

HUMAN INTERACTION WITH MOBILE APPLICATIONS

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ABSTRACT –

Computing - human interaction is a very important paradigm because informatics applications are created to be used by people via human interaction. Nowadays mobile applications are more used so is necessarily to talk about mobile - human interaction. In this paper types of mobile devices are presented. Citizen oriented character of mobile application and his utility are described. Different means of interactions with mobile devices are analyzed and in the end of the paper direction of mobile applications development and mobile gesture recognition are presented.

Keywords – Mobile; Human Interaction; Citizen Oriented Applications; Gesture Recognition

1. MOBILE DEVICES

Electronic devices become smaller and more powerful and are taken by the user in all possible places.

Due to rapid technological change and needs people to have as close to all necessary applications, developing applications for mobile devices grew. Mobile applications are a new category of software as opposed to the usual desktop or web applications, by their size as needed for the application-oriented citizen.

Mobile applications depend heavily on the device characteristics, device platform and operating system implemented on mobile device. Diversity present in the mobile devices is present in the mobile applications too.

Mobile devices are divided into several categories [1]:

- *basic terminals or simple phones* performed basic functions such as send / receive SMS, receive / initiate call; they are not able to use any wireless data communication and multimedia characteristics are limited;
- *feature phones* are mobile low-end mobile devices that have additional functions over and above standard mobile phones like camera, touchscreen and Wi-Fi capabilities; because technology changes rapidly features phones may be considered the low-end smartphones;

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- *multimediaterminals* in addition to basic functions present additional functions such a powerful camera, large storage media, audio and video player;
- *mobile Internet devices* represent an intermediary class of mobile devices that are more than a smartphone and less than a tablet PC in terms of features; they are used mostly for Web browsing based on a wireless network connection; modern tablets are becoming the mobile Internet devices of the moment;
- *mobile standard PCs* are mobile computers that have all the features of a personal computer; Tablet-PCs, laptops/notebooks and ultra mobile PCs (UMPC) distinguish from a classic desktop computer by size, display, weight and peripherals.
- *fashionterminals* includes performance functions like multimedia terminals and has a special design;
- *smartphones* are high-end feature phones with advanced business functions, office applications, high-speed Internet connection, specific multimedia terminals functions, high-resolution touchscreens; they evolved from classic personal digital assistants (PDAs);

Devices on the base class or simple phones require following restrictions for mobile applications:

- monochrome display (black and white);
- small display size;
- minimal use of hardware resources ;
- enter the data via the alphanumeric keyboard;
- unable to connect to the Internet;
- unable to access the GPS information.
- Restrictions imposed by the devices of class features mobile phones on applications are:
 - data input is realized via touchscreen or via keypad;
 - possibility connect to the Internet;
 - possibility to access GPS information;
 - minimal use of battery, the battery has a reduced autonomy;
 - the display size is not fixed and is different from device o device.
- Multimedia terminals requiring the following restrictions on the mobile applications:
 - data input is realized via touchscreen or via keypad;
 - possibility connect to the Internet;
 - minimal use of battery;
 - the display size is different from device o device.
- A Mobile Internet device requires these restrictions on mobile applications:
 - display size is higher than a normal phone display;
 - high autonomy of the battery;
 - data input is realized via touchscreen;

- internet connectivity is a key feature of any application because the devices are used in this purpose.
- Mobile standard PC devices imposed next restrictions for mobile applications:
 - data input is realized via touchscreen;
 - the display size is different from device o device;
 - possibility connect to the Internet;
 - possibility to access GPS information;
 - high autonomy of the battery.
- Terminal devices in the fashion category requiring these restrictions for mobile applications:
 - data input is realized via touchscreen or via keypad;
 - possibility connect to the Internet;
 - the display size and the number of displays is different from device o device (devices with two displays exists);
 - minimal use of battery.
- Devices from smartphones category requiring these restrictions for the applications:
 - the data is input via the touchscreen, the QWERTY keyboard or HALF-QWERTY keyboard;
 - possibility connect to the Internet;
 - possibility to access GPS information
 - minimal use of battery;
 - the display size is different from device o device.

The user satisfaction depends of the complexity of mobile application and that complexity depends of the restrictions of mobile devices for these applications. Mobile applications should meet all the restrictions imposed by mobile devices.

2. MOBILE CITIZEN ORIENTED APPLICATIONS

Citizen oriented informatics applications are designed and developed so that the user's interaction effort is minim and the desired result accomplished [3]. Due to the limitations of the mobile devices not all citizen oriented applications are suitable for porting while keeping all functionality.

The biggest problem encountered while running citizen oriented informatics applications on mobile devices is given by the diversity of technologies used to develop it. As citizen oriented applications are designed to forecast users' actions and minimize the user input they use many different technologies that are not usually available on mobile devices such as feature phones or smartphones. Desktop computers can run applications developed on any regular technology due to the fact that popular technologies have support for all major operating systems. Mobile devices don't usually have implementations for regular technologies, or these are with reduced functionality. The lack of implementations of regular technologies on mobile devices is usually the result of the synergy of many factors:

- the operating memory of the majority of the devices is lower than the minimum needed to implement the technology in a proper manner; due to limitation imposed by the small form factor, mobility and low energy consumption, mobile devices don't have the same amount of random access memory as regular computers; in such cases one approach is to provide the technology with reduced functionality; J2ME is such an implementation for mobile devices that offers limited functionality compared to the desktop counterpart but also provides APIs particular to mobile devices such as access to the phonebook, logs, calls; Python programming language is very popular in the community and it has implementations on a very wide range of mobile devices;
- the processing power is not limited only by the raw force of the CPU powering the device but also by constraints in terms of energy consumption;
- short battery time has been and will certainly be in the future one of the most stringent pressure factors on mobile apps developers; users expect their application to be responsive, useful and fancy but if it drains the whole battery within an hour of use they will certainly not use it anymore; on mobile devices there are many energy eaters: sensors, CPU, memory, communication; the use of sensors certainly increases the level of machine-user interaction mainly in multimedia apps such as games, but at the expense of energy consumption increase; another energy consumer is the integrated GPS; while this is used mainly for navigation by specialized apps, it can also be used in order to determine the user's position and deliver him data regarding surroundings or even deliver a virtual reality based on actual reality; while most technologies on regular computers don't make use of sensors because they are not available, the support on devices that have them is mandatory;
- data transfer was and still is restrictive as without free high speed access offered by WiFi, the only option is given by the mobile operators data packages; mobile data is usually very expensive and most of the users can't afford to use multimedia applications that stream audio or video files; thus, the multimedia APIs of most technologies are found to be useless and thus the implementation effort is in vain.

Another important issue is caused by the limited screen estate that is used both for data input and output. Even if the resolution of small mobile devices' displays is constantly increasing allowing more and more information to be shown at one moment, the physical dimension of the device can't really keep up due to usability issues. Thus, even if the text or images can fit on the display they are too small for most users to look at without zooming in. This causes developers to approach the development of user interfaces for mobile citizen oriented applications from the users' point of view: the images and text on screen must be large enough for most users to read them without effort. Controls are drawn on the screen by taking into account the resolution of the device and the physical dimension of the screen in order to ensure readability on a large diversity of devices. Data visualization on mobile devices is also limited by the lack of a virtual pointer. In desktop and web applications running on computers the virtual pointer placed over different elements of the user interface provide additional information by displaying tooltips or activating additional screen regions. This behavior is not possible on touchscreen enabled devices and thus, a very important interaction method is lost. As getting information by placing the virtual pointer

over elements of the user interface is not possible on mobile devices the UI must be created so that it is clear from the beginning what information is displayed and which is the layout. Data input is not crippled only by the lack of a virtual pointer but also by the absence of a full size QWERTY keyboard. Citizen oriented applications must diminish as much as possible the amount of data they require from the user through automated authentication, storage of historical data and offering suggestions, transportation of data towards all related applications that require it.

Processing power and memory limitations were for a long time some of the most important issues the mobile developers had to deal with. The evolution of mobile processors was difficult for a long period, but in the present high end mobile devices have dual-core or quad-core processors capable of performance similar to two years old desktop CPUs. Thus, processing power is no longer a problem on high-end and mid devices, but is still limited on entry level devices that form the majority of the target group. Citizen oriented applications deal with the power limitations by exploiting the client-server model. All complex application logic is residing on a server and the mobile terminal is just a client executing requests. The client can also process some simple validation logic, but its main role is to be just a graphical interface for the APIs residing on the server. As the device is not required to process any business logic, it just uses the available resources for data input and results display.

External communication is defined as the ability of the device to transfer data to a device residing in the external environment through wireless meanings. Wireless technologies evolved in time and their speed also increased to rates that enable large data transfers. 4G and even 3G mobile networks ensure data transfer speeds high enough for real-time video streaming. This enables users to access multimedia applications with very short periods of waiting and also allows applications to become more complex and content rich. There is no such thing as good and free and this applies to mobile data transfer as well.

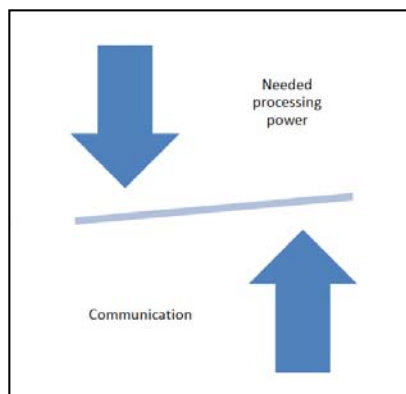


Figure 1. Communication vs. needed processing power

Even though the transfer rates are very high and provide the support for complex applications, the fees for such speeds and traffic are also high. This is the factor that the mobile citizen oriented applications must take into account. Even if there is a small group

having high speed and unlimited traffic, the rest of the target group has only slow speed and a limited amount of traffic. Thus, citizen oriented applications must be designed so that the communication with the server is minimal. This desiderate is opposed to the one of conserving processing power on the device and increasing communication with the server that executes the complex logic. The lower the communication level, the higher the needed processing power as the device must take over a part of the logic. Even if the processing power is increasing permanently, locating a part of the business logic on the mobile device has some disadvantages:

- different clients must be built for different platforms; for mobile applications, there are always differences between platforms and different clients must be built, but incorporating business logic in the client adds additional effort to the implementation and most of all, to the maintenance of code; maintenance of code for many different clients is a pain even when not including business logic, but this takes it even further;
- not all devices may be able to complete complex computing due to hardware limitations; this is a major issue as on such devices and workarounds can't always be found;
- using the processing power of the mobile device rapidly depletes the battery drastically shortening the independent operating time.

There are many limitations the mobile devices have, but also the potential is very large so the citizen oriented applications can enlarge their target group by a large amount only by considering them all. Through attentive selection and fine balancing of the compromises that are to be done the developers can obtain successful citizen oriented applications [4].

3. MEANS OF USER' INTERACTION WITH MOBILE DEVICES

For the mobile devices the interaction has many means like [2]:

- alphanumeric keyboard imply repeated pressing of a key for writing, every key has assigned three or more characters, figure 2;
- QWERTY keyboard is similar with the keyboard of a classic computer with some differences like dimension of the keys, are smaller, figure 2;
- HALF-QWERTY keyboard is a combination of numerical keyboard and QWERTY keyboard. The buttons are larger than the QWERTY keyboard, and each button is for two characters. So to write the first character on the key is necessary to press once and for writing the second character, twice;
- touchscreen is specific for smart mobile devices with a large screen and imitate alphanumeric keyboard or QWERTY keyboard, figure 4;
- mini-Joystick is present additionally at a keyboard and is used to navigate in the phone menu up, down, left and right;
- camera is used to take pictures and with QR codes is possible to input a text via camera. QR codes, *Quick Response*, are similar to bar code that stores a number of information bits. Although these codes are not popular among people with class

based devices, holders of PDAs, smartphones or other smart devices find these codes extremely useful;

- voice is a new trend to interact with the phone using the voice. Applications like SIRI, IRIS or S-Voice using voice for interaction between user and device.



Figure2.
Alphanumeric
keyboard



Figure 3. QWERTY
keyboard

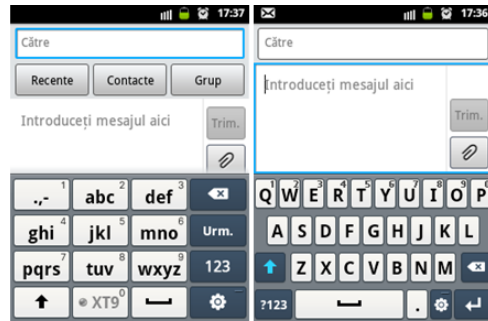


Figure 4. Alphanumeric and QWERTY keyboard
for touchscreen devices

The most used mean of interaction with mobile devices is touchscreen. It is very popular and more devices with that mean of interaction are produced.

4. DIRECTIONS IN MOBILE APPLICATIONS DEVELOPMENT

One of the most important issues in the mobile area is the data input mechanism. Due to small form factor and high mobility the data input methods are limited. Improvements in the data input area are of great impact on all applications used by mobile devices owners.

Gesture recognition is used in the present on some touch-enabled devices such as tablets and smartphones but not by all apps. The generalization of gesture recognition on mobile devices operating systems leads towards a button-less operation of the device and standardization across devices. Having consistent functionality across different mobile operating systems and devices enables users to access their data from different devices and OSs using the same sequence of operations they do on the device they use most. This leads to greater productivity enabling users to focus on the task they must do and not on the mobile device and operating system they are currently using.

In [6] a mobile gesture recognizer is presented for using two applications map navigation and a drawing application. To recognize the gestures seven models are used, like in figure 5.

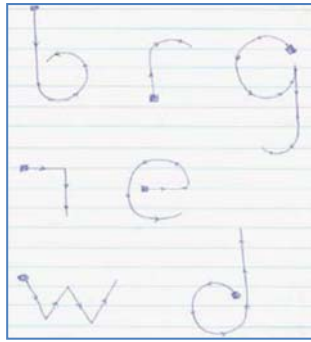


Figure 5. Definitions of letter for recognition

And each model represents something for every application. In that way every application developed should give a mean for every gesture.

The research in domain of gesture recognition is very thorough and many research papers are published in this domain, [7,8].

Kinect is a Microsoft technology used with the Xbox to provide control in applications by analyzing body movement. This enables Xbox users to interact in a more natural manner with the applications and makes multiplayer games more entertaining than before. Using something similar on mobile devices will probably not improve significantly the productivity of the users, but on the entertaining side there will be huge benefits. As there are already mobile smartphones with two cameras in order to enable the capture of 3D photos and videos, these are also suitable for Kinect like controls. Such a phone, coupled with a TV and a Kinect like software to provide control of games and apps would certainly increase the level of users' satisfaction.



Figure 6. Kinect-like control system for mobile devices

HTC EVO 3D is a device with two cameras that can be used for capturing 3D images from which the depth and position of the subject. Even though the Kinect uses a much complex system to determine the position of the subject, this is a good enough solution for occasional gaming as it also needs a large display [5].

5. CONCLUSIONS

Nowadays mobile device have not used only for making calls and sending text messages and they are used to used in any activity.

Technology continues to grow very much bringing new concepts and new tools in the mobile devices environment.

Development of mobile applications involves some features characteristic only for mobile development whichdistinguishes it from conventional computer application development.

The mobile devices have configurations which permit to a person to use these devices every ware without being limited to space or time. In this material are described the means of interact with the mobile phones and features directions for mobile applications development.

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