can be operated right	Following operations cannot be carried out if current form is open	Same as Windows	Same as Windows
4	Number of widgets are not over 10	Whether more that 10	Some of forms have over 10 widgets	Same as windows	Same as Windows
5	Timely feedback	Whether there is progress bar	Except for new pages, rarely no progress bar in operation	Same as windows	Same a windows

(3) Interface aesthetics and coordination testing

Usually, interface design should abide by design specification of Windows interface. The UI that can attract users' attention in valid rage as quick as possible generally has following features: interface has suitable size and pleasing color, which makes users feel comfortable. Otherwise, if the overall tone is in poor harmony and too much space has been occupied, the beauty of the interface will be greatly damaged, losing attractiveness to users. Table 5 presents the corresponding test case.

According to test outcomes, the overall style of the program barely shows difference on different operating system in the respect of interface aesthetics and coordination. However, because pages fill in entire screen interface, aspect ratio of page should be modified correspondingly on Windows, Android and ios. Meanwhile, there is subtle difference in overall layout and details of picture show. In general, this web program has suitable page layout and harmonious color setting no matter on each operating system.

TABLE 5 Test Cases of Interface Aesthetics and Coordination Testing

No	Test Item	Test criteria	Test outcome		
			Windows	Android	ios
1	Aspect ratio -golden ratio	harmonious	All pages has aspect ratio that is golden ratio	Same as Windows	Same as Windows
2	reasonable Page layout ; space is allocated	harmonious	Module settings is in a compact state; navigation is at the top of page, easy to read; effective space	Page layout is reasonable; navigation is at top	Same as Windows
3	Button size is suitable; name is right	harmonious	Buttons is rounded rectangular; same size buttons in same level; name contains directional means.	Same as Windows	Same as Windows
4	Suitable font size	harmonious	Font size in same level is the same	Font size is bit of small	Same as Windows
5	Overall tone; forehead and background color	harmonious	Overall tone is dark green, friendly; forehead and background color in home page is harmonious	Same as Windows	Same as Windows
6	Graphs present means right in suitable size	harmonious	Login interface and home page has succinct background pictures; real size graphs and picture	Login interface has no pictures. home page rarely show picture	Pictures and graphs are shown after zooming
7	Overall style and mixture of all elements	Harmonious	Interface style is succinct, words in different color show different means. Overall design is fascinating	Few of pictures in pages, font size is unified	Font cannot meet with picture in some pages

## 5. Conclusion

Despite the increasingly deeper understanding and unprecedented application of GUI, the development of test sequence has not been laid much emphasis on while the techniques of the rest of the field of computer software testing have been much better-established. The testing method of GUI need to be specifically tailored to the requirements because of its high usability and uniqueness based on event driven. UI testing tools include manual testing and automatic testing. Using intelligent information platform of Urban Construction Group as the prototype of software testing, this article evaluates user-friendliness, content and tables, form, navigation and interface aesthetics, which are some indicators basing on the web applications' interface and usability on Windows, Android and ios operating systems by mainly using manual testing. On the whole, the intelligent information platform of Urban Construction Group examined is of high usability and its user interface design conforms to the basic standards. The subject of UI design and testing on the basis of the features of mobile terminals is to be explored further in the future to ensure the usability of the software.

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