UNIVERSITY OF GOTHENBURG

Comparison of HTML5 and Native Client Development on Mobile Platforms

Bachelor of Science Thesis in Software Engineering and Management

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ABSTRACT

There are an increasing number of software development platforms on the mobile market and different programming languages to target each platform. An emergent HTML5 is a cross-platform solution for the development of mobile application. The objective of this study is to review the benefits and drawbacks of developing HTML5 applications on mobile devices in comparison with native client development. We will refer to an HTML5 prototype application as a case study to illustrate the ideas presented. This study makes suggestions for selecting the best mobile development paradigms.

CHAPTER I
INTRODUCTION

1.1 Background of the Study

The number of mobile devices is rapidly increasing (Jiang, Feng&Luo, 2010). Global mobile penetration reached 89 percent in Q4 2012, number of mobile phone subscribers hit 4 billion, and 40 percent of all mobile phones sold during 2012 were Smartphone (Ericsson, 2013). In addition to the growing number of mobile devices, the number of mobile Operating System (OS) is increasing too. Alongside the well-known OSs, iOS, Android, Windows Phone, and BlackBerry, there are emerging OSs such as Mozilla, Ubuntu, and Jolla as well. Together with mobile OSs, the consumer market is changing as well. The most important selling point of any mobile device is changing from the hardware itself to the applications (apps) that device can run.(Junutunen, Jalonen&Luukkainen, 2013).

Developing a mobile app requires a significant investment in terms of time and effort due to different perspectives that different stakeholders have regarding the app. These perspectives can be organized into three categories of technology, business, and users perspectives (Dakhl&Chouikha, 2009). At present, most of mobile apps are developed separately for each OS. Those kinds of apps are also known as native apps. The native app requires sizeable investment in the development process, due to differences that exists among the different platforms (Johansson &Andersson, 2012).

A new cross-platform solution is required to cater mobile app development across different OSs (Ahlgren&Markkula, 2005). HTML5 is a web technology which offers developers a cross-platform solution to develop a mobile app once, and run it on different OSs (Huy et al, 2012). However, HTML5 is still an emergent technology which implies that there is a conformance gap between mobile platforms and HTML5 standards (Yan et al., 2012).

Since the mobile user is committed to a particular ecosystem related to the platform (Gartner, 2011), an app designer needs to target the user regardless of the device (Gawley, Barr & Barr, 2012; Taft, 2012). The designer's choice of technology is very crucial for the success of the app (Mi, Qiu&Luo, 2010).

1.2 Statement of the problem

The aim of this study is to understand the impact of HTML5 on the mobile platform and how the mobile will correspond. A Case Study approach was conducted to evaluate HTML5 mobile applications. This study aims to answer the question:

What are the benefits and drawbacks of implementing HTML5 and native client development on mobile platforms?

1.3 Hypothesis

Development costs are reduced in implementing HTML5 client solution by writing once and deploying on every mobile platform.

1.4 Scope and Delimitation

This research has been performed in collaboration with Volvo IT, which is part of the Volvo Group. Research was conducted at Volvo IT premises, in Lindholmen, Gothenburg, Sweden. Volvo IT has the interest for the new technologies. This motivated them to explore new possibilities of developing in HTML5 and discover its impact on how the mobile platforms will correspond.

1.5 Significance of the study

The proposed study will help developers to have a deeper understanding to the issues related to Native and HTML5 client development. By this study they will select the best mobile development paradigms according to their requirements.

CHAPTER II
REVIEW OF RELATED LITERATURE

TYPES OF MOBILE APP

1. Native App

A native App is developed specifically for a particular platform or device. The main component is located on the mobile phone. A native app is compiled to the machine code and executed by the platform directly (Huy&Thanh, 2012). Since, native apps are designed for specific platforms; they can take advantage of device-specific hardware and software. However, developers have to keep track of all memory location to avoid memory leak and other unexpected damage to the OS (Huy&Thanh, 2012). Usually, they are distributed over the centralized repository. Despite all the advantages, native apps can be tied to specific platforms and limited by the mobile constraints (Juntunen, Jalonen&Luukkainen, 2013). Developing native apps requires good programming skills; they are costly and time consuming.

1.1 Volvo Trucks Dealer Locator

Volvo trucks dealer locator is a native app. The user can find the nearest trucks dealer according to his location. The app provides the user with different information about the dealer such as address, phone and distance. Volvo Provides two versions of the app, one for Android and other for iOS platforms and it distributed on both Google play (Android App, 2013) and on iTunes store (iPhone, 2013).

2. HTML5 App

HTML5 apps can be run in any modern web browser. The core of the app consists of interpreted language. HTML5 source code is processed by a software program called an interpreter (browser). The user always has access to the latest version of the app and no installation or update is required (Juntunen, Jalonen&Luukkainen, 2013). HTML5 apps can also be just a link in a browser. Therefore no centralized repository is required. HTML5 is the newest version of the web markup languageHTML, promises to provide businesses with powerful, cross-platform tools for their mobile apps (Techworld Staff, 2012). HTML5 is the

combination of HTML, CSS3 and JavaScript (JS). In other words, to obtain the maximum capabilities of HTML5 the developer should utilize the whole package of these technologies.

3. Hybrid App

A hybrid app is a combination of both native and HTML5 app. It has the same core as a HTML5 app. However, instead of running the app on a traditional browser, the html is rendered in a browser which is embedded within the app (e.g. PhoneGap, Sencha Touch). Frameworks such as PhoneGap and Sencha Touch allow developers to design and code cross platforms solution using the power of HTML5 and the abilities of native platforms.

Hybrid app can be deployed on multiple platforms and even it is possible to distribute it through repositories. Therefore, distributing the app on repositories increases the visibility of the app, which is very important for widening the user base.

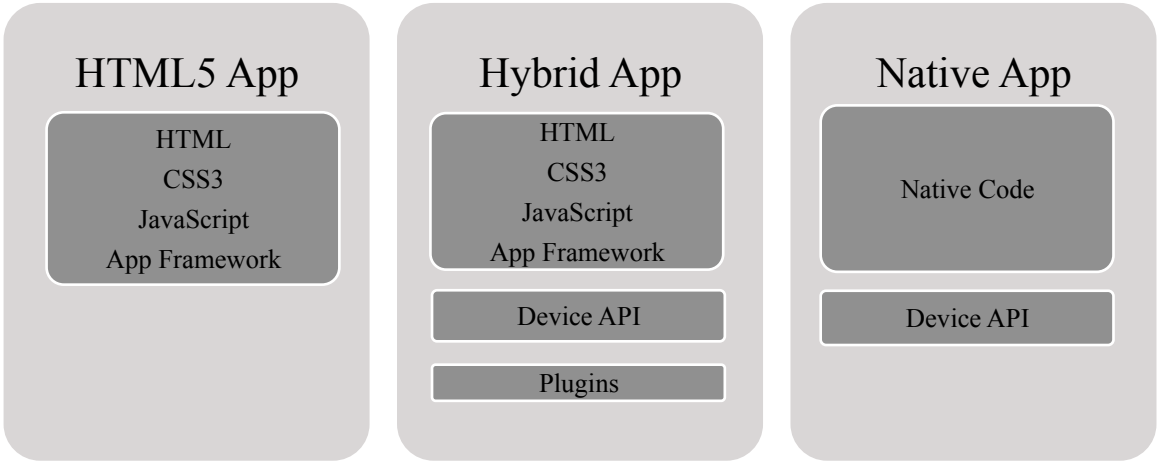

Figure 1 Different types of mobile app

CHAPTER III
METHODOLOGY

This section introduces the research design for this paper (Section 3.1) and then describes the input documents from Volvo IT for this case study (Section 3.2).

3.1 Research Design

This research has been designed based on a qualitative research approach (Creswell, 2009) and in collaboration between IT University of Gothenburg and Volvo IT in Gothenburg. The

six phases of thematic analysis are used as the most appropriate technique to analyze the collected data (Braun & Clarke, 2006) in order to have the most reliable information of the data collected in the real world experience. The extracted data identified was done based on general information collected from previous studies, books, journals and scientific articles, with the focus on HTML5 and mobile app development. That information was collected from digital libraries such as IEEE, SpringerLink, Gothenburg University, Summon Supersearech and other reliable resources. We extended the gathered material with general web search and even used information from mobile app development communities (e.g. Stackoverflow, Google code forum, etc). The case study approach is to validate the data. These approaches were chosen, because we needed to have a deep understanding of HTML5 and to identify problems surrounding this technology. We analyzed the obtained data thematically to build a core resource to generate a guide for selecting the best mobile development paradigms.

3.1.1 Research Instrument

This research used interviews as a verification tool in order to improve the reliability of the data. However, we had lack of people to interview who are experts in HTML5. The need to be systematic is a direct result of fact that the data collection techniques can be constantly updated (Runeson&Höst, 2009). In order to have a clear chain of evidence and derive efficient conclusions, analysis is carried out in parallel with the data collection.

3.1.2 Evaluation standards

In order to evaluate the outcome of the collected data it is necessary to consider the viewpoints for all main stakeholders, a successfully produced outcome satisfies all stakeholders of the study as well as fulfilling the needs of a real world problem (Tork Abadi, 2011). Volvo IT is the main stakeholder in this study which verifies if the outcome satisfies their needs and corresponds to VGTA. The criteria for identifying the mobile app development are based on the three broad development criteria, User perspective, Business perspective and Technology perspective. We mapped these perspectives with the most relevant and important architecture principles for our case from VGTA. These criteria were selected through unstructured interviews with developers and architectures at Volvo IT.

- User-Interface: This principle emphasizes the space where the interaction between the user and the mobile app occurs.

- Business Quality: This principle highlights the investment time and money that is needed for developing the app.
- Functionality: This principle emphasizes functions and their specific properties, whether they are satisfied stated or implied needs.
- Efficiency: This principle accentuates the efficiency of the app in terms of effort and time need to perform a task.

3.1.3 Volvo Trucks Dealer Locator Prototype

Volvo IT provides an app "Volvo Trucks Dealer Locator" to their customers to locate the nearest trucks dealer in any part of the world. The prototype is a mimicked version of that app and is written entirely in HTML5 technology as a cross-platform solution. Software and technologies used during implementing the prototype were Netbeans IDE, WAMP Sever, HTML5, JQuery libraries, Google Maps Libraries and Filezilla. We used geolocation services with an interactive Google Maps interface. We aimed to have a common UI on any platform.

The prototype consists of three views:

Home View: The app starts by showing the background and has three buttons to the rest of the views.

Map View: The user can locate his current location.

Figure 2 Home View

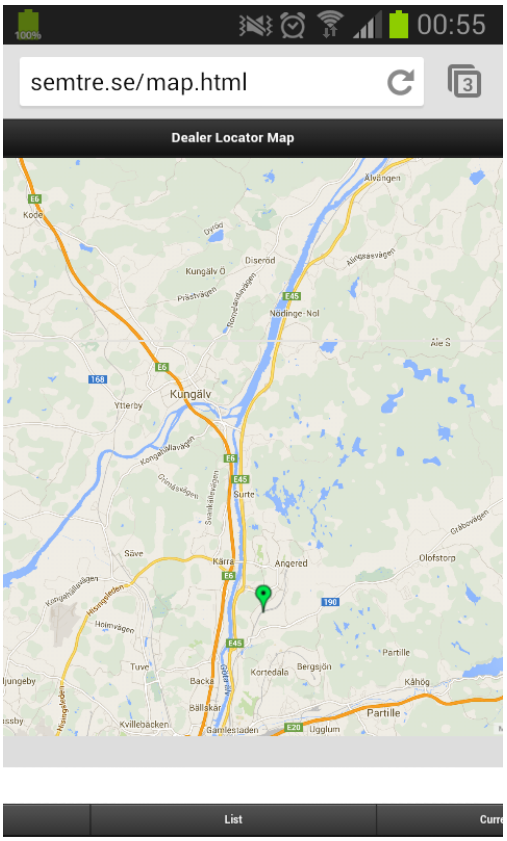

Figure 3Map View

List View: This view provides the user with a list of more than nine hundred dealers located around the world.

3.2 Volvo IT Documents

Volvo IT provided this study with their generic architecture "Volvo Group Target Architecture" (VGTA). VGTA created within Volvo IT and promoted by the Volvo Group IT Governance. Volvo Group IT Governance contains 10 architectural principles (VGAP) as shown in fig 2. These 10 principles should be considered when designing applications and the solution must correspond to these principles. Some of these principles stated below:

1. Simplicity in solutions and work methods
2. Robust solutions
3. Performance focus
4. Secure solutions
5. Maintainable solutions

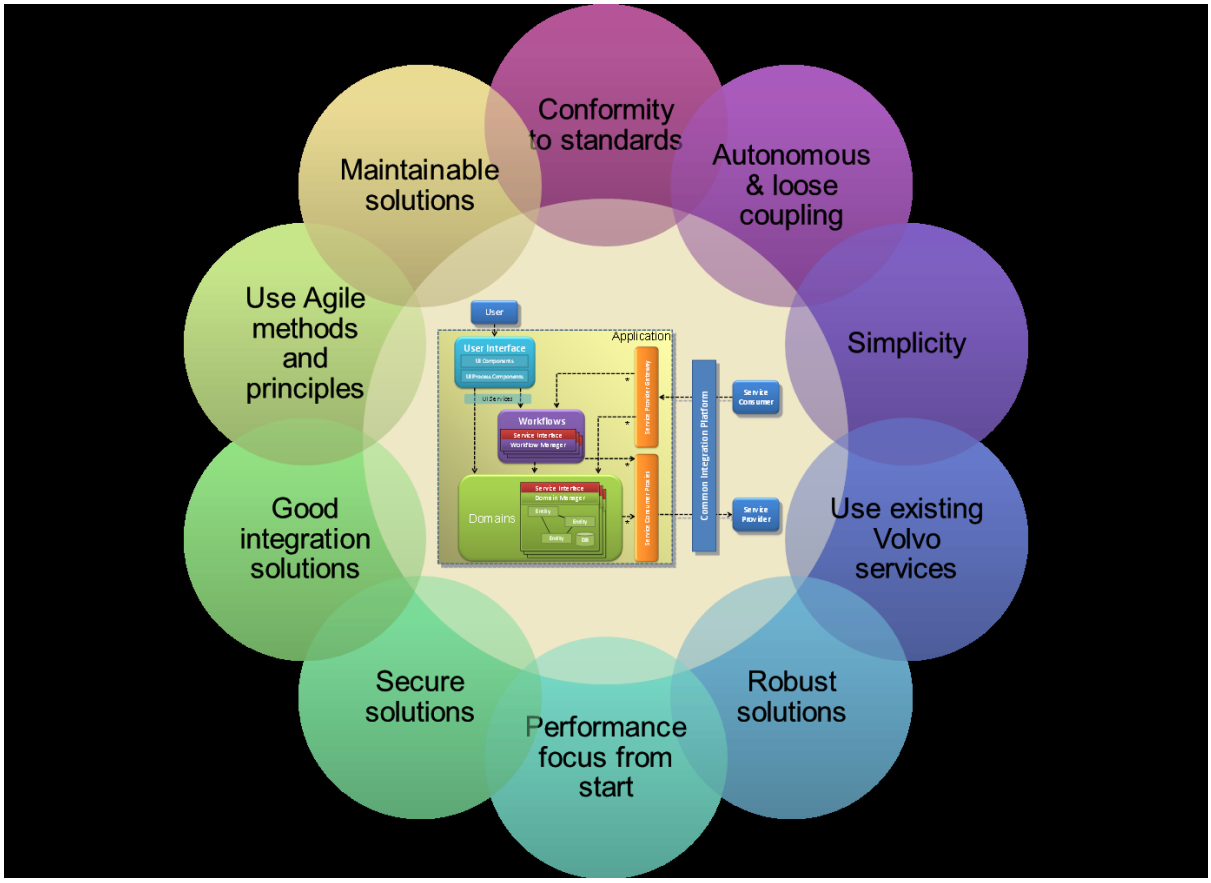

Figure 4 The Target Architecture & the 10 Principles (Liljenberg, 2012)

3.3 Data Validation

We implemented HTML5 app as a prototype to validate the theoretical data mentioned above and generate a reliable result through practice. We choose to develop Volvo Trucks Dealer Locator because it has straightforward use case scenario and requirements such as connect to web services and maps to function properly as well as it need access to the device GPS. We compare the HTML5 app with existing native apps for both Android and IOS platforms. Therefore, our goal was not to implement a full-featured version of the app, rather develop most relevant feature within the time frame. Our prototype is a mimicked version of the Volvo Trucks dealer locator.

CHAPTER IV
PRESENTATION AND ANALYSIS OF DATA

4.1. Presentation of the Theoretical Data

This section presents the data collected from literature review of HTML5 mobile client development.

4.1.1. Browser Support

The main problem with HTML5's acceptance is the limitations of the browsers support. Even though most of the modern mobile browsers are based on a Web Kit rendering engine (Chrome, Safari, Opera), there are still browsers (Firefox, Internet Explorer) that use different JavaScript engines. E.g. on iOS, the position property "fix" value is not supported while it is supported by Android version 2.2 and higher (Charland & Leroux, 2011). Another ugly fact related to media licensing issues, usually rich media has to be compressed in multiple formats to be compatible with most browsers, e.g. web kit based browsers support mp3 format while Mozilla Firefox support ogg format (Gawley et al, 2012). The differences between browsers can cause problems for developers to target multiple platforms because changes to the app source code are required (Junutunen, Jalonen&Luukkainen, 2013). Even the browsers variations make it difficult to the developers to generalize their security.

4.1.2. The Language

Although parts of the HTML5 are very stable, the language itself is considered a work in progress (Sin et al, 2012), so technically, any of the elements could change at any time. The language is not expected to be completed for several years, which complicates things further. Furthermore as mentioned above HTML5 is combination of html, CSS and JS. The JS is an interpreted language and is consistently slower than a compiled native code. HTML5 is an open technology, and by definition anyone can access to the code and manipulate the data (Wasserman, 2010). API specifications do not provide details about the authorization for web app access control (Lyle et al., 2012). HTML5's built-in or included software development kits (SDKs) are limited; these limitations are disadvantage to achieve sophisticated UI effects (Francese et al., 2013). HTML5 as any web technology requires internet connection to perform properly; offline caching is limited which enables the app to function partially when the connection is unavailable. The HTML5 local storage and offline caching may store sensitive data, cookies and cached files in the browser, any security failure may make the web browser a direct gateway to steal credentials for an online service (Juntunen, Jalonen&Luukkainen, 2013). HTML5 is suitable for simple app that doesn't require high processing such 3D game and image processing actions (Charland&Leroux, 2011). Last but not least HTML5 has far-reaching consequences for the user to access the browser to reach the web app (Gawley, Barr & Barr, 2012).

4.1.3. Device Specific Hardware

HTML5 apps have the possibility to access some of the mobile hardware such as the screen and the microphone. Therefore, they support both touch and voice interaction within the app (Juntunen, Jalonen&Luukkainen, 2013). However, HTML5 unable to access the camera, notifications, contacts and calendar (Huy & Thanh, 2012).

4.1.4 New HTML5 Elements

HTML5 provides new elements, properties, and attributes, which enable developers to use in order to make the content more accessible (Casario et al., 2011), e.g. HTML5 web worker acts like a thread. It provides the ability to perform long tasks in the background, while the app remains responsive to any other interaction, or to perform more tasks in the background (Johansson &Andersson, 2012).

HTML5 also provides elements that the developer can benefit and obtain same functionality of using the platform hardware without accessing the hardware, e.g. using Geolocation through the browser instead of accessing the GPS hardware (Sin et al, 2012).

4.1.5 Application Deployment

HTML5 apps can be easily deployed just by developers upload the app on a server, and it is accessible to the user instantly (Juntunen, Jalonen&Luukkainen, 2013). In contrast, native apps need to be downloaded by the users and installed locally on the mobile platform.

4.1.6 Application Distribution

The HTML5 app does not require a repository for distribution. The app is hosted on a server, distributed over the Internet and updated instantly. The user has access to the latest version constantly. However, the HTML5 distribution decreases the chances of monetizing the app and widening user base (Andreucci, 2013).

4.2. Presentation of the Practical Data

This section presents the data collected from implementing the prototype of HTML5 Volvo dealer locator App. The App been tested on different platforms (Android & iOS) and by using multiple browsers (Safari, Google chrome, Opera mini, Firefox and Android native browser). The result was not consistent across both the devices and browsers. Most browsers faced rendering issues to show the content on both platforms (Chrome, Opera & Safari). Firefox on android device was able to deliver best result, however Firefox doesn't support IOs. Android native browser was unable to resize the content according to the mobile screen.

The prototype was able to access the GPS receiver of the mobile device and even take advantage of the Geolocation feature that can determine the location of the user without the GPS hardware. However, the user must grant the access to the browser to use this feature and this feature is not supported in all browsers such as Opera mini.

The app was distributed by deploying it on a server and is accessible by any user through the mobile browser. The user has access to the latest version constantly, no update required.

4.3. ANALYSIS OF DATA

4.3.1. The benefits and drawbacks of implementing HTML5

This section illustrates the benefits and drawbacks of implementing HTML5 client development on mobile platforms in comparison to native development based on the practical collected data through different scenarios.

Assuming that the app development requires delivering a unified UI to the end user regardless of the platform as for now the developers can benefit from HTML5 technology. Except if a native look and feel is required then native development is the only solution.

If the user experience is essential then HTML5 is a drawback. For instance if the app already exists in a native form and as a result of comparing the user will not be satisfied by the equivalent HTML5 version. Considering the Volvo dealer locator native app with the implemented prototype, the native app was running smoothly having much better performance, while the HTML5 app was lagging and taking a longer time to load.

On the occasions that the app requires using the latest device-specific hardware features and APIs HTML5 is a drawback. As mentioned above HTML5 cannot benefit from notifications, contacts, camera, etc. device features. Some can argue that not all native apps use those features but if the app needs any of those features then native development is the proper solution.

Another scenario in case the app is required to process in the background, e.g. playing a next song. In this case HTML5 is a drawback due to the limitations of the browser. The HTML5 app will not be able to play the next song if the app tab is closed, not active or if the screen is locked.

Concerning any app development requires proper skills and tools. To target all mainstream platforms natively then more than one programming language is required as shown in table 1. For instance, taking into consideration the number of targeted platforms, one development team per platform will naturally increase the development cost but the outcome is native app at least fulfills the App stores development constraints. On the other hand, it is possible to target multiple platforms by implementing HTML5 app. However, it is not an easy task as it sound. Changes to the source code is required per targeted browser (there are more browsers

than operating systems), the changes can be minor adjustments or even rewrite a whole solution specific for one of the targeted browsers which might cause pain to the developers and also might lead to increase the development cost and the outcome is HTML5 app weaker than respective native app.

App	WP8	Android	iOS	BlackBerry
HTML5	HTML5	HTML5	HTML5	HTML5
Native	C#	Java	Objective C	Java

Table 1. Skills required for developing the app for different platforms

Developers with web development skills benefit more from HTML5 than native developers because web developers are familiar with this technology. It is challenging for native developers to master HTML5 in a short time as it is not a straightforward language. It is combination of html, JS and CSS. Each of these languages has its own conventions and tricks that one needs to be familiar with and that can't be achieved overnight.

In case security is a requirement then HTML5 is a drawback. The HTML5 local storage and offline caching make the browser contain sensitive data, cookies and cached files. Although the underlying data might be encrypted but it's not as well segmented as a native keychain encryption that protects each app with a developer certificate.

While HTML5 app has the possibility to benefit from limited offline capabilities by caching files on the device. It might be useful if the user want to read an article already cached by the app. However HTML5 unable to perform tasks need computing without internet connectivity.

CHAPTER V
DISCUSSION

In the previous section we identified the benefits and drawbacks of HTML5 client development. HTML5 might improve the web development however it is far from competing with native development at least until the current date or even in the near future.

Native development delivers a single platform app able to have advanced UI interactions, fastest performance, full capability of the device features, and distributed through both App stores and unrestricted such as downloaded from a website. On the other hand, HTML5 development delivers a multiple platforms app with limited capability of the device features and unrestricted distribution.

It is worth mentioning real life cases which might confirm this research results. Facebook switched completely from a hybrid app on iOS to native app. The Facebook CEO stated that their biggest mistake was investing too much on HTML5, rather than developing app natively. Despite this, they are still excited about the future of HTML5 and web platform (Shankland, 2012). Users expect on a platform like iOS a fast performance and good user experience but HTML5 couldn't fulfill those requirements.

Another real case is streaming music service app Grooveshark. The Grooveshark app was banned on app stores due to legal issues; therefore they distributed an unrestricted HTML5 app. However, they clearly stated that the app is facing mobile browsers/OS limitations issues (Grooveshark Help, 2014).

5.1 Study Limitations and Validation

We might have missed some literature for reviewing, due to the HTML5 being a new technology. However, we tried to fill this gap by conducting interviews with industry professionals who gave us a reasonable amount of information based on their personal experience in the field of software development but not HTML5 development. Also, we tried to fill the gap by developing a prototype ourselves to investigate the app in practice, to validate the data gathered from the literature review. We had no previous knowledge in HTML5 development.

CHAPTER VI
CONCLUSION AND RECOMMENDATION

In summary, this study set out to investigate benefits and drawbacks of developing HTML5 app compared to developing a native app. We presented the theoretical background and overview of the three different type of mobile application. A qualitative approach was used to evaluate the theoretical findings of the paper. We referred to an HTML5 prototype app as a case study to illustrate the ideas presented. The research concluded that HTML5 applications can be concurrent being cross-platform, but not as powerful as native apps.

5.1. Future Work

HTML5 is an emergent technology. Major benefits and drawbacks will be realized over lifetime, which means it can take years to assess the actual impact of the technology. However, there is possible improvement for this paper by trying HTML5 as hybrid app.

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