Research Challenges in Mobile Application Testing and Test Cases

Niranjanamurthy M
Research Scholar, Dept. of Computer Science Engg., JJTU, RAJASTHAN,
niruhsd@gmail.com

Sai Prasad C
Student of MCA, MSRIT, BANGALORE,
saiprasad0902@gmail.com

Manushree SP
Student of MCA, MSRIT, BANGALORE,
manushreesp.27@gmail.com

***Abstract* -- Mobile application testing is mainly deals with functionality, Usability and consistency of that application. Mobile devices are everywhere. Businesses depend on them. Customers interact with them like never before. Their exponential growth is creating high demand and an even higher need for advanced functionality. But innovation and increased speed to market bring many testing challenges. Mobile applications either come pre-installed or can be installed from mobile software distribution platforms. Mobile devices have witnessed a phenomenal growth in the past few years. Device and platform diversity, short release cycles, lack of mature testing tools and the variety of network connectivity options result in frequent cost overruns and missed deadlines in today's mobile application testing environment. A comprehensive mobile testing strategy that includes device and network infrastructure, optimized selection of target devices, and an effective combination of manual and automated testing tools to cover both functional and non-functional testing is essential for getting your mobile applications to market on time and within budget. Understanding and learning to create mobile application test cases.**

Keywords*— *Mobile application testing, Types of Mobile Application Testing, Challenges in Mobile App Testing, Customers Challenges in Mobile Testing, , Interruptions of the mobile application Testing, Mobility Testing Process, Security testing in Mobile application, Mobile application test cases.

I. INTRODUCTION

Mobile application testing (MAT) is a process by which application software developed for hand held mobile devices is tested for its functionality, usability and uniformity. Mobile Application Testing techniques are: Functional Testing, Laboratory Testing, Performance Testing, Memory Leakage Testing, Interrupt Testing, Usability testing, Installation testing, Certification Testing, Challenges in Mobile Application Testing are: Types of Mobile Devices, Diversity in Mobile Platforms/OS, Mobile network operators, Scripting.

Mobile app testing is different from testing of desktop applications, as apart from regular functional and UI requirements we also have to consider factors like device hardware, screen size, platform, connectivity issues and many more.

Mobile devices have witnessed a phenomenal growth in the recent years. A study conducted by the Yankee Group predicts generation of $4.2 billion in revenue by 2013 through 7 billion U.S. smartphone app downloads. Mobile application testing involves evaluating functional & non-functional characteristics of application softwares developed for Hand held devices such as mobile phones, tablets etc. Testing a mobile application across multiple devices running on the same platform and every platform poses a unique challenge for testers.

Testing mobile applications through:

i) Devices.
ii) I phone -- Simulator
iii) Android -- Emulator

II. AIM OF THE STUDY

- To understand what is Mobile Application Testing
- To Know the Types of Test techniques required for Mobile Application
- Knowledge on Mobility Testing Process To understand Key Challenges in Mobile Application Testing
- To know Mobile Testing Tools and Tool Selection Criteria
- To understand Customers Challenges in Mobile Application Testing
- Knowledge on Interruptions of the mobile Application Testing
- Understand the Security testing conditions in Mobile Application
- To write basic mobile application test cases.

III. RELATED WORK

The usability of mobile applications is critical for their adoption because of the relatively small screen and awkward (sometimes virtual) keyboard, despite the recent advances of smartphones. Traditional laboratory based usability testing is often tedious, expensive, and does not reflect real use cases. In this paper, we propose a toolkit that embeds into mobile applications the ability to automatically collect user interface (UI) events as the user interacts with the applications. The events are fine-grained and useful for quantified usability analysis. We have implemented the toolkit on Android devices and we evaluated the toolkit with a real deployed Android application by comparing event analysis (state-machine based) with traditional laboratory testing (expert based).

Challenges in Mobile App Testing: It's been clear for a while that mobile devices are the current market players, even more so that some experts have been counting on them to take over the PCs and Desktops in near future. But as with any emerging technology, developing and implementing mobile applications can pose a number of unique challenges.
The major challenge in Mobile App Testing is the multiplicity of mobile devices with different capabilities, features and restrictions. Devices may have different technical capabilities such as amount of available memory, screen resolution, screen orientation and size of the display, network connectivity options, support for different standards and interfaces.

There are multiple operating systems that are prevalent in the mobile space like Symbian, Android, iPhone OS, Windows, Linux, Blackberry OS, palm OS, Brew, etc. Each of the operating systems can have further versions for different types of devices which make platform testing complex and further challenging. Another challenge is that the developers need to focus on developing applications that are easy to use on a mobile and consume less power.

IV. TYPES OF MOBILE APPLICATION TESTING

1. *Functional Testing*- Functional testing ensures that the application is working as per the requirements. Most of the test conducted for this is driven by the user interface and call flows.
2. *Laboratory Testing*- Laboratory testing, usually carried out by network carriers, is done by simulating the complete wireless network. This test is performed to find out any glitches when a mobile application uses voice and/or data connection to perform some functions.
3. *Performance Testing*- This testing process is undertaken to check the performance and behaviour of the application under certain conditions such as low battery, bad network coverage, low available memory, simultaneous access to application's server by several users and other conditions. Performance of an application can be affected from two sides: application's server side and client's side.
4. *Memory Leakage Testing*- Memory leakage happens when a computer program or application is unable to manage the memory it is allocated resulting in poor performance of the application and the overall slowdown of the system.
5. *Interrupt Testing*- An application while functioning may face several interruptions like incoming calls or network coverage outage and recovery.
The different types of interruptions are:
   - Incoming and Outgoing SMS and MMS
   - Incoming and Outgoing calls
   - Incoming Notifications
   - Battery Removal
   - Cable Insertion and Removal for data transfer
   - Network outage and recovery
   - Media Player on/off
   - Device Power cycle

An application should be able to handle these interruptions by going into a suspended state and resuming afterwards.
6. *Usability testing*- Usability testing is carried out to verify if the application is achieving its goals and getting a favourable response from users. This is important as the usability of an application is its key to commercial success (it is nothing but friendliness)
7. *Installation testing*- Certain mobile applications come pre-installed on the device whereas others have to be installed from the store. Installation testing verifies that the installation process goes smoothly without the user having to face any difficulty.
8. *Certification Testing*- To get a certificate of compliance, each mobile device needs to be tested against the guidelines set by different mobile platforms.
The Certified Mobile Application Tester popularly known as CMAT certification exam is offered by the Global Association for Quality Management (GAQM) via Pearson Vue Testing Centre world wide to benefit the Mobile Application Testing Community.

V. MOBILITY TESTING PROCESS

Testing is a process rather than a single activity. This process starts from test planning then designing test cases, preparing for execution and evaluating status till the test closure. So, we can divide the activities within the fundamental test process into the following basic steps: Planning and Control, Analysis and Design, Implementation and Execution, Evaluating exit criteria and Reporting, Test Closure

activities. A typical end-to-end mobile testing process should start from creating test cases of the application, performing user acceptance and finally device testing stage. The stages in mobile application testing process are as follows:

Test case Preparation	Start by Preparing test cases
Automated script identification & Modification	Identify the re-usable automation scripts And modify the scripts as per the project requirement
Manual & Automated testing	Execute both manual and automation test cases
Usability Testing	User experience is key for apps to be accepted by end users. Check usability issues, navigation and content
Performance Testing	Test the performance of the mobile application for its responsiveness, scalability, resource usage and stability based on standards
Security & Compliance Testing	Ensure the app is secure by checking SQL Inhection, Datadump, Man in the Middle, Session Hijacking, Packet Sniffing, SSL Validation
Device Testing	Execute test cases in other family of devices in the lab or testing simulation tool (Example: Perfecto, Mobile/Device Anywhere)

Fig. 1. Testing Process

Security and data privacy are of highest importance in today's scenario. Users are worried about their privacy.

VI. KEY CHALLENGES IN MOBILE APPLICATION TESTING

1. *Variety of Mobile Devices*- Mobile devices differ in screen sizes, input methods (QWERTY, touch, normal) with different hardware capabilities.
2. *Diversity in Mobile Platforms/OS*- There are different Mobile Operating Systems in the market. The major ones are Android, IOS, BREW, BREWMP, Symbian, Windows Phone, and BlackBerry (RIM). Each operating system has its own limitations. Testing a single application across multiple devices running on the same platform and every platform poses a unique challenge for testers.
3. *Mobile network operators*- There are over 400 mobile network operators in the world;[2] out of which some are CDMA, some GSM, whereas others use less common network standards like FOMA, and TD-SCDMA. Each network operator uses a different kind network infrastructure and this limits the flow of information.
4. *Scripting*- The variety of devices makes executing the test script (Scripting) a key challenge. As devices differ in keystrokes, input methods, menu structure and display properties single script does not function on every device.

The following points that are to be considered while testing mobile applications are to be addressed with the following questions:

1) Which mobile devices and operating system versions will this application support?
2) How do we test applications to make sure they run on those platforms?
3) What modifications must be made to accommodate the differences among platforms?
4) How will industry innovations be supported going forward, since new mobile devices, technologies, and applications are constantly being introduced?
5) How will development and testing processes accommodate the inherent differences among wireless network protocols and mobile service providers?
6) How do we know how much testing is enough?

VII. SOME POPULAR MOBILE TESTING TOOLS AND TOOL SELECTION CRITERIA

Fig. 2. Mobile testing tool

Tool Selection Criteria:

It is based on:

- Cost Benefit Analysis
- Timelines for the project
- Regression Test Count & Complexity

Scope based decisions:

- Platforms support
- Supported Versions of platforms
- Types of automation supported.
- Device variants within a platforms (form factors)

Feature based decisions:

- Working on both simulator /device
- Integration to test management
- Ease of use and scripting support Infrastructure

Infrastructure decisions:

- Stability
- Dependency on Mac/desktops
- Cloud based/stand alone

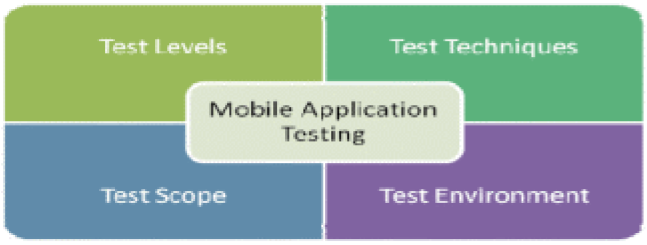

Fig.3. Mobile Application Test Matrix

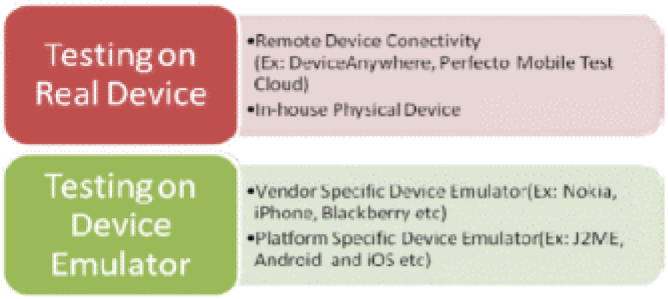

Figure4. Mobile Application Test Environment

VIII. CUSTOMERS CHALLENGES IN MOBILE TESTING

- Variety of mobile devices in market and multiple manufacturers
- Coping with the short lifecycle of the mobile application in market
- Huge variety of hardware capabilities
- Shorter duration of device life in the market
- Variety of network modes like 2G/3G/4G/Wi-Fi/Wi-Max
- Huge investment and high time frame to set up an test lab
- Most of the tools are image based comparison tool
- One test tool may not support all platforms versions
- Tools may need jailbreak/rooting that invokes security threat
- Testing on latest technologies like HTML5, NFC, etc.
- High rise of localized application capability
- Choice between simulators and real devices for testing.

8.1. *Mobile testing how is it different?*

1. *device diversity*
   - Multiple Platforms
   - Multiple Browsers
   - Rendering differences
   - Mobile devices have different application runtimes.
2. *network challenges*
   - Multiple type of Networks (GSM / GPRS / Wi-Fi / Wi-Max etc)
   - Unpredictable time taken for data transfer
   - Different speed of connectivity across geographies
   - Multiple Network Operators with customized Network features
3. *hardware challenges*
   - Limitations in processing speed
   - Limitations of Memory size of mobile
   - Differences in Communication Protocols of devices WAP/ HTTP.

IX. INTERRUPTIONS OF THE MOBILE APPLICATION TESTING

There are various events that can interrupt the flow of your application. Your application should be able to handle these and should be tested for the same.

- Incoming Call
- Text message
- Other app notifications
- No storage
- Airplane mode
- Intermittent connectivity
- Home screen jump
- Sleep mode
- Storage low
- Battery low
- Battery dead

X. SECURITY TESTING IN MOBILE APPLICATION

Security and data privacy are of highest importance in today's scenario. Users are worried about their data and recommendation being exposed through vulnerable applications.

- Is your application storing payment information or credit card details?
- Does your application use secure network protocols?
- Can they be switched to insecure ones?
- Does the application ask for more permissions than it needs?
- Does your application use certificates?
- Does your application use a Device ID as an identifier?

XI. TEST CASES

Test cases are shown in Table the Table below.

Sl. No.	Module	Sub-Module	Test case Description	Expected Result
1	Installation		Verify that application can be installed successfully.	Application should be able to install successfully.
2	Uninstallation		Verify that application can be uninstalled successfully.	User should be able to uninstall the application successfully.
3.	Network Test Cases		Verify the behaviour of application when there is Network problem and user is performing operations for date call.	User should get proper error message like "Network error. Please try after sometime"
			Verify that user is able to establish data call when Network is back in action.	User should be able to establish data call when Network is back in action.
4	Voice Call Handling	Call Accept	Verify that user can accept Voice call at the time when application is running and can resume back in application from the same point.	User should be able to accept Voice call at the time when application is running and can resume back in application from the same point.
		Call Rejection	Verify that user can reject the Voice call at the time when application is running and can resume back in application from the same point.	User should be able to reject the Voice call at the time when application is running and can resume back in application from the same point.
		Call Establish	Verify that user can establish a Voice call in case when application data call is running in background.	User should be able to establish a Voice call in case when application data call is running in background
5	SMS Handling		Verify that user can get SMS alert when application is running	User should be able to get SMS alert when application is running.
			Verify that user can resume back from the same point after reading the SMS.	User should be able to resume back from the same point after reading the SMS.
6	Unmapped Keys		Verify that unmapped keys are not working on any screen of application.	Unmapped keys should not work on any screen of application.
7	Application Logo		Verify that application logo with Application name is present in application Manager and user can select it.	Application logo with Application name should be present in application manager and user can select it.
8	Splash		Verify that when user selects application logo in application manager splash is displayed	When user selects application logo in application manager splash should be displayed
			Note that Splash do not remain for more than three seconds.	Splash should not remain for more than three seconds.
9	Low Memory		Verify that application displays proper error message when device memory is low and exits gracefully from the situation.	Application should display proper error message when device memory is low and exists grac3efully from the situation
10	Clear Key		Verify that clear key should navigate the user to previous screen.	Clear key should navigate the user to previous screen.

XII. CONCLUSION

Mobile application testing is a process by which application software developed for hand held mobile devices is tested for its functionality even more so that some experts have been counting on them to take over the PCs and Desktops in near future. Mobile app testing is different from testing of desktop applications, as apart from regular functional and UI requirements we also have to consider factors like device hardware, screen size, platform, connectivity issues and many more. Testing can show the presence of faults in a system; it cannot prove there are no remaining faults. Component developers are

responsible for component testing; system testing is the responsibility of a separate team. Integration testing is testing increments of the system; release testing involves testing a system to be released to a customer. Use experience and guidelines to design test cases in defect testing. Tool Selection Criteria It is based on cost Benefit Analysis, Timelines for the project Regression Test Count & Complexity and Customers Challenges in Mobile Testing. Mobile application test cases play an important role in identifying bugs and assure quality factors in the application.

ACKNOWLEDGEMENT

We thank Dr. T. V. Suresh Kumar, Prof. and Head, Dept. of MCA, MSRIT, Bangalore-54. for his continuous support and encouragement for completing this research paper and also thanks to MSRIT management.

We thank Mr. S.Jagannatha, Associate Professor. Dept. of MCA, MSRIT, Bangalore-54. for his constant support and motivation.

REFERENCES

[1] Xiaoxiao Ma, Bo Yan Guanling Chen- "Design and Implementation of a Toolkit for Usability Testing of Mobile Apps" Published online: 21 November 2012 - Springer Science -Business Media New York 2012.

[2] R Ramchandra Nimbalkar - "Mobile Application Testing and Challenges" - International Journal of Science and Research (IJSR), -Volume 2 Issue 7, July 2013 -India Online ISSN: 2319-7064

[3] Http://www.tcs.com/resources/white_ papers/Pages/ Mobile_application_testing.aspx

[4] http://en.wikipedia.org/wiki/Mobile_application _testing

[5] http://www.infosys.com/flypp/resources/ Documents/ mobile-application-testing.pdf

[6] [6] http://www.rapidvaluesolutions.com/mobile-application - testing-step-by-step-approach/

[7] http://mindqsystems.com/Mobile_Testing.php

[8] http://www.tutorialspoint.com/white-papers/335.pdf

[9] Julian Harty, Mahadev Satyanarayanan A - Practical Guide to Testing Wireless Smartphone Applications (Synthesis Lectures on Mobile and Pervasive Computing)- 2009 - ISBN-10: 1608452530

[10] Rex Black: Advanced Software Testing — Vol. 1, Shroff Publishers, 2011

[11] Srinivasan Desikan Gopalaswamy: Software Testing Principles and Practices, 5th Edition, Pearson Education, 2007

[12] http://www.qaac.org/wp-content/uploads/2012/07/ Mobile-Testing-QAAC.pdf

[13] Selvam R, Dr. V. Karthikeyani - "Mobile Software Testing – Automated Test Case Design Strategies" (IJCSE) - ISSN: 0975-3397- Vol. 3 No. 4 Apr 2011