

Mobile development tools and cross-platform solutions

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Abstract—The usage of tablet and mobile devices has growing potencial. The fragmented mobile landscape presents considerable challenges around application development. The key element for publishing software applications in Apple's iOS or Google's Android operating system is to build them with software development kit. HTML5 web apps are emerging as an alternative. This paper deals with available frameworks, cross-platform solutions, mobile development tools, summary of mechanical engineering apps and development of mobile dictionary of the English-Czech automatic control terms.

Keywords—mobile web; mobile frameworks; HTML5

I. INTRODUCTION

With exponential growth in the mobile device market over the last several years, users are increasingly using smartphones and tablets instead of desktop computers to access products and services.

According to International Data Corporation (IDC) [1], tablet shipments in Europe, the Middle East and Africa reached more than 20 million units by the end of the year 2011. Usage of tablet is mostly for entertainment purpose - business purchases represent less than 10% of the entire tablet market. Nevertheless the opportunity for growth and interest from businesses is huge following the success of the Apple's iPad. Functionalities such as a responsive touch screen user-interface, portability/design, and a plethora of business application solutions that address specific vertical business needs, are all factors that motivate the adoption and demonstrate the value in businesses. Strong interest in adoption of mobile devices is among IT services, professional services industry and other sectors such as transport and storage, utilities and distribution.

Tablets are already used across various sectors, including healthcare [2], manufacturing, financial services, real estate and retail. Hospitals are using tablets to facilitate information sharing. From the emergency room to the boardroom, tablets and other mobile devices are decreasing paper-based processes, as well as improving communications, workflows and efficiencies.

However, today's application offerings are often ported from existing applications and do not translate smoothly to the tablet because they were created without much consideration for touch-enabled devices.

II. NATIVE APPS VS. CROSS-PLATFORM SOLUTIONS

Development for mobile devices often requires different skill sets and familiarity with different runtime environments than those more commonly used on desktop PCs.

Native applications for smartphones and tablets include software written in Java for Android, Objective C for iPhone, C++ for Symbian, and C++ for Windows Mobile. Programs written for the device's native runtime environment have rich APIs and tend to be able to use all the facilities of the phone, including sensors, media playback, file management, and network access.

Distribution of the apps is often fragmented and disorganized and many users are still unfamiliar with the mechanisms available to download applications to their devices. While some Smartphones and tablets such as the iPhone/iPad, Android, Windows Phone platforms are addressing this issue successfully, delivery to many other devices is still problematic.

Developers of native applications must expect restrictions and costs associated with developing and deploying to certain platforms, such as needing an Apple developer license and Apple's approval to distribute applications to iTunes Apps Store. Device fragmentation continues to be a problem for developers with many different phone operating systems, and programming APIs. Access to the device's sensors such as location and accelerometers can be restricted to certain applications or programming languages.

An ideal goal would be the ability to write an application once using a well-documented and supported language and set of APIs and have this application instantly available to all mobile devices irrespective of device or network. Emerging web standards as HTML5 are one possible solution to the problems outlined above, however makers of mobile applications still need to find compromises and increased the barriers to entry to this field. [3]

There is ongoing debate between developing native and mobile web applications. Four different technical configurations are available:

- **Native apps.** These mobile applications are fast, reliable, and powerful but are tied to a mobile platform. That means developer must duplicate them using the appropriate programming language in order to target another mobile platform.
- **Hybrid apps.** Development relies at frameworks and these mobile apps offer a compromise because they ensure cross-platform compatibility and can access the mobile device's hardware (camera, GPS or user's contacts).
- **Dedicated web app.** A mobile web site which is tailored to a specific platform or form factor.
- **Generic mobile app.** A mobile web site designed to match every web-enabled phone or tablet.

Context of the mobile application will drive decision for choosing the best configuration. If mobile application is mainly used to display and interact with online content or services, it is better to avoid the native choice. However, if mobile application is mainly used offline, a native app will offer a better user experience.

III. MECHANICAL ENGINEERING APPS AT MOBILE DEVICES

The goal of The Department of Control Systems and Instrumentation is to develop dictionary of the English-Czech automatic control terms. To get a perspective about available apps we collect, analyze, and summarize mechanical engineering apps at mobile devices for students, teachers and professionals.

From January 16 to 21, 2012, the Apple iTunes store and Android Market was queried for mobile apps related to mechanical engineering. This was performed using search terms including mechanical engineering, engineering, CAD, automation, robotics and using suggestion from stores ("Users who installed this also installed" on Android Market or "Customers Also Bought" on Apple iTunes store).

Methodology is based by Franko, O.I. & Bhola, S. [2], they analyzed orthopedic applications for iPad. Each app summary page was reviewed, and data were collected regarding the app's name, publication date, cost, average rating, and number of ratings. After reviewing the summary and screenshots from both app stores, a determination was also made regarding a categorization for the app (educational, productivity, reference) and the intended audience (students/teachers and professionals).

Once data collection was complete, data were summarized, tabulated, and presented using spreadsheet. A complete analysis was performed comparing the relationship among app characteristics, intended audience, and cost. Descriptive statistics were used to report the data in the form of median and standard deviation, and chi-squared analyses were performed when comparing qualitative data between groups; $P=0.05$ was considered statistically significant.

A total of 49 mechanical engineering related applications were identified using the search algorithm. Of them, 19 (39%) had been updated in the prior 2 months and 29 (59%) had been updated in the prior 6 months. On one side there were six apps (12%) which had 0 reviews and same number of apps had more than 500 reviews, 23 apps (47%) had >20 reviews from consumers.

Both mobile apps stores - Apple iTunes store, Android Market – use categories to sort apps. For example, top five categories in Apple iTunes store are Games, Books, Entertainment, Education and Lifestyle, which covers 56% of all apps [13]. Mechanical engineering apps are mostly from Productivity, Books & Reference and Education category. [Fig. 1]

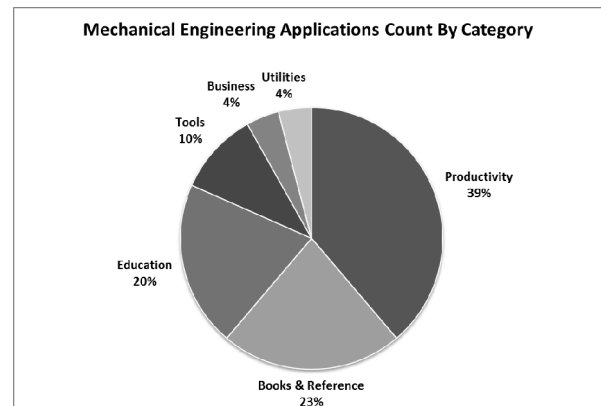


Figure 1. Apps count by category from iTunes store and Android Market

From the 49 apps identified, 25 were primarily designed for the general public or students (51%), 24 were designed for mechanical engineering professionals (49%). The purpose of applications for the general public and students were mostly limited to educational information and reference information.

The average price for apps ranged from \$0 to \$179.99. A single app that sold for the highest price was based on a German dictionary, once excluded from the analysis, all apps had a mean and median cost of \$3.90 and \$0.99, respectively. The applications for the general public and students had a mean and median cost of \$5.10 and \$1.99, on the other side apps for mechanical engineering professionals had a much lower price – mean cost of \$1.80 and median cost were even free of charge.

IV. HTML5 MOBILE FRAMEWORKS

The context of the English-Czech automatic control terms dictionary is mainly used to display and interact with online content, therefore we decided to use HTML5 mobile frameworks for development.

Developing web applications and mobile version of websites for the mobile devices has its own sets of challenges and techniques - user interface is optimized for fingers instead of mouse cursors, fragmented platforms, there are usually the bandwidth limitations. To help developers rapidly deploy cross-platform mobile apps and websites, there is a wide range of frameworks they can take advantage of. Common characteristics of mobile web development frameworks

include:

- **Cross-platform:** Support for multiple mobile device platforms allows to deliver app to a wide range of users.
- **Lightweight:** Due to current bandwidth limitations, a stronger emphasis on lowering file weight is placed into mobile web development frameworks.
- **Optimized for touchscreen devices:** Fingers as input devices instead of mouse cursors provide an extra set of challenges in user interface design. Mobile web development frameworks provide standard user interface elements and event-handling specifically for mobile device platforms.
- **Uses HTML5 and CSS3 standards:** Most mainstream mobile devices have web browsers that support HTML5 and CSS3, and so mobile web development frameworks take advantage of new features available in these upcoming W3C specifications for a better user experience.

List of available mobile frameworks includes:

- **Sencha Touch** [4]
The open-source framework built specifically to leverage HTML5, CSS3 and Javascript to its highest level of power and flexibility, such as local-storage, video and audio components supported. Besides, the framework also offers data integration from variety of sources such as AJAX, JSON and YQL.
- **jQTouch** [5]
A jQuery plugin offers multiple of pre-installed themes, with the features of offline mode viewing, geo-location and screen transitions to create mobile web app for iPhone, iPod Touch and Android devices.
- **jQuery Mobile** [6]
Cross-platform & cross-device framework provides tools to build dynamic touch interfaces that will adapt to a range of device form factors. The system will include both layouts (lists, detail panes, overlays) and a rich set of form controls and user interface widgets (toggles, sliders, tabs).
- **Wink** [7]
Lightweight JavaScript toolkit offers the basic functionalities from touch event handling to DOM manipulation objects, mathematic libraries or CSS transforms utilities.
- **M-Project** [8]
The framework follows the model-view-controller (MVC) software architecture pattern, has offline support (automatic cache manifest generation) or DataProvider for local and remote storage persistence.
- **Jo** [9]
HTML5 lightweight Javascript framework creates applications compatible with iOS, Android, BlackBerry, supports HTML5 widgets.
- **Titanium** [10]
A Javascript based interface to native code modules included in the framework, it can store user preferences, save data files, or implement the mobile version of a

cookie using SQL Lite and the iPhone or Android's native file system.

- **PhoneGap** [11]
HTML5 application platform that allows to author native applications with web technologies and get access to native APIs and app stores. The resulting applications are hybrid, meaning that they are neither truly native (all layout rendering is done via the webview instead of Objective-C or Corona apps) nor purely web based (many of the functions would be supported by HTML5).
- **DHTMLX Touch** [12]
HTML5/Javascript framework contains a visual editor for building mobile user interfaces, which help developers to construct user interface with minimal coding.

Other frameworks work on similar principles: iUI, iWebkit, WebAPP.net, Zepto.js, LingoJS, Joshfire.

After analyzing and summarizing various mobile frameworks, The jQuery's mobile framework was picked for English-Czech automatic control terms dictionary.

V. HTML5 MOBILE APP - AUTOMATIC CONTROL TERMS DICTIONARY

Web based dictionary of the English-Czech automatic control terms proceeds from course book [14] and is intended for bachelor and master students of automation and technical cybernetics study program.

Dictionary is divided into three parts:

- **English-Czech dictionary of the fundamental automatic control terms** is devoted to basic and most common terms from classic and current literature.
- **Commonly used abbreviations** explain its origin and describe Czech equivalent.
- **Dictionary of antonym terms** provides help during preparation of professional papers when use of antonym is needed and it is not possible to find it in general dictionary.

The first part of the dictionary was applied into web portal e-Automatizace (<http://www.e-automatizace.cz>) which goal is to create a starting point, a gateway to other resources on the web from automation field for students and academic staff of Faculty of Mechanical Engineering and other universities in Czech Republic.

The English-Czech automatic control terms dictionary includes also references into two other knowledge sources:

- **Ninjawords** [15] is an English online dictionary and it provides quick definition or list of definitions. It is based on the Princeton WordNet project and also from Wiktionary. Ninjawords allows user to look up multiple words in the same search - separated by commas, and in the URL. It comes also with a spell check and synonyms.
- **Wikipedia** [16] is a multilingual, open content encyclopaedia project.

Every term in dictionary at e-Automatizace portal contains now:

- Czech translation of term.
- Service represented by icon to search quick English definition of the term in Ninjawords website.
- Service represented by icon to search encyclopedia article in the English version of the Wikipedia website.

To create mobile web applications of the English-Czech automatic control terms dictionary [17], a generic mobile app build with touch mobile web development framework approach was taken. The jQuery's mobile framework [6] offers a unified user interface system that works seamlessly across all popular mobile device platforms and is focused on a lightweight codebase built on progressive enhancement with a flexible, easily themeable design. [Fig. 2]

This framework is set out to make easy for developers to fast deploy mobile applications with a minimal learning curve. The interface configuration is markup-driven, which means that developer can create basic app interface using just HTML language. It provides a series of custom events to detect mobile and touch specific actions like tap, tap-and-hold, swipe, and orientation change (i.e. rotating the device).

Initial steps to start deploy mobile applications with jQuery Mobile includes:

- Include the framework files in header of the webpage.
- Use data attribute in HTML markup. The *data-role* element specifies which block should be used for the header, footer and content, all of which are inside the main page wrapper.
- ThemeRoller is a web-based tool that allows creating custom themes without writing a single line of CSS. Theme colors and textures are defined once in the stylesheet and could be easily mixed, matched and combined to achieve a wide range of visual effects.

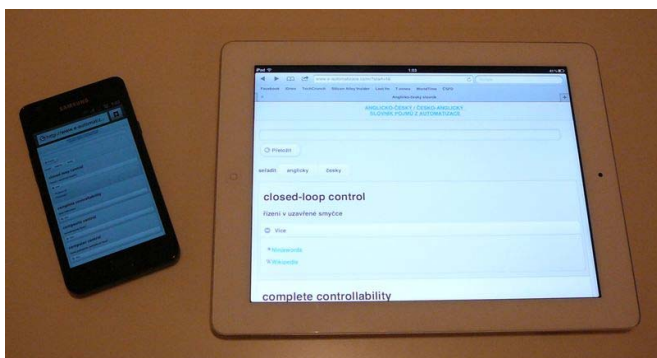


Figure 2. The English-Czech automatic control terms dictionary running as generic mobile app at wide variety of mobile devices

Mobile application of English-Czech automatic control terms dictionary is available online [17] and was tested on mobile phones with Android operation systems (version 2.1 and 2.3.4) and Apple tablet (iPad 2 with iOS 5.1 operation

system).

VI. CONCLUSION

The emergence of mobile devices over past years pushed attention to more sophisticated mobile web apps. Ongoing debate over future of mobile web include predictions, if native applications going to be the dominant form of digital interaction or new and developing browser technologies like HTML5 make the mobile web preferable to apps.

Consuming content via a smartphone or a tablet, a native app takes advantage of the deeper integrations of the device like accelerometers, ingrained video capabilities, cameras and location-based services. The mobile Web is used more often for research and reference. Audience, content and context of the mobile application are key indicators to decision for choosing the best configuration.

A generic mobile app build with touch mobile web development framework approach was taken to create mobile web applications of the English-Czech automatic control terms dictionary.

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