

System Quality Characteristics for Selected Mobile Platforms

Ahood Al-Darmaki¹ Nabeela Badursha² Ibtisam Al Shibli³ Mohamed Sarrab⁴

Abstract— The number of mobile devices are increasing rapidly and manufacturers are competing to make the best device that satisfies the consumer's needs. With the huge number of devices available today, companies also developed special operating systems to differentiate their products from others. Some are open source and others are closed-source, each with special features and characteristics. This paper compares two of the most popular platforms iOS (as closed source platform) and Android (as open source platform) considering system quality characteristics including availability, reliability, performance, usability, and functionality. These characteristic are tailored to the criteria having been built from background study, standard for software quality and guidelines.

Index Terms— Mobile platforms, system quality characteristics, iOS, Android.

XXXVII. INTRODUCTION

SOME software has source code that cannot be modified but the person, team, or organization who created it maintains exclusive control over it. This kind of software is frequently called "proprietary software" or "closed source" software, because its source code is property of its original authors, who are the only ones legally allowed to copy or modify it. Internet Explorer, Adobe Reader, Adobe Photoshop, VMS, Microsoft Office etc. are examples of proprietary software [1]. In order to use proprietary software, computer users must agree (usually by signing a license displayed the first time they run this software) that they will not do anything with the software that the software's authors have not expressly permitted. Open source software has different concept. Its authors made the source code available to others who would like to view that code, copy, learn, modify, or share it. Anypic, ifixit, Ethita, Vim, istrobe etc are examples of open source software for iOS and BlueGPS, Kontalk, Moss, VLC etc are examples of open source software for Android. As they do with proprietary software, users must accept the terms of a license when they use open source software but the legal terms of open source licenses differ dramatically from those of proprietary licenses.

^{1,2,3}Communication and Information Research center, Sultan Qaboos University, P.O. 17, Al-Khodh, Muscat-123, Sultanate of Oman (phone: 968-24143697; fax: 968-24144336; e-mail: ahood@squ.edu.om, anabeelapb@squ.edu.om, Ibtisamq@squ.edu.om

⁴Communication and Information Research center, Sultan Qaboos University, P.O. 17, Al-Khodh, Muscat-123, Sultanate of Oman (phone: 968-24143698; fax: 968-24144336; e-mail: sarrab@squ.edu.om

Open source software licenses promote collaboration and sharing because they allow other people to make modifications to source code and incorporate those changes into their own projects. Some open source licenses ensure that anyone who alters and then shares a program with others must also share that program's source code without charging a licensing fee for it. In other words, mobile application developers can access, view, and modify open source software whenever they like as long as they let others do the same when they share their work [2].

XXXVIII. MOBILE PLATFORMS

The mobile platform also refers to mobile operating system, is an operating system that is specifically designed to run on mobile devices such as mobile phones, smart phones, PDAs, tablet computers and other handheld devices. Mobile operating system is the software platform on top of which other programs, called mobile application programs, can run on mobile devices [3][4]. It is responsible of managing between hardware and software, performs basics tasks, management of memory, and ensures that different applications are running at the same time without any interference. The types of mobile platforms (based on existing operating system used by computer) [5]:

- Real-Time operating system,
- Single user, single tasking operation system,
- Single user, multi-tasking operating system, and
- Multi-user operating system.

XXXIX. QUALITY CHARACTERISTICS

System quality implies the desirable characteristics of the mobile platform product. The selected criteria differ from the empirical study of open source software selection for adoption based on software quality characteristics [6].

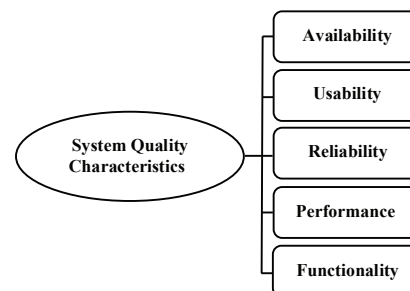


Fig. 1 The used quality characteristics to select Mobile Platforms

Also it differs from the selection criteria of open source software: first stage for adoption [7] which involves system

quality, information quality and service quality. Our approach considers the system quality characteristics that include availability, usability, reliability, performance and functionality. The selected criteria may contribute to the success of mobile platform development and adoption among potential developers and users [8][9].

XL. THE STUDY

The compared platforms are iOS and Android, two of the most popular mobile operating systems. Android mobile operating system is based on the Linux kernel and Google's open and free software stack that includes an operating system, middleware and also key applications for use on mobile devices, including smart phones. Updates for the open source Android mobile operating system have been developed under "dessert-inspired" codenames (Cupcake, Donut, Eclair, Gingerbread, Honeycomb, Ice Cream Sandwich, Jelly Bean, KitKat, Lollipop) with each new version arriving in alphabetical order with new enhancements and improvements.

Android technology is based on Java. In order to create applications in Android, developer has to know software development kit (SDK). The SDK can be downloaded freely from the Internet and can work on multiple operating system, that's why many developer prefer development using SDK. Also, they can sell their creations for many consumers [5]. Android system is programmed in C, C++ and JAVA languages [10]. The Android developers use the open source code as a foundation for community driven projects that add new features for advanced users. Android's API allows exploring the device's capabilities to give the application chance to adapt accordingly.

Apple's iPhone OS was originally developed for use on its iPhone devices. Now, the mobile operating system is referred to as iOS and is supported on a number of Apple devices including the iPhone, iPad, iPad 2 and iPod Touch. The iOS mobile operating system is available only on Apple's own manufactured devices as the company does not license the OS for third-party hardware. Apple iOS is derived from Apple's Mac OS X operating system. iOS system is programmed in C, C++ , Objective C and Swift languages.

The multi-touch interface, 3D components and flawless usability makes it widely used among Smartphone user interfaces. iOS limits access to some websites as it does not support Java or Flash currently. Apple iOS developers were allowed to develop applications for iPhone and iPod Touch using SDK on March 6, 2008. Apple also enabled application test on " iPhone simulator". Downloading applications into devices are allowed only after paying iPhone Developer Program fee [11].

A. Availability

Availability of the mobile platform means the availability of latest version and upgrades for the latest released devices. The availability of mobile platform in different languages is very important. Any upgrade in the software version or addition of new features should be made available to the mobile platforms at the expected time.

Table 1. Mobile Platform availability

Mobile Platform	Availability
Android	Google provides major upgrades, incremental in nature, to Android every six to nine months. Compared to iOS, Android updates are typically slow to reach actual devices [12]. Android is available in about 57 languages [13].
iOS	Apple provides update to the iOS almost once a year. 90 % of devices are using the latest version [14]. Most iPhones are allowed to make upgrades from one generation to another [15]. iOS supports around 36 languages [14].

B. Usability

Usability in mobile platforms refers to the ease to master the platform and get used to its features. It also refers to how easily the platform operates and accessed without a third party software. Usability of mobile platforms has increased greatly in recent years allowing users to perform more tasks in a mobile context.

Table 2. Mobile Platform Usability

Mobile Platform	Usability
Android	Android devices had front-facing cameras first but relied on third party apps to handle the video call, even over 3G, but with decidedly mixed results. This complexity makes it less useable. [16]
iOS	iOS consistency, attention to interface and experience detail, and level of fit and finish make it just as inarguably more usable [17]. iOS leaves an impressive 70% of its users very satisfied with the experience of using it.[18]

The ISO standard outlines the usability criteria in terms of three attributes; effectiveness, efficiency and satisfaction.

- Effectiveness: Accuracy and completeness with which users achieve specified goals;
- Efficiency: Resources expended in relation to the accuracy and completeness;
- Satisfaction: Positive attitudes towards the use of the product.

Issues such as the small screen size, poor connectivity and limited input modalities have an effect on the usability of mobile platforms. The factors such as User (Person who interacts with the product), Goal (Intended outcome) and Context of use (Users, tasks and the physical and social environments in which a product is used) are considered while evaluating usability criteria for mobile platforms [6].

C. Reliability

Mobile platform reliability refers to how mature the platform is and how many years it has been up in the market. It also refers to how much stable and secure the

platform is. Reliability also refers to the support available in case of issues and tolerant. Reliability is an important attribute of software quality. Software Reliability deals with the probability that software will not cause the failure of a system for a specified time under a specified condition which reflects the design perfection. The tools such as RGA 7 from ReliaSoft and SMERFs (Statistical Modeling and Estimation of Reliability Functions for Software) are used for testing the reliability of mobile platforms [7].

Table 3. Mobile Platform Reliability

Mobile Platform	Reliability
Android	Android is about 6 years old [19]. It lacks a complete stable version due to many released firmware numbers. According to a report from FixYa, android is 187 % reliable than iOS [15].
iOS	iOS is 7 years old [20]. Apple’s tech support is quick, friendly and helpful. One can get help through phone call, live chat, or simply the support webpage [21]. iOS is more secure from malware applications and most applications are designed to be compatible to any iOS version, which makes it more reliable [15].

The reliability of the application depends on the skills of the developer and the tester. The five key challenges faced while assessing and improving the reliability of mobile platform are:

- Impact of context on reliability: There is a wide spectrum of contextual properties that may influence the reliability of a software system: changes in the hardware platform (e.g., depleted battery, memory usage), fluctuations in the network (e.g., network drop outs, bandwidth variations), unanticipated usage, timing of operations, and so on.
- Impact of dynamism on reliability: Allocation of software components to OS processes directly impact the reliability of a software system. Therefore, in the mobile computing domain, where architectural reconfiguration occurs frequently, the ability to assess its impact on reliability and determine the most reliable configuration is critical.
- Difficulty of predicting reliability: The ability to determine an ideal reliable configuration for a software system depends on the ability to accurately estimate the reliability of the software system in its future operation.
- Quality reliability prediction: The configuration is considered preferable if the components are extremely reliable and efficient where as if the components are highly unreliable it is more resilient to failure.
- Scalable online analysis: The scalability of analysis is extremely important for the platform that is performed online at runtime [22].

D. Functionality

Functionality is a feature that depends on usability and it refers to achieving the user’s expected requirements. It refers

to the features and the functions the platform can do to satisfy the user’s needs.

Table 4. Mobile Platform Functionality

Mobile Platform	Functionality
Android	Users can do more in android than they could in any other OS, which makes it functional [16]. Google keeps adding new functions to its new android versions like printing on the go, built-in sensors, low power location monitoring, easy home screen switching, built-in infrared blaster support and a redesigned downloads app [23].
iOS	The newer upgrade of the iOS named iOS 8 has many functions cannot be found in any other mobile OS, like connecting all kinds of iDevices, sending any kind of messages from any device and answering calls from any device. [24].

E. Performance

Performance is the most important differentiator when it comes to mobile platform adoption. Performance is mostly about speed; how easy it is to install, configure and operate within a short time. The design of the user interface (UI), is an essential part for the performance of mobile platform. The design of user interfaces is necessary to be compatible with the demands of users [25].

Table 5. Mobile Platform Performance

Mobile Platform	Performance
Android	The overall performance is excellent except for the compatibility issues [26].
iOS	Everything from software updates to automated data backups can be managed effectively using the iTunes interface, which gives it a fast overall performance without the need to any tweaking [16].

XLI. DISCUSSION

The above five tables showed the two compared platforms with respect to the five features; availability, usability, reliability, functionality, and performance respectively. The availability in iOS is considered better than android, because each new iOS version is backward compatible with the older devices. In the other hand, a new android version is not necessarily compatible with the older devices. In fact, android updates are mostly specified for only specific devices manufacturers. However, looking at the languages supported by the two platforms, it is clear that android beats iOS by a big deal by supporting 21 more languages than iOS. Usability and functionality are two related features. More usable means less complexity which comes from the functions. iOS is considered more usable. As it has a very simple interface and most of the management tasks that are not needed by the user are hidden behind the scene. Unlike android, its interface is more complex and users can get messages related to memory

management and other things. However, android is more complex and can do more functions than iOS. Looking at the reliability of the two platforms, iOS wins the battle. iOS is more stable and secure which makes a huge percentage of users move to the newer versions of it. This helps apple to concentrate on the newer version and finding issues and fixing them. In the other hand, android does not have a stable version since it is being developed by many companies. So, different devices have different versions of android depending on the manufacturer. The performance of the two platforms can be considered the same. Both have good performance and good techniques to maintain higher performance for a better user experience.

XLII. CONCLUSION

Although mobile platforms are relatively similar with respect to their hardware capabilities, they differ greatly in their native application development models. Android is a mobile operating system running on the Linux kernel that uses Java as the development language. iOS use Cocoa Touch as user interface that developed using Objective C language. The user interface of Android simplifies internationalization and allows depicting the user interface on different screen resolutions. Cocoa Touch offers a variety of UI elements. Unlike Android, Cocoa Touch offers no layout manager so the UI elements have to be positioned in terms of absolute coordinates on the screen at design time. Android applications can more easily adapt to different devices that makes them cross compiled to other platforms. Apple iOS is fairly hostile when it comes to other platforms and requires developers and companies to submit an application for a service they want to add to its OS. Android has the largest installed base worldwide on smart phones and iOS stands second. Android platform offers high performance due to its multitasking capabilities and are fast and easy to access. iOS is less virus, fast boot and software are compatible with the operating system. The transfer of multimedia files is limited in iOS.

ACKNOWLEDGMENT

This article is based upon research work funded by The Research Council (TRC) of the Sultanate of Oman, under Grant No: ORG/SQU/ICT/13/006, (www.trc.gov.om).

REFERENCES

- [1] Sarrab M, Mobile Learning (M-learning) Concepts, Characteristics, Methods, Components. Platforms and Frameworks, Nova Science Publishers , Newyork, USA, 2014. ISBN 978-1-63463-342-0
- [2] Sarrab M, M. Elbasir and L. Elgamel, An Overview of the Technical Challenges of Migration to Open Source Software. Free and Open Source Software Conference (FOSSC-13), Muscat Oman, pp 39-42. February 18th- 19th, 2013.
- [3] Vangie B, Mobile Operating Systems (Mobile OS) Explained, webopedia. August 10,2011 http://www.webopedia.com/DidYouKnow/Hardware_Software/mobile-operating-systems-mobile-os-explained.html
- [4] Alzahrani A, Alalwan N, Sarrab M. Mobile Cloud Computing: Advantage, Disadvantage and Open Challenge, Proceedings of the 7th Euro American on Telematics and Information Systems, (EATIS 2014); 2014 Article No. 20 ACM New York, NY, USA.
- [5] Gaurav Jindal, Mayank Jain, "A Comparative Study of Mobile Phone's Operating Systems", November2012, International Journal of Computer Applications & Information Technology Vol. I, Issue III
- [6] Rachel Harrison, Derek Flood and David Duce, "Usability of mobile applications: literature review and rationale for a new usability model", 2013, Harrison et al. Journal of Interaction Science.
- [7] Sam Malek , Roshanak Roshandel, David Kilgore , Ibrahim Elhag, Improving the Reliability of Mobile Software Systems through Continuous Analysis and Proactive Reconfiguration.
- [8] Sarrab M, Rehman O. Empirical Study of Open Source Software Selection for Adoption Based on Software Quality Characteristics. Advances in Engineering Software, Elsevier. Vol. 69, pp. 1-11, March 2014.
- [9] Sarrab M, Rehman O, Selection Criteria of Open Source Software: First Stage for Adoption, International Journal of Information Processing and Management (IJIPM), Vol. 4, No. 4, pp. 51-58, 2013.
- [10] Kristen Dietiker, "Managing iOS Mobile Devices", November 2011, ACM.
- [11] Mark H. Goadrich, Michael P. Rogers, "Smart Smartphone Development: iOS versus Android", 2011, 978-1-4503-0500.
- [12] Mike Isacc, A deep-dive tour of Ice Cream Sandwich with Android's chief engineer, Oct 21 2011, <http://arstechnica.com/gadgets/2011/10/a-deep-dive-tour-of-ice-cream-sandwich-with-androids-chief-engineer/>
- [13] Apps4android. Languages and Locales Supported by Android. apps4android.org. April 15th, 2012, <http://www.apps4android.org/?p=3695>
- [14] Apple Inc, App Store Distribution,2014, <https://developer.apple.com/support/appstore/>
- [15] Ryan Inoyori "iPhone Tops Reliability Survey, Better than Android Phones" February 27, 2013, <http://au.ibtimes.com/articles/439836/20130227/iphone-tops-reliability-survey-android-phones.htm#.U-MN19bHiRu>
- [16] Bryan Wilde, "iOS vs Android vs Windows: The Battle of the Mobile OS", November 22, 2013, <http://www.udemy.com/blog/ios-vs-android-vs-windows/>
- [17] Rene Ritchie, "iPhone, Android, and the difference between usability and functionality [Sticky]", Dec 22, 2010, <http://www.imore.com/iphone-android-difference-usability-functionality>.
- [18] Nick T, "Apple's iOS tops the customer satisfaction charts; Android holds third place", 21 Jul 2011, http://www.phonearena.com/news/Apples-iOS-tops-the-customer-satisfaction-charts-Android-holds-third-place_id20512
- [19] Dan Morrill, "Announcing the Android 1.0 SDK, release 1", 23 September 2008, <http://android-developers.blogspot.in/2008/09/announcing-android-10-sdk-release-1.html>
- [20] Mathew Honan, "Apple unveils iPhone", Jan 9, 2007, <http://www.macworld.com/article/1054769/iphone.html>
- [21] Michael Andronico, "Apple Tech Support: 2014 Rating", Sep 30, 2014, <http://blog.laptopmag.com/apple-tech-support-2013>
- [22] Sonia Meskini, Ali Bou Nassif, Luiz Fernando Capretz, Reliability Models Applied to Mobile Applications, 2013, Seventh International Conference on Software Security and Reliability Companion.
- [23] Azzief Khaliq, "Android 4.4 KitKat: 10 New Features You Should Know",<http://www.hongkiat.com/blog/android-kitkat-features/>
- [24] Apple Inc, "iPhone, iPad, and Mac. Connected like never before.", 2014 <http://www.apple.com/ios/ios8/continuity/#gallery-handoff-section-3>
- [25] Farhad Soleimani Gharehchopogh, Farzaneh Abbaspour, Maryam Tanabi, Isa Maleki, "Review and Evaluation of Performance Measures in the Mobile Operating Systems", March-2013, International Journal of Scientific and Engineering Research Volume 4, Issue3 ISSN 2229-5518.
- [26] Andrew Williams, "Google Nexus 5 - Android 4.4, Apps and Performance", 5 Nov 2014, http://www.trustedreviews.com/google-nexus-5_Mobile-Phone_review_android-4-4-apps-and-performance_Page-3