AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
COMPUTER AND SYSTEMS DEPARTMENT

Mining of Software Design Patterns

A THESIS
SUBMITTED FOR THE PARTIAL FULFILLMENT OF
MASTER DEGREE IN ELECTRICAL ENGINEERING
(COMPUTER AND SYSTEMS ENGINEERING)

By

Eng. MOHAMED ABOU-BAKR MOHAMED SOLIMAN
B.Sc. in Computer and Systems Engineering
Faculty of Engineering, Ain shams University, 2005

Supervised by

Prof. Dr. AYMAN MOHAMED WAHBA
Faculty of Engineering
Ain shams University

Dr. ISLAM AHMED ELMADDAH
Faculty of Engineering
Ain shams University

Cairo 2010

APPROVAL SHEET

Thesis title: Mining of Software Design Patterns
Presented by: Eng. Mohamed Abou-Bakr Mohamed Soliman
Degree Name: Master of Electrical Engineering
(Computer and system Engineering)

Thesis Defense Committee

Name, Title and Affiliation **Signature**

1. **Prof. Dr. Mohamed Gamal El-Din Darwish**
   Faculty of Computers and Information, Cairo University

2. **Prof. Dr. Hani Mohamed Kamal Mahdi**
   Faculty of Engineering, Ain shams University

3. **Prof. Dr. Ayman Mohamed Wahba**
   Faculty of Engineering, Ain shams University

STATEMENT

This dissertation is submitted to Ain Shams University in fulfillment of the requirements for master degree in Electrical Engineering.

This work included in the thesis was made by the author during the period from October 2005 to October 2010 at Computer and Systems Engineering Department, Ain Shams University.

No part of this thesis has been submitted for degree or qualification at any other university or institute.

Date:

Signature:

Name: Mohamed Abou-Bakr Soliman

Contents

List of Tables and Figures

List of Figures

List of Tables

Acknowledgments

My thesis would not have been possible without the expert guidance and everlasting patience of my advisors, Prof. Dr. Ayman Wahba and Dr. Islam El-Maddah. I thank them for their comments which were always insightful and appropriate. Many thanks go to my thesis committee for revising my thesis. I thank them for their efforts and comments in perfecting my thesis.

The writing of a thesis can be a lonely and isolating experience, yet my research journey to an MSc degree would not have been possible without the help and support of numerous people. Thus, my sincere gratitude goes to my mother, father, and all my friends for their love and their personal and practical support over the last few years.

Special thanks to my leaders in Hewlett Packard – HP Company for their continuous support and their invitation to attend the HP Tech Conference.

Mohamed A. Soliman
Computer and Systems Engineering Dept.

Mining of Software Design Patterns

Abstract

One of the most repeatable and time consuming tasks in the software development process is trying to analyze and understand the technical implementation and design of an existing program source code. Design patterns encapsulate solutions to common object oriented design problems which make them an aid to understand different design decisions taken by software designers in existing software. Thus, by detecting design patterns from the source code, we can understand the main intent of the design. Current approaches for design patterns detection described design patterns based on a specific pattern implementation without considering the pattern semantics which prevents the detection of many existing pattern implementation variants. This thesis presents a new, fully automated source code pattern mining approach. The new approach is based on a new design pattern description which describes design patterns based on the pattern semantics. We claim that design pattern description has a great impact on the accuracy of a design pattern mining tool. Our approach is capable of detecting a variety of design patterns' implementations based on the proposed pattern description. This thesis also describes our tool, DPM, that implements the new pattern description based on a model transformation approach. DPM is using graph matching and constrain satisfaction problem (CSP) algorithms to detect patterns' instances. DPM has been tested against benchmark applications, including JUnit and Java AWT. Comparison to