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# List of pictures

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# Naming conventions

Widgets, apps, applications, components, GUI widget

# Introduction

## Android platform briefly

Nowadays one of the most popular operating systems targeted on mobile devices is undoubtedly Android. As of second quarter 2013, almost 80 percent of newly sold devices use Android as its platform. The greatest share of all manufacturers belongs to Samsung.

This operating system can not be compared to previous versions of desktop platforms, because the one of the key advantages is missing. The touch input. For majority of users, especially the ones who browse the internet a lot, the real breakthrough came with all the touches. In history not so distant, the only possibility to comfortably search the web was to use standard desktop computing inputs – mouse and a keyboard. But what about mobile users? They tend to operate in much more compact environment with limited access to all the gadgets connected with desktop computing. As a result, all users, hungry for browsing the web were sentenced to use arrows or in better cases, some kind of trackball. The real power of fast browsing basically came with three things – wifi/3G internet connection, high definition screens and the ability to input via touches. Its important to stress, that the first two mentioned would not significantly improve the browsing experience itself. But with the connection of the touch screen everything took the whole new direction. Let’s have an example. Filling the form on e-shop – a classic task on desktop computer. What a nightmare on pre-historical mobile device. User was forced to skim through all these visible elements to finally acquire the targeted one. The whole operation was matter of seconds. Compared to touch input, this was very poor performance. Average user, when given low-end Android device, is able to target the form field in a matter of tens or hundreds of milliseconds. And when it comes to filling some input, the screen of the mobile gadget is so large, that a full version of qwerty keyboard fits in.

One of the key values, that caused the major breakthrough of Android is its Linux kernel ,which is hidden under the shiny hood of all the functions, that are presented to the final user. This “glue” is used to offer an interface to all the internal hardware, such as gyroscope, accelerometer and proximity sensors, that are brought to the end user to enrich the interaction with either default or third party applications.

Open source nature of Android, device manufacturers, professional and enthusiast developers are free to update the code under Apache licence.

## Widgets

Synonym for application, or app. Widget is not connected only with Android platform, it can be easily found on desktop PC, as well as on Windows Phone, or iOS. When compared to common software packages, or even large software suites, widget is a lightweight application, that does not necessarily consumes all users attention. Easily imagined example would be widget, that shows the current CPU/memory load, weather forecast app, or calendar.

Among the coding society a wide variety of terms related to widgets is used. Content of this work will be further discussed, but it is targeted on GUI widgets. These elements are previously known from desktop computing under the name components. All the checkboxes, radio buttons, faders and even grouped elements like dialog boxes - these are all GUI widgets.

Android comes with rich set of widgets, that are professionally looking, ready to be used in an out-of-the-box manner. Adequate event-driven mechanism is included, so that these widgets respond accordingly to user actions, like touches, clicks, drags, etc.

Android developers have basically two possibilities to include existing widgets into their apps.

* Specify the layout with all the widgets in XML document (preffered way)
  + Pros and cons,
  + Easily changed without the explicit need to recompile source
* Set the layout programmatically
  + Pros and cons

But what about the situation, when none of the supported widgets fits the developer’s needs and he wants to design a custom one? Of course, there is the possibility to create own components, that might extend the basic functionality of existing ones, or to offer a whole new approach. The question of setting up the initial layout stays almost the same. While there is of course need to specify custom functionality programmatically, once the widget is set up, it can be added to existing layout via XML, or by code change.

Example of programmatic layout setup and XML-based

## History

The original developer of today most popular platform - Android, Inc. was founded in 2003. Their primary intention was to develop a smart operating system targeted on digital cameras. When studying the situation on the market, the original targeted device changed and all the effort was now directed towards newly originated smartphones with clear vision to rival Symbian and Windows Mobile. The idea was clear, keep the newly designed operating system as a secret as long as possible. In 2005, the whole company was acquired by Google, with all key employees and the founders staying.

With this acquisition, Google secretly planned to enter the growing market of smart phones. In spite of this move, certain hardware components were lined up and several software partners were asked to cooperate.

While the background development went on, Apple presented their first version of touchscreen-based phone – the iPhone. At that time, Google had a prototype codenamed “Sooner”. This prototype was similar to BlackBerry phones, because it has no touchscreen and only the physical QWERTY keyboard was present. Immediate actions were taken and the whole operation system was reengineered. Combination of traits, that came from previous designs with overall experience marked the clear goal – prepare competitive rival for iPhone.

On November 5, 2007, the Open Handset Alliance (OHA) was publicly presented. OHA incorporates technology companies, wireless carriers, and device and chip manufacturers in common intention to develop open standards for mobile devices. As a result of all previous steps, first Android based smart phone was released – HTC Dream on October 22, 2008. Critical reviews stated that the phone itself looks both futuristic and retro, but it is not an “iPhone killer.” On the other hand Android as an operating system was received quite well and a major commercial success was yet to come.

Android corresponds to real world actions, like touching, sliding, pinching, reverse pinching, etc. Direct manipulation in general.

Other visual stimuli are presented through the ability to receive events through internal hardware devices, like gyroscope, accelerometer, proximity sensors, GPS module and many others.

## Extensibility

Android is a very popular platform for developers. As of April-May 2013, 71% developers targeted their applications on Android.

Android is open source and build on Linux kernel. Source codes are released by Google by Apache License.

October 2012 almost 700000 apps were available to be downloaded via Google Play and the total number of downloads from Google Play reaches 25 billion.

As of May 2013 the total number of app download reaches 48 billion.

September 3, 2013: 1 billion Android devices has been activated so far.

Despite primary targeted on smartphones and tablets, Android quickly attacked the market with smart televisions, game consoles digital cameras and other electronics.

Easy to start bundle, free to use even for commercial development, mention more than ADT bundle, but also the IDE based on IntelliJ IDEA (compare this one to Eclipse, user satisfactory, usage)

What is necessary to perform to write custom apps

Bridge between hardware devices(gyro, sensors, …) easy used through API

Developers today are given the opportunity to keep using Eclipse IDE even for Android development. The only thing needed is Android Developer Tools (ADT) plugin that gives them useful tools when building, debugging and testing their application. There is also possibility to install the whole ADT bundle package, which contains the Eclipse with ADT plugin pre-configured.

Some developers argue that Eclipse is heavyweight and slow. Quick and easy solution is to use Android Studio based on IntelliJ IDEA. Developers can benefit from IDEA’s valued features, like code navigation, refactoring, code analysis etc. Despite the fact, that final version of Android Studio has not yet been released; it is obvious, that it will be the preferred IDE in the future.

Novice developers may use the integrated UI builders that help them create custom layout in a drag and drop manner, while experienced ones will directly write into layout XML files and value the desired control over the UI elements.

Because the Android platform is “developer friendly,” Google has incorporated several functions that enable the developer to quickly run the application on target device via USB. Common problems, like memory leaks or performance critical areas can be revealed by using profiler directly on target device. In a situation, when no physical device is available, an embedded emulator can be used. When in developer mode, useful statistics, like CPU and memory usage, device’s network bandwidth usage or debugging information, can be displayed.

Every level of a newly created application needs its tools for testing. Android testing framework comes as an integral part of ADT plugin. Test suites are based on JUnit, which gives you the opportunity to use classic JUnit to test classes that does not use Android API. In case of more sophisticated classes that use Android API, JUnit extension should be used when testing. These extensions make it possible to create mock objects and methods that help the developer affect the lifecycle of the component.

## History of Android releases

### Android 1.5 Cupcake

First major Android release was introduced April 30, 2009. Noticeable features, which were presented in this release, were: newly integrated home screen widgets, folders visible on home screen, stereo Bluetooth support, ability to copy/paste within web browser, and video recorder with playback. Devices worth mentioning were: HTC Hero, Samsung Moment or Motorola Backflip.

### Android 1.6 Donut

Donut release presented the quick search box, interface for camera was updated, as well as Android Market, and gallery. Battery usage indicator and text-to-speech engine were added. Devices, which benefited from these new features were LG Optimus, Samsung Galaxy, or Sony Xperia X10.

### Android 2.0 – 2.1 Eclair

Google Maps Navigator in beta version was firstly presented with the Eclair release. Other features were: update browser based on Chrome engine, support for multiple accounts, or improved keyboard. High-end devices, which used Eclair were HTC Desire, Samsung Galaxy S and Motorola Droid.

### Android 2.2 – 2.3 Froyo

This release finally added support for Adobe flash, as well as multiple keyboard languages. Certain actions were taken and the whole system was optimized towards higher performance with slightly decreased computational demands. Noticable devices of this period are Nexus One or HTC Evo.

### Android 2.3 – 2.3.7 Gingerbread

As a minor release, Gingerbread offerred noticable UI refinements, support for NFC and faster text input. From all the devices from this period, Nexus S, HTC Sensation or Samsung Galaxy S II stand out the most.

### Android 3.0 – 3.2 Honeycomb

Honeycomb release meant a breakthrough mainly for table users, because holographic UI design was added, as well as action bar, improved multi-tasking or updated Android apps, which came in the bundle. Among others, Motorola Xoom, Eee Pad Transformer or Samsung Galaxy Tab were presented.

### Android 4.0 Ice Cream Sandwich

Release 4.0 meant improved multi-tasking, ability to unlock the screen by face detection, resizeable widgets and the option, that soft buttons can replace hard keys. This era presented Galaxy Nexus, HTC One or Sony Xperia T.

### Android 4.1 – 4.3 Jelly Bean

Jelly Bean came with streamlined UI, multi-user profiles for tablets, lock screen widgets and OpenGL ES 3.0. Devices worth mentioning are Samsung Galaxy S3 and S4, HTC One or Sony Xperia Z.

### 

# Aims of the work (motivation)

The motivation behind this work is to have a tool that allows us to remotely configure the UI on target Android device. This means not only to remotely setup the UI, but also to receive events, generated by the UI widgets and respond accordingly.

## Study different ways of user interaction with VR devices at various levels of immersion.

## Study possibilities of interaction using Android-based mobile devices

## Propose and implement methods for general description and dynamic generation of graphical user interfaces on Android, based on the needs of VR applications. Make the system easily extensible.

## The result of the work will be a protocol description, an application for Android platform, client library and a simple application using the library demonstrating usability of the protocol.

## Conduct user testing and evaluate usability.

## Document how to extend the system with new controls.

# Existing solutions

## What is the difference between this solution and UI protocol?

# Design and architecture

## Protocol

## Modularity

# Implementation

# Testing

# Conclusion

## Causes of higher latency + suggestions on how to decrease it

## Future development

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# User screeners

# CD/DVD contents