User Interface Design for Mobile Learning Applications

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Abstract: *This paper examines the types of mobile user interface. A methodology for developing user interface for mobile learning applications is proposed. The requirements for mobile user interface are defined and a concrete approach for realisation is suggested.*
Key words: *Mobile Learning, User Interface, Human-Computer Interaction*

INTRODUCTION

Nowadays mobile devices become more widespread and are increasingly used for many purposes. Fewer customers worldwide use mobile devices only as a single function unit. Gradually these devices become a platform for a wide range of applications - shooting and sending photos, listening to music, watching video, receiving GPS information, obtaining information from Internet and others. The mobile devices also provide an opportunity for the realisation of mobile learning.

User Interface (Human Machine Interface) includes the methods by which the users interact with a device. The user interface provides two basic options [8]:

- Input, through which users can control and interact with a device;
- Output, which reflects the users' actions.

The development of user interface for applications for mobile devices - cell phones, smart phones, PDAs (Personal Digital Assistants) and super phones deserves special attention, as they have some limitations, most important of which are less screen resolution and smaller keyboard than the desktop computers [6, 7]. This is the reason why the user interface for mobile applications (Fig.1), including these for mobile learning, should be well designed and implemented.
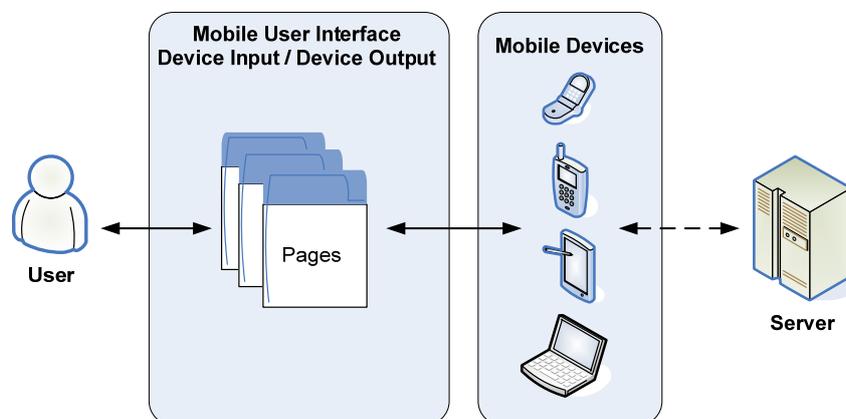

Fig.1. Mobile user interface

The paper examines a methodology for developing of user interface for mobile learning applications, the requirements for this interface are determined and a concrete approach for implementation is suggested.

LAYOUT

1. Types of mobile user interface

At present, two main types of mobile user interface are used:

- Graphical user interface (GUI) takes user's input information through various mobile computer keyboards (virtual, mini-QWERTY, foldable) and/or pointing methods which react to the screen. The GUI displays relevant information on

the screen of the mobile devices.

- Web-based user interface accepts a user request, transmits it to web server, receives response and displays the information on the mobile device screen using mobile web browser.

2. User interface design

User interface design or user interface engineering is the design of computers, appliances, machines, mobile communication devices, software applications, and websites with the focus on the user's experience and interaction [8]. The main purpose of the traditional graphic design is to make a product attractive while the goal of the user interface design is to facilitate the user-application interactivity and to increase the effectiveness of the user's work.

Development of user interface for mobile application is a part of the overall process of design and development of a separate mobile learning application or of complete mobile learning management system [3]. Most often at this stage a graphic designer, a user interface designer and a programmer work together.

There are several iterative stages during the development of the user interface for mobile applications:

- Analysis of potential users;
- Definition of the functional requirements to the user interface depending on the purpose of the application and the potential needs of the users;
- Development of a navigation scheme of the application;
- Development of a prototype in the form of a simple interactive screens, which include basic information - text, graphics, audio and video;
- Testing with emulators - testing the prototype with appropriate emulators for mobile devices (embedded in the development environments or provided by other developers);
- Usability testing - testing the prototype with real users from different groups [5] using mobile devices;
- Development of final version of the user interface. The results of testing with the emulator and/or testing with real users may be taken into account. If it is necessary the architecture of the application can be changed. In some cases it may be necessary to develop different graphic templates for different screen resolutions.

3. Designing for different screen resolutions

Development of user interface for personal computers is easier than for mobile devices because of the following reasons:

- PCs support higher resolution (at least 1024x768 pixels);
- PCs have a full size keyboard;
- The users can use mouse as a pointing device.

The great diversity of supported screen resolutions (Fig.2) - from 128x160 pixels to 480x800 pixels, and methods by which the users can interact with applications and to input information in mobile devices is observed.

If a web-based user interface is developed one solution is to provide recognition of the web-browser and the resolution of the device and to implement adaptation of the information for the purpose of appropriate visualization. It is also recommended to group some resolutions to reduce the number of supported resolutions and to reduce the complexity in the development of different design of user interface [1].
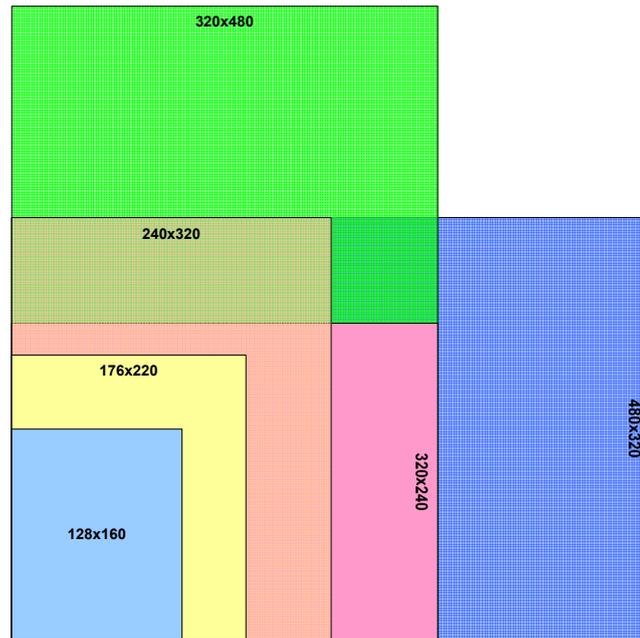
Fig.2. Mobile devices main screen resolutions

Development of a graphical user interface of a mobile application for all platforms and resolutions at this time is a difficult task. In general a mobile application for concrete platform and resolution is developed.

4. Mobile navigation paradigms

At present a variety of navigation schemes for e-learning systems are applied. Very often a tabbed navigation and/or menus navigation located in left and right sides of the main content (Fig.3a) are used. They are suitable for use in PCs, Notebook and Netbook computers that have high screen resolution, full sized keyboard and mouse.
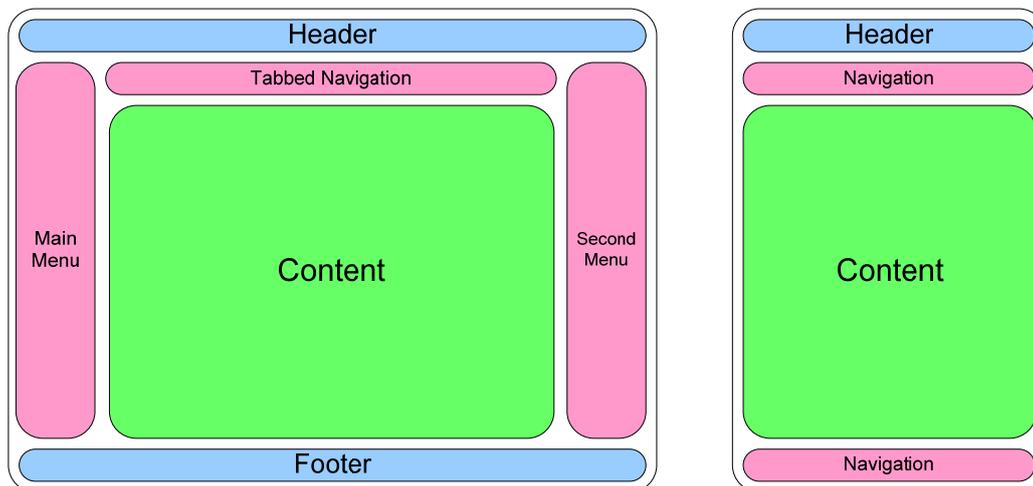
a)   b)
Fig.3. Most used navigational schemes
a) for personal computers; b) for mobile devices

These popular schemes are not applicable to mobile devices since they have a small screen, small keyboard and limited methods of navigation.

Preferred method during the development of mobile navigation schemes for mobile phones is using a numbered vertical list of options which are associated with the corresponding numbers (0-9) from the phone's keypad [1].

During the development of navigation for PDAs or smart phones more modern methods of navigation can be applied. However, the orientation of the screen should be taken into account, as most of mobile devices still work in a vertical mode and they cannot display text in several columns. It is recommended that the navigation scheme support two fields with navigation - at the top and bottom of the screen (Fig.3b) and the information is visualised between them [1].

5. Requirements for realisation of user interface for mobile learning applications

The following requirements to the user interface of mobile learning applications can be defined:

Regarding the navigation:

- The navigation should be intuitive, located at the top and/or bottom of the screen and must support work with mobile device keyboards.
- To reduce re-visualization of the main menu and submenus of each screen (page) it is appropriate to place them on individual screens and the navigation must support links to these screens.
- The navigation buttons should be large enough to work with them using stylus or touch screen.
- The navigation elements should be visualised in the same way on mobile devices with different screen resolution.
- It is better to provide a choice of several options, rather than to enter the text [6].

Regarding the multimedia elements:

- The length of the text must be consistent with the size of the screen and not more than 3 times the height of the screen [6].
- Horizontal scrolling of the text must be avoided.
- A possibility to change the font size must be provided. This will give an opportunity to users to increase or decrease the font size when it is needed, as the text with small font size is difficult to read [4].
- Due to the lower screen resolution serif text fonts should be used.
- The text should be easily reading and for this purpose it should be contrast on the background.
- The size of graphic images (in pixels) must be consistent with the size of the screen.
- It is appropriate to separate graphics from the text - for example on separate screens (pages) which to be displayed only by user's request. This will increase the speed of loading pages containing mainly text information.
- If the application includes audio and it is intended to be controled by the user, it is appropriate to provide a separate screen on which the control elements to be arranged.
- If the application includes video a separate screen for its reproduction also has to be provided.

Regarding the verification of users' knowledge:

- In the implementation of tests is appropriate that the questions and tasks to appear on separate screens.
- It is best to use "true-false" or "multiple choice" questions types. If "fill in the blank" type is used, the text that users must type in should not be too long.
- If during the tests a specific time for their completion is given, it must be greater

of the time that is given to the same tests, but performed on personal computers. In literature source [2] is determined that the text entry speed in mobile devices is about 3 times lower than that of PCs.

6. Realisation of user interface for mobile learning applications

Thus defined requirements are used in the realisation of the user interface for mobile applications for teaching the course "Multimedia systems and technologies". These applications are developed using Adobe Flash.

Fig.4 shows screens of a mobile multimedia application for training on theme "Audio". On Fig.4a and Fig.4b is shown the ability to change text font size. On the same screens there is a link to other screen (Fig.4c) on which the user can see the image associated with the text.

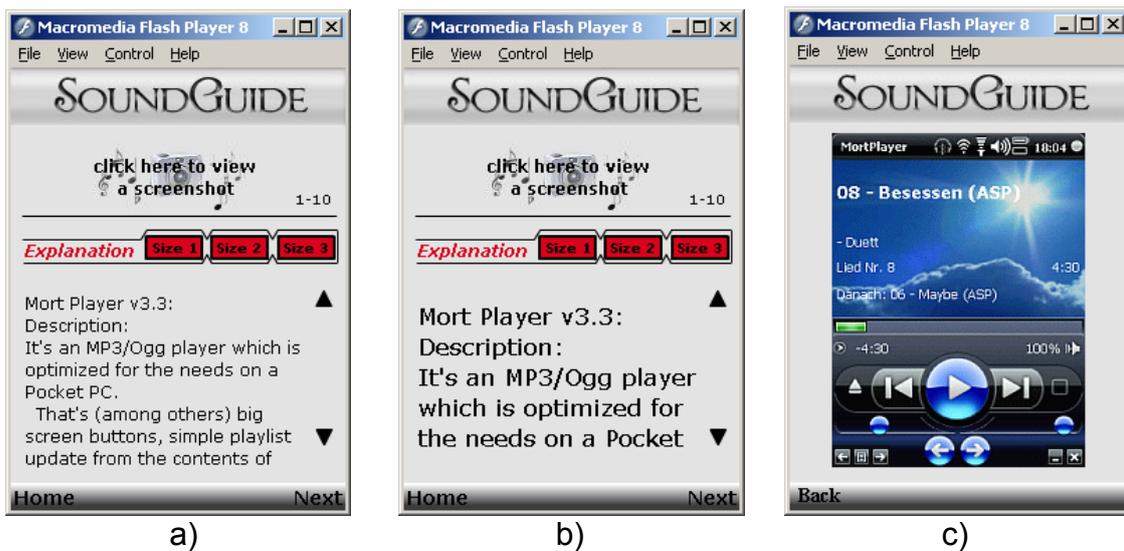

a)   b)   c)

Fig. 4. Screens from multimedia mobile learning application "Audio"

Fig.5 shows relevant screens for audio control (Fig.5a), for video control (Fig.5b) and for testing students' knowledge (Fig.5c).
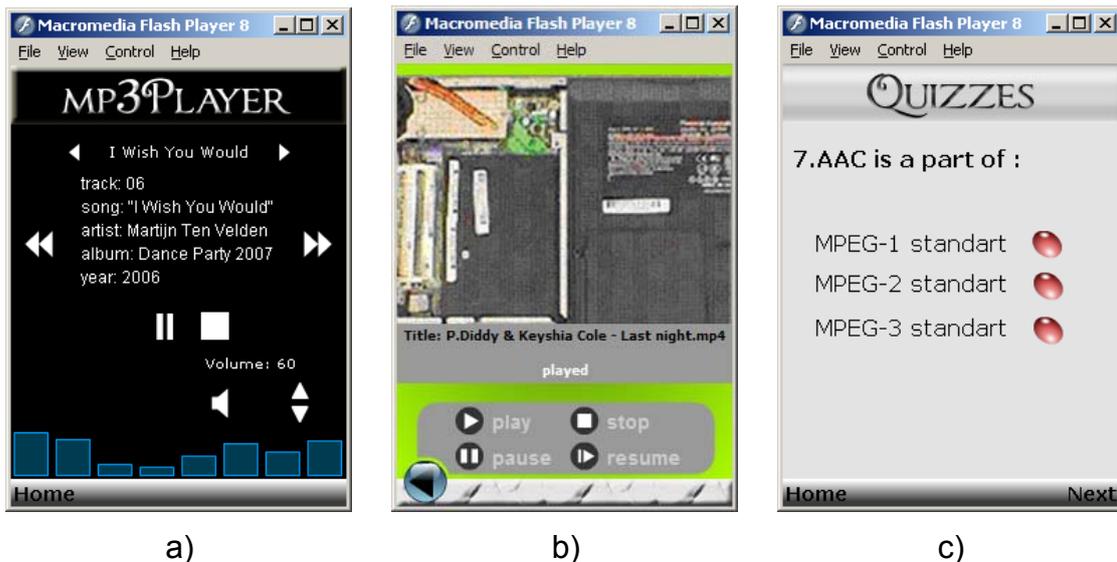

a)   b)   c)

Fig. 5. Screens from multimedia mobile learning application "Audio"

CONCLUSIONS AND FUTURE WORK

The user interface for mobile devices is crucial in the development of mobile learning applications. The well designed user interface of a mobile application can

attract customers while the good functionality and learning content can keep them to use it.

The proposed methodology and the defined requirements can be used for development of a graphical user interface as well as for development of web-based interface for mobile learning applications.

They are practically implemented during the development process of series of multimedia mobile applications for training students at the University of Ruse in the subject "Multimedia Systems and Technologies".

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