MODELING ACTIVITY DIAGRAM TO COLORED PETRI NET FOR VALIDATION AND VERIFICATION BASED ON NON FUNCTIONAL PARAMETERS

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A project report submitted in partial fulfillment of the
requirements for the award of the degree of
Master of Science (Computer Science)

Faculty of Computer Science and Information Systems
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NOVEMBER 2008

ABSTRACT

UML is one of the modeling tools which gains wide area of usage in developing softwares. It consists of many diagrams which help developers of a software to produce better product. One of its diagrams is called Activity Diagram. It is a deliverable which is usually produced in the analysis phase of software. It consists of many important benefits, yet it has weaknesses too. One important thing which the current Activity Diagram is unable to do it is that it can not be validated and verified. The current Activity Diagram is a functional diagram and to extract non functional parameters from functional diagram is impossible but through modeling it to colored Petri net and by using the formalism of colored Petri net we may able to verify and validate the Activity Diagram. The ultimate outcome of this study would be handful information to manage the current mentioned Activity Diagram's weakness. Moreover a computer tool is provided called ADET to validate and verify the activity diagram.

ABSTRAK

UML ialah salah satu alat permodelan yang mendapat penggunaan meluas dalam pembangunan perisian-perisian. Ia mengandungi pelbagai rajah yang membantu pembangun perisian untuk menghasilkan produk yang lebih baik. Satu dari rajah-rajah berkenaan dikenali sebagai Rajah Aktiviti. Ianya bersifat penyampai yang biasanya dihasilkan di dalam fasa analisis bagi sesuatu perisian. Ia mengandungi banyak kelebihan disamping terdapat juga kelemahan. Satu perkara penting yang mana Rajah Aktiviti yang ada sekarang tidak mampu lakukan adalah ia tidak boleh disah dan ditentusahkan. Rajah Aktiviti yang ada kini adalah rajah fungsian dan adalah mustahil mengekstrak parameter-parameter bukan fungsian daripada rajah fungsian, akan tetapi dengan memodelkannya kepada *colored Petri net* serta menggunakan perumusan *colored Petri net* kita mampu untuk mengesah dan menentusahkan Rajah Aktiviti. Dapatan daripada kajian ini berupa maklumat berguna untuk mengurus kelemahan Rajah Aktiviti yang ada sebagaimana disebutkan tadi. Tambahan juga, peralatan computer yang dipanggil *ADET* disediakan untuk mengesah dan menentusahkan rajah aktiviti tersebut.

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CHAPTER 1

INTRODUCTION

1.1 An Introduction to UML

UML is a visual modeling language. It‘s a tool for developers for analyzing and designing an object oriented system. UML is a specification introduced by OMG. UML contains some rules and instructions which are commonly graphical. Unified Modeling language is a visual language for specifying, constructing and documenting the artifacts of systems. The word visual in the definition is a key point. The UML is the de facto standard diagramming notation for drawing and presenting pictures (with some text) related to software – primarily OO software. UML is known as one of the most common methods in software engineering. The Unified Modeling Language (UML) is a standard language for specifying, visualizing, constructing, and documenting the artifacts of software systems, as well as for business modeling and other non-software systems. The UML represents a collection of best engineering practices that have proven successful in the modeling of large and complex systems. The UML is a very important part of developing objects oriented software and the software development process.

The primary goals in the design of the UML were:

1. Provide users with a ready-to-use, expressive visual modeling language so they can develop and exchange meaningful models.
2. Provide extensibility and specialization mechanisms to extend the core concepts.
3. Be independent of particular programming languages and development processes.
4. Provide a formal basis for understanding the modeling language.
5. Encourage the growth of the OO tools market.
6. Support higher-level development concepts such as collaborations, frameworks, patterns and components.
7. Integrate best practices.

As the strategic value of software increases for many companies, the industry looks for techniques to automate the production of software and to improve quality and reduce cost and time-to-market. These techniques include component technology, visual programming, patterns and frameworks. Businesses also seek techniques to manage the complexity of systems as they increase in scope and scale. In particular, they recognize the need to solve recurring architectural problems, such as physical distribution, concurrency, replication, security, load balancing and fault tolerance. Additionally, the development for the World Wide Web, while making some things simpler, has exacerbated these architectural problems. The Unified Modeling Language (UML) was designed to respond to these needs.

1.2 An Introduction to Petri Net and Colored Petri Net

Petri Net is a tool for studying systems. Petri Net is mathematical and it is a modeling tool. Since we can not study and analyze many fields directly, it is better we analyze them indirectly through modeling. Model is a pattern that conveys important specifications of an under studying system. In most of modeling mathematic is used. System first is modeled to Petri Net, and then the model will be analyzed. The results of analysis lead us to a useful system in other word; the model converts a complicated system to a simple system. This concept is depicted in figure 1.1.

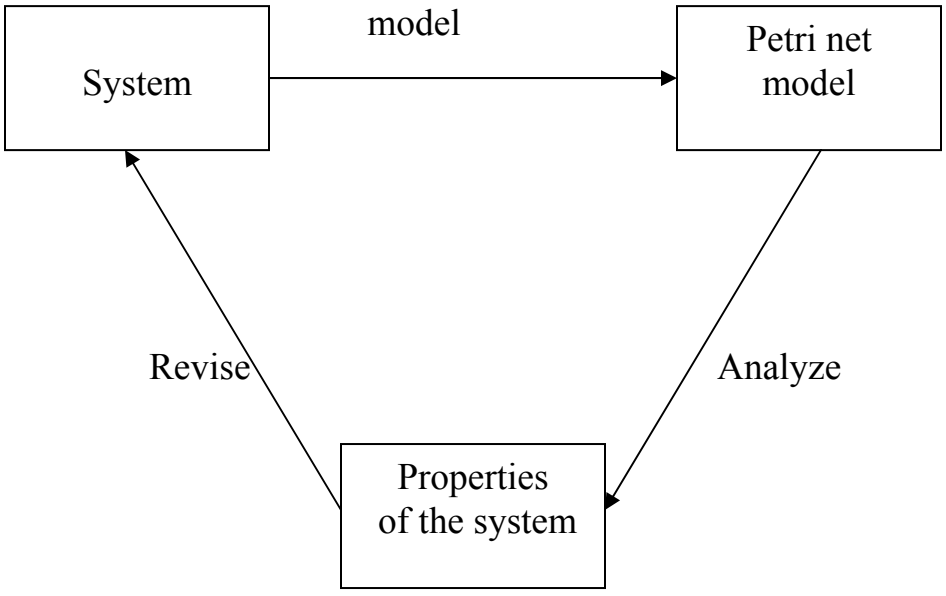

Figure 1.1: Modeling Schema Using Petri Net

An extension of Petri net is called *colored Petri net* which is more powerful than Petri net since it can distinguish the tokens. It is more practical and it has more usage than PN. It is developed for systems in which communication, synchronization and resource sharing play an important role CP-nets combine the strengths of ordinary Petri nets with the strengths of a high-level programming language. Petri nets provide the primitives for process interaction, while the programming language provides the primitives for the definition of data types and the manipulations of data values. CP-nets has an intuitive, graphical representation which is appealing to human beings.

1.3 Problem Background

Nowadays, UML is a powerful and advanced methodology for analysis the complicated systems that many of software engineers and designers use to produce softwares. Despite of this, the methodology has a basic shortcoming that is lacking of a tool to verify the correctness of logic function of the diagram. In fact, this model is not still converted to a formal and verified model. Although UML system sequence diagrams are useful and used widely in analyzing, but data in these diagrams are changeless and because of lacking of dynamism, we cannot implement the diagram. Implementation of diagrams is so important that we can verify the correctness of the diagram. On the other hand, one of important problems of analyzing phase in software engineering is to verify all analyzed things before going to the design phase because starting of design phase before verifying analyze phase is a big risk in big projects. So, one of common methodologies in analyze phase is UML that have various diagrams. It does not have the ability to be tested or verified. Many researches have been done to convert UML to Petri Nets. MuDer Jeng and WeiZhao Lu have a methodology that converts UML models to Petri nets for modeling semiconductor manufacturing systems [1]. Some other tried to convert activity diagram to CPNs [2]. But still no efforts have

been done to convert UMLmodels, especially UML diagrams, to a model that can accept fuzzy inputs in order to test and verify the correctness of the diagrams.

1.4 Problem Statement

In this project a new technique will be proposed using coloured Petri Net. Through the technique we can validate and verify the Activity Diagram based on nonfunctional parameters. First it is tried to convert the activity Diagram to coloured Petri net. And then validation and verification process started. The basic question of the research is: *Given an Activity Diagram, how we can validate and verify the Activity Diagram based on non functional parameters?*

1.5 Project Aim

The aim of the project is:

To provide a modeling facility for validation and verification of UML activity diagrams using colored Petri net.

1.6 Objectives

This project follows four objectives:

a. To investigate the formalism of Coloured Petri Net for determining quality values.
b. To model an Activity Diagram with CPN to find out Activity Diagrams non functional parameters.
c. To develop the verification and validation process of Activity Diagram via CPN.
d. To develop a verification and validation tool for Activity Diagram called ADET.

1.7 Project Scope

This project is focusing on investigating CPN parameters and to find a way to formalize the activity diagram in UML. The scopes of this project are as follow:

a) Initially, using Coloured Petri net to investigate the quality attributes of a software system.
b) To Verify and validate Activity Diagram via CPN.
c) To provide a tool that validates and verifies the activity diagram.

1.8 Significance of Project

Nowadays it is one of the important things in modeling to know how we can find out non functional parameters of the system. This is not achieved if you have powerful modeling tool that can formalize the software based system. On the other hand we can use the findings from the project to formalize some diagrams in UML like the activity diagram which is straightforward to be converted to the CPN as a formalized modeling tool. On the other hand the tool is used to formalize software systems to find quality attributes.

1.9 Organization of Reports

In the following chapters literature review, methodology, validation and verification model for activity diagram using coloured Petri net, tool development, results and discussions and conclusion and future work will be discussed respectively. Chapter 2 in which literature review will be discussed deeply will be divided in to two 2 parts, first there will be a powerful introduction of keywords and important definitions, second there are related works and backgrounds. Chapter 3 discusses how to achieve our objectives in the project. And chapter 4 concentrates on validation and verification process. Chapter 5 focuses on the architectural aspect of the tool and depicts its operation step by step. Chapter 6 calculates the results. Finally in chapter 7 concludes with the conclusion and discusses the future work.

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