CHILDREN AIMED INTERFACES FOR ANDROID RUNNING DEVICES

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Abstract

The paper focuses on the development of mobile interfaces for children. The Android operating system is presented from appearance with its features, hardware support and its advantages over others operating systems. Mobile software development requirements on different platforms for mobile devices are identified and described. A graphical interface aiming children is designed and its features are presented. The interface includes an application for managing the school related tasks and time. Children manage the time of the days of the week differently. They have access to a task management system and a progress reporting tool. The advantages and development requirements are identified and discussed.

Keywords: mobile, software, development, Android, devices, interfaces, children.

1. Introduction

Android is an open-source software stack for mobile phones and other devices. Android was originated by a group of companies known as the Open Handset Alliance, led by Google. Today, many companies, both original members of the OHA and others, have invested heavily in Android, typically in the form of allocating significant engineering resources to improve Android and bring Android devices to Market. The goal of the Android Open Source Project is to create a successful real-world product that improves the mobile experience for end users [1].

Google's Andy Rubin describes Android as [2]:

"The first truly open and comprehensive platform for mobile devices, all of the software to run a mobile phone but without the proprietary obstacles that have hindered mobile innovation."

A simple definition of Android is presented in **Error! Reference source not found.** as a combination of three components:



Figure 1 - Android's components

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Android is a Linux operating system kernel that provides low-level interface with the hardware, memory management, and process control, all optimized for mobile devices [2]. Although Android applications are written in Java language, but these are not running within a Java ME virtual machine, as it has its own Dalvik virtual machine. The platform offers also open-source libraries for application development, including SQLite, WebKit, OpenGl and media manager.

These are written within different languages such as: C, C++ and Java, included in the Android Native Development Kit. The most important thing that Android platform offers to the developers of mobile applications is the open development environment built on an open-source Linux kernel. All developed applications have hardware access through the API libraries. What's really impressing and also useful for creative developers is the fact that users can remove and replace any native applications are written with the same APIs. Development on Android is made even easier through the simple access to web services [3]. This enables fast development of distributed applications.

According to the official site of Android developers [1] there were lunched nine different versions of Android, which fixed bugs and added new features. Each version includes updates of API libraries. Before creating an application that runs on the Android platform, a developer should think at the compatibility of the application with the devices. Updates to the framework API are designed so that the new API remains compatible with earlier versions of the API.

Developers that want to cover a large market of Android devices should choose the platform that has the lowest version of the API. If they develop on a platform with a new level of API, an older one will not contain the updates of the first one and the application will not be compatible with devices that have older versions.

The most important advantages that Android has over other mobile operating systems are:

- The programming is done using Java syntax. The Android operating system is based on a Linux kernel and has native support for modified Java applications. The Android Dalvik virtual machine delivers high performance when running mobile optimized Java applications. Developers that already have knowledge of Java programming must only learn the principals of the Android operating system in order to develop high quality mobile applications.
- The operating system is open source and the developer community is very large thus ensuring the approach of much more problems that would be possible for a closed operating system and commercial development team. There are many web sites that host Android related discussions. These are grouped for the experience level of the reader. General discussions approach issues about the use of Android devices and applications. Advanced topics include discussions about custom ROMs, rooting and hacking. The most advanced discussions approach programming issues on different versions of Android and under different devices.
- Manufactures were very receptive of this new platform and produced from the start many devices that run Android. Early devices had no dedicated graphics processor and all the processing was done by the main CPU. As the operating

evolved and supported more advanced features, the manufactures also improved the hardware capabilities of the handsets. One GHz CPUs, dedicated graphics processors and high density screens are common for devices running Android Froyo.

With every version developed and lunched, Android has become a strong, reliable, complex and powerful platform for mobile software development. Differences between versions are significant and almost all bugs have been remediated. Being an open source platform, developers with imagination will certainly create application in order to surprise the market that is in continuously growth.

2. Mobile software development

Mobile software development is the air of all mobile devices. As human been have a body and organs that are activated through the air, mobile devices have the hardware support but needs the software development which makes them alive. Depending on the type of mobile devices different applications are made to fulfill user's needs. For example the use of a digital camera is to make and store photos, videos and audio records. For this type of devices are developed different applications of data viewing, data editing, data stored and data transfer. There are also created applications that improve the quality of the picture, video and audio files, etc. Mobile phones include features of all mobile devices and that's why the market of mobile software development is on a continuously growth. Depending on users demands software developers have created thousands of different types of applications, including edutainment applications [4], mobile peer-to-peer social networking application [5]. Location proofs applications is another interesting software development for mobile devices. A location proof is a piece of data that certifies a receiver to a geographical location. Location proofs are handed out by the wireless infrastructure (e.g., a Wi-Fi access point or a cell tower) to mobile devices. The relatively short range of the wireless radios ensures that these devices are in physical proximity to the wireless transmitter. As a result, these devices are capable of proving their current or past locations to mobile applications [6]. The common type of mobile applications are the interfaces, that's how was born also the idea of multi-device interfaces. As mobile devices have internet access, a common interface can be created. This technological context imposes new challenges in user interface software engineering, as it must run on different computing platforms accommodating the capabilities of various devices and the different contexts of use. Challenges are triggered also because of the universal access requirements for a diversity of users [7].

The most powerful advantage of the Android is the fact that is an open source platform. This way many creative developers can experiment all their ideas without any cost. Since it was lunched, manufacturers began to create devices that support the Android platform. All versions have brought new important features that challenged developers to create applications at a new level.

The targeted group for the application under development is represented by children. The main characteristics of this group are the following:

- According to their age, children have different preoccupations and are attracted by different things. In order to create an application that pleases most of the users in the target group one must take into consideration these aspects. Every child needs a timetable, but the interface should be designed depending on their age. With the first version of the application I would like to cover children that have the age in the interval of [6, 14] years. For the animated character that is the guide of the application I will create a survey and I will interrogate 40 children with the age between [6, 8] years, 40 with the age between [9, 11] years and 40 with the age between [12, 14]. The results of the survey will help me create a list of animated characters that will please any child with the age between [6, 14] years.
- Their sex is also an important characteristic. Girls can be attracted by fairies, princesses and singers while boys can be attracted by kings, cars, warriors, heroes. In order to identify animated characters for all of them, half of the interrogated children will be girls and the other half will be represented by boys.
- The education of a child is a big influence for their personalities. Their level of education is reflected in their interests, their preoccupations, their activities, their knowledge and so far.
- Parents' financial situation and their occupations are also a big influence in children's education. The mobile devices that they will buy for their kids will be reported to their incomes. Because of that the application should be created in order to run on devices with low costs and also on devices with upper costs.
- The nationality of the children is also another characteristic that should be taken into account. Differences between cultures, mentality and habits influence children's growth.

The *Timetable* application should be managed easily by all children regardless their age, sex, nationality, financial situation or education. Because of that the application's menu is the same for all of them, but the interfaces are personalized. In order to accomplish this task is created a large list of characters that should be the guide of the application. The categories for the characters are represented in Figure 6.

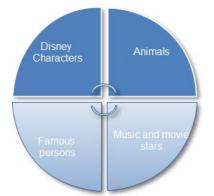


Figure 2 - Categories of animated characters

For each of these categories surveys are designed in order to identify the most popular characters and are added to the list of guides available in the application.

The application will use language files to store the messages for the users. This allows the easy localization of the application. The speaking engine is available only for English, French, Spanish and Italian.

Due to the special characteristics of children, the application has the following particularities:

- An animated character is the main point of interest at the interface. The animated character is available in many forms so that more than 95% of the interviewed children will be able to find the favorite character. Four categories of animated characters were defined: Disney characters, famous persons, music and movie stars, animals. Disney characters are very popular among children due to the highly mediatized movies, stories and cartoons. Famous persons that have done something really important for the human kind are included as there are many children that have such an idol and wish to follow him. Music and movie stars form another category that is formed of heroes from children movies and singers popular among children. The forth category will contain animals as most of the children already have many animal shaped toys
- A text-to-speech engine is incorporated in most parts of the interface. The text-tospeech engine has the task of reading out the messages that the user receives in normal use. The text-to-speech is helpful both for children that can't read well and for those that can't focus on using the device because they have a more important ongoing task. This text-to-speech engine will also be used by children to read out notes and school materials. This will improve the learning process as children can listen to lessons and other materials using headphones while they travel from home to school and the opposite or when they have no space to use their physical materials.
- The interface possesses a panic button at one touch distance. The panic button is design to take the GPS position of the phone and send it to a predefined number or email address. This is very useful in critical situations, but with just one touch the parent is informed that his child has a problem and also knows his location. It is very important to have the panic button accessible with very few clicks, but in the same time it should not be pressed accidentally. The number to send SMS to is configured by the parent and so is the email address.
- A quick way of sending audio messages to predefined numbers is available in the interface. The form for the audio message recording and sending must be kept as simple as possible. Necessary controls are the record message button, the play message button, a grid view with images for selecting the receivers and the send button. The audio message will be sent as multimedia message.
- The usability of the application is reflected in the simplicity of the interface. This is designed in order to be intuitive for children of any age. Since the first use of the application, children will get familiar with its features without needing specific knowledge. Graphical controls must contain symbols associated with the actions they perform.

Due to the special target group of the interface, its success depends exclusively on the analyses of its members. Both implicit and explicit requirements are identified through the analyses of the target group and the study of the behavior of the children testing the interface. Parents are also an important party as they also have requirements for the interface.

3. Age specific applications development for Android devices

People at different ages have different: priorities, preoccupations, activities, therefor they have different necessities. That's why developers have to create age specific applications in order to please any user. Before creating a new application one has to think in context and find the answers of a few questions like: who are the users of the application, when will they interact, where can they be located when are using your application and at what moment at time they can use it, why will they use your application and what information can they obtain from it, how are they using their mobile device [8].

The visual design of an application is certainly one of the most important aspects of a project because it represents the first impression the users will have. A great design gives the users high expectation of the application, meanwhile a poor design leads to lower expectations. Being the first impression of a product the visual design has the power to influence the user's interest. If it is attractive the user will spend more and more time to discover the product. There are six important elements for a design: the context, the message, the layout, the color, the psychology of colors, color pallets and the typography. Any design should transmit a message to users, which means that only by having a look at it; users should understand what they can do with the product and what information they can obtain. The layout determines the ease of use for the users. The possibility to return with one move at the main menu from any interface of the application can represent a good management of the layout. Page layout is the art of manipulating the user's attention on a page to convey meaning, sequence, and points of interaction [9]. Some major elements of the layout are: visual hierarchy, visual flow, grouping and alignment. Nowadays mobile devices have the entire spectrum of colors. Mobile screens have different color or bit depths, which means the number of bits used to represent the color of a single pixel in a bitmapped image. When complex designs are displayed on different devices that have a specific color depth can appear unwanted views of the images. Psychology of the colors can be also a strong point of design development because colors can evoke in people different emotions. With the right color one can transmit the right message. Users can have also different expectations of the product depending on the colors that have been used. Another important aspect of the color is that one color, in different cultures, can be associated with different concepts, emotions, feelings, etc. In (Table 1) are present some meanings for a few colors [8]:

Red	Passion, strength, energy, fire, sex, love, romance, excitement, speed, heat,							
	arrogance, ambition, leadership, masculinity, power, danger, gaudiness,							
	blood, war, anger, revolution, radicalism, aggression, respect, martyrs,							
	conservatism (U.S. politics), Liberalism (Canadian politics), wealth							
	(China), and marriage (India)							

Orange	Energy, enthusiasm, balance, happiness, heat, fire, flamboyance, playfulness, aggression, arrogance, gaudiness, over emotion, warning, danger, autumn, desire
Pink	Spring, gratitude, appreciation, admiration, sympathy, socialism, femininity, health, love, romance, marriage, joy, flirtatiousness, innocence and child-like qualities
Brown	Calm, boldness, depth, nature, richness, rustic things, stability, tradition, anachronism, boorishness, dirt, dullness, heaviness, poverty, roughness, earth

Children are an important category of mobile phone's users. The parents buy mobile devices for their children in order to maintain contact with them and also because it's quite a common toy for them. The evolution of technology has also brought new exposures to danger for children. Internet is one of the most dangerous things for a kid because they can be contacted by everyone and they can be easily tricked. In order to decrease parental stress and to increase children's safety has been constructed a software for mobile phones that offers strong monitoring. In this way parents can install this kind of software in their children's cell phones, without their knowledge. Parents are able to discretely monitor their children's cell phone activities, including checking sent and received SMS messages, inbound and outbound call logs and location tracking their children by GPS to know the location they call from and who they are communicating with without getting noticed. These are software applications that treat the security, but I would like to talk about usability of mobile phones and also about the specific age design. The main menu should be intuitive, simple and also attractive. A good strategy to make the interfaces more attractive is to use Disney characters for icons and also as backgrounds. An animated popular character gifted with a pleasant voice is really helpful for children that can't read in discovering and using to the phone's features. The voice of the character should be an option of the menu, in order to be activated when children can't read and when they grow up to have the possibility to deactivate it. The icons for any option of the menu should be represented by an animated character representatively disguised. Messages from main menu are represented by the animated character disguised as a postman or will have a paper with a pen in hands. Contact is represented by the personage with an agenda in his hands and so on.

Character will also be responsible of announcing events, reminding tasks, announcing battery charging, showing limits of resource. Character usability in developing children mobile interfaces is presented in Figure 7.



Figure 3 - Character usability in children mobile interfaces

The *Timetable* application has an animated partner that is responsible to guide the user, announce warnings and tasks. The application will contain the school timetable for the entire week, daily school tasks and is able to warn the child to leave for school with a predefined time interval before the first school hour. Parents will not worry anymore for their children's school tasks, because the product can be also set to daily remind all their tasks at a specific hour. Once homework is finished, it can be marked as completed. At a specific hour the animated character will show a report of daily tasks and completed tasks in order to help children to verify themselves. The application will make a difference between week time and weekend. During the weekend children don't have to go to school and that's why the application won't have to remind them the school time. The specific hours for homework announcement and tasks report are different from those during the week. Architecture of *Timetable* application is presented in Figure 8.

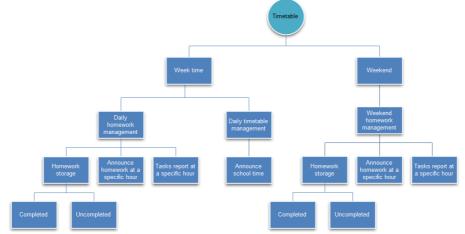


Figure 4 - Timetable architecture

The application makes use of many features of the Android OS. The most used once are SQLite and the notification feature. Android offers the SQLite relational database library that provides a robust persistence layer. Every application can create its own database

over which it has complete control. Android Content Provider offers a generic, welldefined interface for using and sharing data.

Android databases are stored in the /data/data/<package_name>/ databases folder on the device or emulator. By default all databases are private and can be accessed only by the application that created them. *Timetable* application is based on many interactions with the database. In order to simplify these interactions is created a helper class that will contain intuitive and strongly typed methods for adding, removing, updating items and also for creating opening and closing the database.

To add a new record of a task in the tasks database the following code is used:

// Create a new row of values to insert.
ContentValues newValues = new ContentValues();

// Assign values for each row. newValues.put(COLUMN_NAME, newValue); [... Repeat for each column ...]

// Insert the row into TimeTable table
timetableDatabase.insert(TIMETABLE, null, newValues);

The COLUMN_NAME parameter is changed for each column. The newValue parameter is the value that is desired for the associated column. The put method of the ContentValues object is called for all the values that must be inserted into the database.

For notifications a new Android Activity must be created. Android activities are designed in an xml file in order to keep interface elements and application's logic as separated as possible.

This approach has the advantage of keeping the application's interface separated from the logic. Also another great advantage is the fact that the interface is resolution independent. Regardless the resolution of the display of the device the application is running on, the interface is rendered nicely. The logical the application resides in a different file. The association affections to the interfaces elements, is made through code. Interfaces elements are retrieved by a special function that uses their id as identification method. In the xml file the controls must have defined only the proprieties that are needed by the logic of the application. If the code does not interfere with the control from the graphical interface this one doesn't even need to have an id attribute defined in the xml file.

The application is currently under development using the Eclipse IDE version 3.5 and the SDK 2.0. The testing is done on a HTC Desire device with 1 GHz CPU and 512 RAM with a resolution of 800x480 running Android Froyo 2.2.

The steps for developing the *Timetable* application are:

• The design of the *Timetable* application is the process in which the requirements of the application are identified. A sample of the target group is analyzed in order to identify all implicit and explicit requirements. During this step the forms of the application are designed and also the functionalities are formalized. The results of

this step are documents that contain the application's requirements and the design. The *Timetable* application has been designed to have clear forms and straight logic; forms for the management of the timetable for each day of the week were designed; controls for the quick selection of data were created. The form presenting the daily timetable has been designed as simple as possible and delivering the most frequent functionalities with just one touch. The forms for the management of homework and the reports about tasks have been designed to use graphical elements for quick perception of important information.



Figure 5 - Design forms for the daily timetable

Figure 9 shows the design of the daily timetable management; the forms allow quick navigation so that the user can see the timetable and easily add new classes to a day's schedule.

• The implementation is the step of the process when the development team does the actual coding and builds the elements of the application. For this step correct and complete requirements form the design stage are essential. Without complete and correct requirements, the implementation process will be repeated as in the testing phase many faults will be identified. During this step the members of the development team take each requirement and implement the logic for it and tie it with the interface of the application. The interface of the *Timetable* application is optimized for the operation with touchscreens. The controls are large, to allow the users to press them without much effort, the messages are clear and concise and the navigation structure is kept simple to facilitate the operation. The implementation of the *Timetable* application is done by one programmer using the eclipse programming environment with plug-ins for android development and the official android sdk. The machine used for development runs windows 7 business edition.

For the *Timetable* application, the design of the forms is separated from the logic of the application. The design of the forms is made through XML files and the logic is implements in Java classes.

The code implements the functionality of the buttons defined in the associated XMLfile.

Another graphical interface of the application is the one where children introduce their homework in order to take an evidence of them. The steps that children must follow in order to introduce homework are: they have to select the object for which they have to prepare a task, then they have to write the statement of the task and finally they have to pick the deadline day. The graphical interfaces that cover all these steps are presented in Figure 10.

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Figure 6 - Design forms for daily tasks

For the first step that one has to do in order to add a task of a specific object it was used a Spinner control, which is shown in the first photo of (Figure 10 - Design forms for daily tasks) and the xml code is:

```
<Spinner android:id="@+id/spinner"
android:layout_width="fill_parent"
android:layout_height="wrap_content"
/>
```

The objects that spinner should contain are stored in the file string.xml. The connection between the control and the list of objects is made through an ArrayAdapter as is shown in the following code:

```
Spinner spinner = (Spinner) findViewById(R.id.spinner);
```

```
ArrayAdapter<CharSequence> adapter =
```

ArrayAdapter.createFromResource(this, R.array.objects_array, android.R.layout.simple_spinner_item);

adapter.setDropDownViewResource(android.R.layout.simple_spinner_dropdown
_item);

spinner.setAdapter(adapter);

For the statement of the task was used an EditView control and the xml code for it is the following:

<EditText android:id="@+*id/statement*" android:layout_width="*fill_parent*"

android:layout_height="wrap_content" />

In order to make the application more attractive for children, characters from the selected theme are displayed in the spaces that are not filled up by the controls.

- The testing step has as objective the identification and correction of the faults . present in the application. The most obvious effect of a successful testing process is an application without bugs and of great quality. Faults are errors made by the members of the development team during the implementation process. Faults are caused by typing errors, wrong use of data structures, algorithms, incorrect logic or lack of sufficient knowledge about the used technologies. The testing process is started short after the implementation one, as the programmer tests the functionality he adds continuously. The testing made by the programmer is completed by dedicated tests made by specialized persons and users. For the *Timetable* application, the testing process involves the tests of the programmer and the tests made by a tester. Users will be allowed to test the application at a later development stage when more features will have been implemented and more faults corrected. Datasets have been used for the testing of the Timetable application. The application is tested on a HTC Desire with a CPU of 1 GHz, 512 RAM and a resolution of 800x480.
- The documenting of code is an important process for further maintenance and updates. The process of code documenting must be started and run with the implementation one. This will ensure all written code will be documented at the end of the development cycle. The documentation of code during the implementation process also ensures a more rapid identification and correction of faults. It is of very high importance to document all lines of code so that a different programmer understands what has been done and can do modifications in a short time interval. For the *Timetable* application, the documentation process is parallel with the implementation one. The code is documented on the measure it is written.
- The deployment of the application means the distribution to the users after all faults identified by the testing process have been corrected and all requirements defined in the design stage have been implemented. The deployment of the *Timetable* application will be done as a .pkg file using the android market. Through the android market the application will be available to all users with compatible devices and parents will be able to test it and evaluate the suitability for their children.
- The training of the users is made through a video tutorial that shows the features of the application and how these are to be used. The learning process is simple and quick and users will be able to use the application immediately after it.
- The maintenance process involves the correction of faults identified by users after the application has been launched on the market and also the addition of additional features. The faults can be reported by users through the dedicated feature of the application that allows the users to report errors directly to a dedicated web server. The dedicated feature can also be used for comments and suggestions.

Once will be implemented and tested to find and fix all errors that can occur the application will be presented on Android market so that every child that wishes to have a school helper to own it.

4. Conclusions

Android is a strong platform for software development on smart phones with full physical keyboard but also for those with touch screen. For applications that use a database, Android OS offers the SQLite relational database library that provides a robust persistence layer. Every application can create its own database over which it has complete control.

Creating citizen oriented applications is the essence of success. People at different ages have different: priorities, preoccupations, activities, therefor they have different necessities. That's why developers have to create age specific applications in order to please any user.

In my opinion mobile phone users can be divided in the following categories: children, old people, blind people, business people and regular adults. Mobile software development for the first three categories can be a great challenge for me and in the future I will focus on developing mobile applications for them. Children's exposure to danger is a real problem and should be diminished, but beside this I think there are also other aspects that we have to think such as their education and personal development. It is psychological demonstrated the fact that children learn easier through games. This aspect favors the development of edutainment games which increase children's abilities. Developers with great imagination are in strong competition, because children also get bored very fast. Games that teach little users to figure, write, recognize and combine forms (puzzles), develop their vocabulary are the most popular. All these games have the same purpose but design is what makes the difference between them. A child can be a harsh critic and this fact lunches a new challenge. For feature applications development I'll try to find a game with an unusual purpose and an attractive design.

Old people make me think at all grandparents in the world and I really would like to make friendlier to them this new technology of mobile phones. The interfaces should be more visible and also could be interesting an alarm for their medicaments.

The biggest challenge for mobile software development is created by blind people in my opinion. It is harder to make mobile phones friendlier to them. Normally we have to think at an audio interface for them. Devices with touch screen, in my opinion, facilities software development for blind people easier than those with normal keyboard. The way menu items are distributed on the screen and also their number is a good start for oriented blind application. In my opinion the menu should contain only five elements on the screen for each interface. Four of these elements should be distributed in the corners of the screen and the fifth one in the center of the screen. This way they can't failed access them. The back, main menu, exit menu options should be associated to the physical dial-up and dial-close buttons.

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