AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

Computer and Systems Engineering Department

Cross-Platform Mobile Development

A Thesis

Submitted in Partial Fulfillment of the Requirements of the Degree of

Master of Science in Electrical Engineering

(Computer and Systems Engineering)

Submitted by

Wafaa Samy Abdul-Hamed El-Kassas

B.Sc. of Computer Engineering, 2000

Computer Engineering Department

Faculty of Engineering, Cairo University

Supervised by

Prof. Dr. Ayman Mohamed Wahba

Dr. Ahmed Hassan Yousef

Dr. Bassem Amin Abdullah

Cairo, 2015

Examiners Committee

Name: **Wafaa Samy Abdul-Hamed El-Kassas**

Thesis: **Cross-Platform Mobile Development**

Degree: Master of Science in Computer Engineering

Title, Name and Affiliation	**Signature**
Prof. Nevin Mahmoud Darwish **Cairo University,** **Faculty of Engineering,** **Computer Engineering Dept.**	**……**
Prof. Ashraf El-Farghaly Salem **Ain Shams University,** **Faculty of Engineering,** **Computer and Systems Engineering Dept.**	**……**
Prof. Ayman Mohamed Wahba **Ain Shams University,** **Faculty of Engineeing,** **Computer and Systems Engineering Dept.**	**……**
Dr. Ahmed Hassan Yousef **Ain Shams University,** **Faculty of engineering,** **Computer and Systems Engineering Dept.**	**……**

Date:

Statement

This thesis is submitted as a partial fulfillment of Master of Science in Electrical Engineering (Computer and Systems Engineering), Faculty of Engineering, Ain shams University, Cairo, Egypt.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

Name: Wafaa Samy Abdul-Hamed El-Kassas

Signature:

Date: 8/8/2015

Researcher Data

Name	:	Wafaa Samy Abdul-Hamed El-Kassas
Date of birth	:	24/9/1978
Last academic degree	:	B.Sc. of Computer Engineering
University issued the degree	:	Faculty of Engineering, Cairo University
Date of issued degree	:	June 2000

Abstract

Wafaa Samy Abdul-Hamed El-Kassas, "**Cross-Platform Mobile Development**", Master of Science dissertation, Ain Shams University – Faculty of Engineering, 2015.

Smartphones become much more used these days than feature phones and personal computers because of the variety of mobile applications that are available to be downloaded from the application stores. There are many smartphones' vendors in the market and each vendor uses a different mobile platform. Each platform vendor provides different development tools and programming languages for the developers. Therefore, the development of the same application for different platforms means repeating the same work several times; each time using the programming language and development tools of a specific mobile platform. Cross-platform mobile development solutions solve this problem by having a main concept. This concept is enabling the developer to develop the application once and run it anywhere. The cross-platform solutions use different approaches for native development such as: Cross-Compilation, Interpretation, Model-Driven Development, Component-Based …etc. This thesis surveys the existing cross-platform mobile development approaches, attempts to propose a comprehensive categorization for them, defines the pros and cons of each approach, and explains sample solutions per approach. The survey defines the limitations of the existing cross-platform solutions and the open research areas. This thesis introduces an Integrated Cross-Platform Mobile Applications Development (ICPMD) solution which attempts to enhance the limitations of the existing solutions by: (1) helping the developer to develop with the most popular programming languages like Java for Android and C# for Windows Phone, (2) focusing on both the source code and user interface transformations to generate full applications, and (3) supporting code reuse. The ICPMD supports two platforms: Windows Phone 8 and Android. This thesis proposes and implements a new code conversion approach by using the Extensible Stylesheet Language Transformation (XSLT) and Regular Expressions. The implemented approach is used to convert several mobile applications from the Windows Phone 8 platform to the

Android platform and vice versa. The thesis compares the generated application from the proposed ICPMD approach to its native counterpart and to generated applications from two commercial tools (Titanium, and Xamarin). The evaluation of the ICPMD generated applications shows substantial improvement over the existing cross-platform mobile development solutions.

Keywords: Mobile Applications; Cross-Platform Mobile Development; Trans-Compilation; Model Driven Development; Code Conversion; Code Reuse; Code Generation;

Summary

“Cross-Platform Mobile Development”

Researcher Name: Wafaa Samy Abdul-Hamed El-Kassas

This thesis introduces an Integrated Cross-Platform Mobile Applications Development (ICPMD) solution to enhance the limitations of the existing cross-platform mobile development solutions by: 1) helping the developer to develop with the most popular programming languages like Java for Android and C# for Windows Phone, 2) generating full mobile applications by focusing on both the source code and user interface transformations, and 3) supporting code reuse. This thesis compares the generated application from the proposed ICPMD solution to its native counterpart and to applications that are developed by using two commercial tools: Titanium, and Xamarin. The evaluation of the ICPMD generated applications shows substantial improvement over the existing cross-platform mobile development solutions.

Chapter 1 introduces the thesis and summarizes its contributions.

Chapter 2 presents a background about the mobile applications development.

Chapter 3 presents the literature survey of the cross-platform mobile applications development approaches and sample solutions per approach.

Chapter 4 presents the proposed solution (ICPMD) and illustrates the building blocks of the proposed architecture along with the internal design details of the ICPMD main modules.

Chapter 5 introduces the proposed code conversion approach which is based on the XSLT and Regular Expressions.

Chapter 6 introduces the implementation results of the ICPMD.

Chapter 7 presents the evaluation criteria and results of: 1) evaluating the proposed code conversion approach, and 2) comparing the generated application from ICPMD to its native counterpart and to the output applications from other cross-platform solutions in commercial use.

Chapter 8 gives the work conclusions and future work.

References and appendixes exist at the end of this thesis.

Acknowledgment

First praise is to Almighty Allah who gives me the power to complete this work. I would like to thank my parents. Their patience, care, and love are what guided me through my whole life. I pray to God for my mother who taught me invaluable lessons in life. I would like to thank my father who was beside me until I did this work and for his continuous support and encouragement.

I would like to thank my family, friends, and colleagues who always encourage me to complete my research.

I would like to thank my supervisors Prof. Ayman Wahba, Dr. Ahmed Hassan Yousef, and Dr. Bassem Amin Abdullah for their efforts, guidance, help and patience. I learned so many valuable things from them, but above all, they taught me how to be devoted to research and how to help others.

Table of Contents

List of Figures

List of Tables

List of Abbreviations

ACL	Android Compatibility Library
ADT	Android Development Tool
AMS	Authentication and Management System
AOT	Ahead of Time Compilation
API	Application Programming Interface
App	Mobile Application
ARM	Advanced RISC Machine
ASEJ	Ain Shams Engineering Journal
AST	Abstract Syntax Tree
CDLOC	Correctly Detected Lines of Code
CI	Cloud Infrastructure
CLR	Common Language Runtime
CRUD	Create, Retrieve, Update, and Delete operations
DOM	Document Object Model
DSL	Domain Specific Language
GCC	GNU Compiler Collection
GUI	Graphical User Interface
GWT	Google Web Toolkit
ICPMD	Integrated Cross-Platform Mobile Development
IDE	Integrated Development Environment
IMEI	International Mobile Equipment Identity
IPR	Intellectual Property Right
Java ME	Java Mobile Edition
JIL	Joint Innovation Lab
JIT	Just in Time Compilation
JSAF	JavaScript Application Framework
JVM	Java Virtual Machine
LOC	Lines of Code
MB-UID	Model-Based User Interface Development