IMAGE COMPARISON BASED MOBILE USER INTERFACE VERIFICATION FRAMEWORK

Maha Kumarage Dinu Sandaru Kumarasiri

168238F

Degree of Master of Science

Department of Computer Science and Engineering

University of Moratuwa

Sri Lanka

March, 2020

IMAGE COMPARISON BASED MOBILE USER INTERFACE VERIFICATION FRAMEWORK

Maha Kumarage Dinu Sandaru Kumarasiri

168238F

Thesis submitted in partial fulfillment of the requirements for the degree Master of Science in Computer Science and Engineering

Department of Computer Science and Engineering

University of Moratuwa

Sri Lanka

March, 2020

DECLARATION

I declare that this is my own work and this MSc thesis project report does not incorporate without acknowledgement any material previously submitted for the degree or diploma in any other university or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Also, I hereby grant University of Moratuwa the non-exclusive right to reproduce and distribute my dissertation, in whole or in part in print, electronic or other medium. I retain the right to use this content in whole or part in future works (such as articles of books).

Signature: ……. Date: …….

Name: M.K.D.S. Kumarasiri

I certify that the declaration above by the candidate is true to the best of my knowledge and that this report is acceptable for evaluation for the CS-6997 MSc Thesis.

Name of the supervisor: Dr. Indika Perera

Signature of the supervisor: ……. Date: ……

ABSTRACT

Due to the highly competitive market, user interface of a mobile application plays a major role in attracting and retaining its user base. In a full stack or web application development, there is usually a user interface (UI)/ user experience (UX) designer or a front-end engineer who implements the front end. On the contrary, in mobile applications, the app developers themselves implement the front end according to the mockups provided by the UI/UX designers. The verification of the user interface of the actual application against the provided mockup happens manually by developers and testers and not by the designers which makes it less accurate and time consuming since their eyes are not trained to identify pixel level visual differences.

Until now various researches have been done on automating the verification step of the event flow and underlying functionalities. But verifying the user interface of mobile applications is still left for the human eye.

The main objective of this research is to develop a mechanism to get a quantifiable score based on how much the user interface of a mobile application matches with its initial mockups. Two accuracy levels are considered for computing this score; layout and overall. Layout score limits the comparison to the layout of the user interface whereas the overall score compares layout along with color, orientation, etc.

For the layout level comparison, three local feature matching algorithms namely, SIFT (Scale-Invariant Feature-Transform), CSIFT (Color SIFT), PCA-SIFT (Principal Component Analysis SIFT) along with a simple bob detection matching algorithm are considered to be experimented with. For the overall level comparison, a pixel level comparison algorithm is used.

In parallel a survey is conducted where UI/UX designers would provide a layout and overall score for a set of selected use cases. These scores were compared with the scores from the image comparison algorithms. Based on this, CSIFT is chosen as the underlying algorithm to compute layout comparison scores as it outputs the closest values mimicking designers. For the overall value the pixel based scores ended up being stricter than values given by the designers.

In conclusion, the objective of the research is successfully achieved by implementing a framework which will output a score based on the comparison between the mockups and the actual user interface of mobile applications in two accuracy levels; overall and layout only. Overall score based on pixel level matching turned out to be too strict and better suited if the requirement is a strict conformity to the provided user interface. Layout score also has limitations with text intensive applications when the data is dynamically loaded. Both these scores can be used to verify the user interface, but the thresholds and which score to use is dependent on the application and how much deviation the company allows against the provided mockup.

ACKNOWLEDGMENT

I owe my deepest gratitude to my supervisor, Dr. Indika Perera, for his invaluable support in providing relevant knowledge, advice and supervision throughout the project. This would not have been possible without his expertise and continuous guidance.

I am deeply grateful for the support and advice given by Dr. Malaka Walpola by providing feedback on the presented work during the continuous progress evaluations.

Further I would like to thank Mr. Dhanika Perera, Chief Executive Officer, Mr. Chamika Weerasinghe, Chief Technology Officer, of Bhasha Lanka (pvt) Ltd for providing the, access to the mockups and case study details and advise in the development process of mobile domain.

Finally, I would like to thank my colleagues at MillenniumIT and Amazon, for covering my work and helping me to balance the workload. Without them, this project would not have been possible.

Special thanks go to all the UI/UX engineers and designers who participated in the survey and provided an invaluable input to my research.

Last but not least, I am grateful for all the people who supported me throughout this research in various means.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Abbreviation	Description
GUI	Graphical User Interface
UI/UX	User Interface/User Experience
MoGUT	Mobile GUI Testing
SUT	System Under Test
SIFT	Scale-Invariant Feature-Transform
CSIFT	Color Scale-Invariant Feature-Transform
PCA-SIFT	Principal Component Analysis Scale-Invariant Feature-Transform

LIST OF APPENDICES