How to Develop Mobile Applications with Web-Technologies

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Mobile applications are the new hype since the launch of the first iPhone generation on 2007. The market of mobile application was grown extremly fast and the varity of applications also. The next trend will be location-based service, mobile search, mobile payment and mobile social networking. Hybrid applications could be one way to develop applications with these services. It is easy to design with a application with HTML and Javascript and the biggest benefit is, the easy way to deploy the app on different platforms and devices. The new technologie HTML5 will bringing new features to the devices and hybrid applications will realy benefit from that. This thesis will introduce into hybrid technology and will show you the opportunities with a prototype.
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1 INTRODUCTION

1.1 BACKGROUND AND MOTIVATION OF THE THESIS

In the year of 2007 Apple Computer Inc. represented their first mobile phone, the iPhone. It was a revolutionary Smartphone with a big touchscreen and only one button for the navigation, which they called “Home-Button”. It was the first Smartphone with a browser who looks and feels like a desktop browser. Every mobile phone in the past used other technologies like WEP with a special browser for the mobile phone. It was not user-optimized. The iPhone was the first mobile which enabled a user-friendly and a very comfortable way to surf on the web.

The next big thing was the Application Market. Apple offers a Marketplace integrated in the iTunes application, to sell small applications for her iPhone, iPad and iPod. Every device used the same operating system which is called iOS. So it was easier to develop applications for the iOS and the three devices. But it was absolutely necessary to develop the applications in Objective-C.

In the autumn of 2008 the Google Inc. released their first Smartphone with an own operating system Android. Google brought a company with the name “Android” and started with the design and development of her own operating system in the summer of 2005. Android works with a Linux-Kernel and is based on the Java-Technology from Sun Microsystems (Oracle since 2010). Many programmers prefer Java or C to develop new applications for desktop PCs. So it is easier for them to develop new apps for smartphones also in Java.

The main difference between iOS and Android is the range of devices. The iOS from Apple is strictly aligned to the products from Apple. It works only on iPhone, iPad and iPod. However, Android works on many devices on the market. The big players like HTC, Samsung, LG etc. use Android on their smartphones. In conclusion: you will be able to reach more users by developing apps for Android.
1 Introduction

The main target of the most mobile applications is, to reach as many users as possible. In Figure 1 you can see a table with the market share of the different operating systems for smartphones. In example, if you develop your application for Android you will reach 22.7 percent of the end users. So if you want to reach more users, the normal way is, to develop the same app for every device unique.

Every company who wants to bring out a mobile app spends a lot of money to programming the same app for every device. It could be possible for them to save a lot of money by using web-technologies with special frameworks. They would just need a framework which is connected to the device and the special mobile functions.

The aim of this Thesis is to show a simple way how and why to develop mobile applications with web-technologies.

1.2 Problem Statement

Since the release of HTML5 in the year of 2010 web developers have the opportunity to develop more complex websites. E.g. one new feature is, to store data local without any database. That feature and many others supports the development of more attractive web-applications which look and feel like desktop applications or java-applets.
1 Introduction

It is easy to develop web-applications just for desktop users with their public browsers like Firefox, Chrome, Microsoft IE and Safari. But the tricky thing is, to bring the web-applications on the smartphone devices. Normally, the user case is completely different to desktop or laptop users. Smartphone applications have to be quick and very simple in use. You have no peripheries like a complete keyboard, mouse or a big monitor. The screen size is limited and the users navigate with her fingers or a pen. So it is necessary to use the same user interface in the application like native applications on the Smartphone. One way is, to imitate the user interface from the device so it looks like a native program.

Some frameworks on the market provided to bring web-applications on smartphones. In this Thesis I will show how it works with Phonegap and iWebKit. Phonegap is a small framework which displays a browser widget and extends default browser capabilities. You have direct access to device specific functions like the camera, sensors etc. Figure 2 shows which popular functions are supported by Phonegap. The application could be completely coded in HTML.

<table>
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<th>Function</th>
<th>iOS (Phone 3G)</th>
<th>iOS (Phone 3GS and newer)</th>
<th>Android</th>
<th>OS 4-7</th>
<th>OS 5.x</th>
<th>OS 6.0+</th>
<th>Palm</th>
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<tr>
<td>Notification (Vibration)</td>
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<td>✓</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Figure 2: Phonegap supported features on the devices
1 Introduction

iWebKit is framework for the user-interface, it will shape your application to look like a native application. Additional iWebKit provided the same animations on the Menus, Buttons and Lists like the iOS or Android.

After this short introduction into the frameworks, I will provide a workflow from the installing of the programming environment, the Android SDK with the emulator and finally the both frameworks, Phonegap an iWebkit. Accordingly, i will program a small HTML-based hybrid application to demonstrate how it works on an Android device.

1.3 RESEARCH QUESTIONS

The following questions are important to the development of mobile applications with web-technologies. Because the main aspect of software development are the costs of the development. It is very important to know how much money must be invested in the development. It depends heavily on the content of the Application. E.g. in the case of an highend 3d game a native application written in java or objectiv-c must be your first choice. Hybrid applications are preferred e.g. for location-based services, dealing with charts and tables or similar.

1.3.1 WHAT IS STATE OF THE ART IN THE MOBILE APPLICATION MARKET

I will present some facts about the mobile market especially the application market. How the market has grown and which categories of application are the most wanted today and will it be in the future?

1.3.2 WHAT IS THE FUTURE IN MOBILE APPLICATION MARKET

Before you take the decision in which technology the mobile application will be developed, it is important to know which kind of applications are the most wanted in the future. Hybrid technology is not the best way in every kind of application, e.g. 3D games need more performance, but in other kinds like location-based services it could be the first choice.
2 Mobile Application Market

1.3.3 **What Are The Benefits For Developing Hybrid Applications**

What is the main reason to develop your mobile application with hybrid technology. Why is it so comfortably to publish the application on multiple platforms. And why is it cheaper for companies to develop their apps with this technology?

2 **Mobile Application Market**

*In this section I will present a short analyse about the mobile application market and the challenges and chances into the future of this market.*

2.1 **Market Analyse**

The Gartner research company figured out that in the year of 2010 1.6 Billion units of mobile devices were sold to the end users and that in the same time the growth of the smartphone market was 72 percent. 19 percent of the sold mobile devices are smartphones (Egham_3, 2011).

They forecast that 17.7 billion applications from the app stores worldwide with a value of 15 billion USD2011 will be downloaded in 2011 (Egham_4, 2011).

It is big market with a big capital and the question is, which kind of mobile applications are the most wanted today and in the future? The following List will show you which are the most popular categorys in the Apple App Store with facts about the units and market share. (148Apps, 2010 last update 15.05.2011)
2 Mobile Application Market

- Games 54,538 Units 15.00%
- Books 53,466 Units 14.71%
- Entertainment 36,090 Units 9.93%
- Education 31,366 Units 8.63%
- Lifestyle 27,478 Units 7.56%
- Utilities 22,341 Units 6.15%
- Travel 21,305 Units 5.86%
- Music 14,941 Units 4.11%
- References 13,914 Units 3.83%
- Business 13,119 Units 3.61%

As you can see the most wanted applications are games. Some of them based on high performance 3D engine like the game: “Need for Speed”. In this case it is necessary to develop the application native in Objective-c on the iOS or pure Java for Android. Other categories like “Books”, “Education” or “Lifestyle” are predestinated to be developed with web-technologies like HTML5, Javascript etc. because they don’t need high performance graphics. It is possible to create apps with the same look and feeling like native applications. Normally, the customer cannot distinguish between native and hybrid applications. The most frameworks on the market for hybrid applications support this feature.

The Cost for the developing makes the difference. On the German market are the average costs for a programmer with Java, C++ or Objective-c skills 69 Euro per hour. A web-designer with Javascript PHP and MySQL skills is 10 Euros ore 15 percent cheaper in average. In the conclusion the developing of hybrid applications with a web-designer should be cheaper. (Calculator: http://www.gulp.de/kb/tools/money.html)

The Forrester Research Company published on the Report “Is an iPhone App Right For You?” some facts about the real costs of developing a iPhone application. The cost for an app started between 15,000 USD and 20,000 USD, high sophisticated apps could be bringing up the cost to 150,000 USD. (Lomas, 2009)
2 Mobile Application Market

These calculated costs are only for one platform, if you want to reach more then 16% percent (iOS market share in 2010) of the market with your application, you have to develop the same app for multiple platforms like Symbian, Android or Palm. Every porting to another platform is associated with additional costs. In case of developing hybrid applications the cost for porting is a minimum, because you can use the same programming language and normally 80% or 90% of the sourcecode is the same like on other platforms. You just need to change the version of the used frameworks, e.g. from Phonegap for iPhone to Phonegap for Android.

2.2 THE BENEFITS OF MOBILE APPLICATIONS

One big benefit of a mobile application for the business is, to stay in touch with their customers. It is possible to combine a useful feature like a weather forecast or a simple game with marketing tools, e.g. a page with advertisement as a preloader for the application.

The Gartner Research Company say, two of the biggest future topics in the mobile application market will be location-based services with 1.4 billion users by 2014 and mobile payment with the smartphone. One scenario could be: A customer is looking for a special offer for lunch near by. With location-based service it is possible to check up the space around you with a geolocation service and special attributes like “special offer” and “restaurant”. The restaurants will be listed in a database with their gps coordinates and their special offers. On the second step it could be a feature for the customers to pay their lunch with the mobile phone (STAMFORD, 2011).

The location-based service is further the chance to the traditional business which are located with stores in the citys to catch some new customers with special offers from the ambience. If the User will allow push service and localisation for the mobile application, it is possible so send him push-messages directly on the main mobile screen with offers who could be interesting for him.

In some years - three are expected - will be HTML5 the new HTML standard on the web. (W3C, 2011) Today many Browsers are already supports the new features of HTML5 e.g. localstorage or embedded video. It is very comfortable to build web-applications with these
new features and it is also possible to use these features in a hybrid mobile application. The Main Browsers in iOS and Android are the mobile versions of Safari and Chrome and both of them supporting the new HTML5 features.

2.3 WHy DEVELOP WITH HYBRID TECHNOLOGY

The most Companies with an own IT-Department have specialists for the network, server, user and application support and webdesigner for the intranet and the company webpage. If the company business is not on software development, they will not have specialists in objectiv programming languages. So, if they decided to bring out an application for their customers ore the employees of the company, they must buy external resources for a native application. On the other hand they can use inhouse experts with webdesign-skills if they decided to develop with web-technologys. The benefit of inhouse development is not only the reduction of costs. If your application handle with sensitive data it is better to make the development inhouse.

The second cause is, if you want to bring some new content to your application and use a distributed application which one will load some content or pages from an external webservice - like the prototype in this thesis - it is easy to create new content on these sites or to make an update. At the next start of the application or reload, the new content will be available. You don’t need to update the whole application with a new download from the app store. The last cause as I mentioned above is the portability of the application. It is easy to bring out your application on multiple platforms with a minimum of costs and low efforts.
3 Android and iOS

On this Section I will compare the Operating Systems Android from Google and iOS from Apple. I will show the differences in case of developing mobile apps on the both plattforms and how it works with web-technologies.

3.1 Differences Between Android and iOS Development

The main difference between programming applications for Android or iOS is the programming language. Android is really Java-based so you’re able to develop native applications in pure java code. The Tools you needed is the Android SDK it comes with an Emulator for testing the application. Normaly programmers will use a programming environment like Eclipse or Netbeans, it is useful to integrate the Android SDK into these programmes. If you want to publish your application on the android app market you need to pay the developer fee of 25 USD for one time.

In case of developing apps for iOS it is essential to have a mac with the programming environment Xcode from Apple. You also need a license-key to develop applications and the developer fee for one year ist 99 USD. The main programming language is Objective-C and somtimes C or C++. For Testing it is recommended to use a real iPhone or another device with iOS. The Simulator didn’t work if your application wants to use build-in gps-modul or the camera.

3.2 Native Applications

The normal way to develop applications for a mobile is to make a native application. Native means the application is written in a language like the operating system. In Case of iPhone it is Objectiv-C and for Android it is Java. For sure not everyting is written in one language, some funtions e.g. for the graphical driver must be also written in C or C++ in operating system. Native applications are able to use the operating system APIs (application programming interface), it means a direct interface to the libraries and the functions on the
Android and iOS device without any container like phonegap. Further The native apps can be distributed directly on a app-store or a marketplace of the device.

In the case of iOS, the native application is written in objectiv-c, or something in C++ or C and the programming environment must be Xcode from Apple. The compiler produce a executable Binary which one is packed to a distributable package with “.app” extension. The last step is, to bring the application into the App Store. Figure 3 shows the development for native Apps. The excludet Resources like images or videos will be packaged by the SDK Tools with the executable binary part of the application.

For Android the workflow will be mostly the same. The developer will be produce the app in Java and compile it with the Android SDK from Google which one can be includet in the programming environment Eclipse 3.X.

The finaly product with the external resources and binaries will be published on the Android Market. Figure 4 lists some device functions which one are directly accessible over the API, e.g. the Camera or GPS.
3.3 Hybrid Applications

Hybrid Applications are native applications with embedded html code and characterized by using a framework like Phonegab. This Framework represent the interface to the operating system APIs. The big benefit is, you have full access to the API of the Device and you can sell the application like other native Apps on the App-Store. For the look and feel like a native application there are many frameworks available on the web. The differences between the frameworks are basically in the user interface the animations and the speed. A selection of the main frameworks for the user interface are represented on the following table with some aspects about speed, complexity and technology.

Table 1: Mobile Web Applications Framework (Kosmaczewski, 2009)

<table>
<thead>
<tr>
<th>Framework</th>
<th>Speed</th>
<th>Complexity</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>jQTouch</td>
<td>good</td>
<td>complex</td>
<td>HTML, Javascript</td>
</tr>
<tr>
<td>iWebkit</td>
<td>very good</td>
<td>complex</td>
<td>HTML, Javascript</td>
</tr>
<tr>
<td>Sencha Touch</td>
<td>very good</td>
<td>high complexity</td>
<td>HTML, Javascript</td>
</tr>
</tbody>
</table>
It is also possible to create an application which one is distributed on different places, on part – the main frame - is embedded in the application on the mobile device and some other parts will be downloaded later by the app when it is necessary. So it is easy to add some new feature or change something in the app. Because you don’t need any update by the App-Store, just modify the web-parts on the server. On the next start of the application the modified part will be loaded by the app. This concept could also a security risk for the end-user. Apple will check every application before they give you the possibility so publish the app on the App Store. But if the application is distributed and you will change something on the server part, apple will not check this again, because the next content goes directly to the user client.

On Figure 5 is presented how a hybrid application will work. The Main API from the device to display the content is the “Browser API”. The Application could be completely written in HTML and the native portion of the app will do the call to the APIs.

![Figure 5: Hybrid Application - Interaction with Mobile Device. (Worklight, 2011)](image-url)
Android and iOS

With HTML5 you will have more features like a native application e.g. local storage which one is a special type of DOM storage. The “key” to the localstorage is a combination of protocol, host and port. This will prevent collision of different applications with localstorage. (Kröner, 2010) The data will be stored from the app inside of the Browser. It is just a simple storage and comparable with the storage of Cookies.

The Data are stored as a simple tuple which one is reachable over an index. On Figure 6 is the workflow for a hybrid application presented. It looks similar to a native application with additional part of sources. The html source code is stored in a resource folder. On the Phonegap framework the folder is called “www”. The distributed parts from an external Server will be called on the html source.

3.4 DESIGN OF MOBILE APPLICATIONS

The Design of mobile Applications is completely different to desktop applications. On smartphones the users will have normally only a small screen where the information presented and on the same way he will use the screen by touching or with a pen to navigate on the mobile and in the applications.
Hybrid Application Prototype

The User-Experience is also different to desktop applications. Normally they will use the applications outside from home on the way to work or school or something like that. So, they expect a fast user-interface with interaction field (e.g. Buttons). The interaction must be as simple as possible and robust for failing inputs. In example, a user is looking for a store around their position, it easier to navigate with the pull function on a touchscreen with one finger then he must typing the name of the store on a keypad.

Another aspect is the presentation of informations. If the user take a search on the web with a mobile application he don’t wont to spend time on comparing results, e.g. if the user is looking for a store around the position, normally he’s interested on the closest store.

In Conclusion, the design of a mobile application must be simple to use, with big elements for interaction, the complexity must be low and the application speed must be high. Because he will not spend to much time and want the results as fast as its possible.
In this section I will represent the prototype of a hybrid application. The app is called “Store Locator”. Which one will use location-based service and localstorage to find a store around your position and a shopping card to save your stuff on a list you want to buy.

4.1 INTENTION OF THE Prototype

The intention of the prototype was to develop a simple app which one is useful every day and uses new features from html. The idea was to help mobile users to find a store next to her position. The scenario could be the following. The user will go to a place like another city for a meeting and he didn’t know the ambience and want to buy some stuff e.g. for a brake or a gift. The solution is, to develop an application which one will show you with a minimum of input the next stores like Coop, Migros or Denner in Switzerland. The prototype will show you the first results with two fingertaps, on the settings are the stores from Coop chosen and a radius of one km. If you want to change the kind of store you will become the results just after four fingertaps.

The second feature of the app is the “Shoppingcard” it’s suitable for a big shopping trip like some people do one day per week. This feature will use the localstorage function of HTML5.

4.2 DEVELOPMENT ENVIRONMENT

Before we start with the development we need to choose the platform of the application. If we want to develop a Android application we can use the programming environment Eclipse Helios. In the situation of developing a iPhone application we need to use Xcode from Apple.

I decided to develop for both of them, because I want to demonstrate how easy it is to deploy the application on different platforms. At first I will shortly describe which tools we need for a Android application. On the beginning we need programming environment Eclipse, I’ve chosen 3.6.2 Helios. On the second step we need the Android SDK from Google and install
Hybrid Application Prototype

it with the plugin manager from Eclipse. The Android SDK comes with an Android Virtual Device Manager which one need to specify the emulator of real device. We are able to choose the screensize the android version up to the newest one for tablets and some other options like the screen solution or additional space. After the configuration of a device we can start to develop pure native applications. For the prototype we need some frameworks because want to develop a hybrid application. The native part will be realised by Phonegap and the user interface will be designed with iWebKit. That’s all we need to start with the developing.

The workflow for an iPhone application is completely different. At first we need a mac or a virtual machine with a Mac OS X and Xcode. On the second step we need a developer license from apple to deploy the application to an iphone. For universities and their students the license is free but it is not possible to sell the app on the App Store. After that we need also the frameworks Phonegap and iWebKit. Phonegap will reserve a folder which is called “www” there will be the whole source code of the application like html, javascript and the framework for the user interface iWebKit. On the Android version it is the same folder.

Now we can started with development of the application. Hybrid applications will act like web application, so we make the code with a simple editor like Notepad++ and test it with the browsers Safari and Chrome. When we want to make the real native application we just need to copy the content and the iWebKit to the “www” folder.

4.3 THE PROTOTYPE “STORE LOCATOR“

As I mentioned above, I developed an application which one will use the geolocalisation with the GPS module and localstorage on the device. On Figure 7 is shown where are the data will be stored from the application and how it works. The “stores around me” function will call a simple HTML page inside of the application (step_in.html). This side have a section with an iframe, there will be displayed the content of a page (geo-oneshot.html) from the webserver “stud.hswlu.ch”. This page will get the gps-coordinates from the device and make a call on a php file which one will make a SELECT with the geo-coordinates and the radius on the database “filialfinder”. The User (storesaroundme) of the database is predefined with only
Hybrid Application Prototype

the right to read on the database. The received data from the database will be displayed on Google Maps API V3 with special designed markers for the stores. The actual position of the user will be displayed with a blue dot and a circle around them. The circle will represent the selected radius on which one the user wanted to search for stores.

Figure 7: Data storage of the "Store Locator"

Figure 8: The "Stores around me" function

Figure 9: “Shopping Card” on iOS and Android
Hybrid Application Prototype

On Figure 8 is the function “stores around me” displayed. The first information to the user is the gps coordinates and the store which one will be the closest to the actual position. The interaction with google maps is fully available e.g. zooming and moving the map. By tapping on the store marker will be open a small window with some additonal informations about the store like the address and how far away is it.

The “Shopping Card” function from Figure 9 is a simple to do list with editable items from the list. The items will be stored locally till the user will delet it ore by a reset of the browser.

4.4 Problems by the Development

The main problem by the development was on google maps. It was tricky to make the map touchable inside of an iframe, because it is a reported bug that u can’t interact with the map inside of an iframe. The bug means, the first 100 pixel of the iframe are not reachable for interactions. The solution was, to bring the map on a lower part of the iframe and fill the upper part with some useful messages.

4.5 Future Features of the Prototype

In the future it could be possible to add some more informations to the database like special offers of food or win. A combination of the shopping card with the localisation of stores and special offers could be very interesting. One szenario could be, the user will add the most wanted stuff, e.g. a special kind of food, on the shopping card and when he will start the application a automatic call goes to the webserver with the database and checking for special offer hes interested on and combine it with the stores around the position. The benefit is, the user will never miss a special offer of the stuff he wants and he will never must be check uo the storewebsite or newspaper for special offers.
5 LITERATURVERZEICHNIS


Software & Frameworks


http://www.gartner.com/it/page.jsp?id=1544815


http://www.w3.org/2007/03/HTML-WG-charter.html


http://de.wikipedia.org/wiki/Apple_iPhone


Software & Frameworks

6 SOFTWARE & FRAMEWORKS


Phonegap 0.9.4 Framework, http://www.phonegap.com/

JQTouch 1.0 Beta 2 Framework, http://jqtouch.com/