Visual Scenarios for Validation of Requirements Specification

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Abstract. The development of a large information system is generally regarded as one of the most complex activities undertaken by organizations and it is dependent on the communication and understanding among the actors of the system (i.e. managers, users, developers, etc.). The Validation phase of Requirements Engineering, involves checking the formal description of the universe of discourse, against the non formal description of the user's needs and domain knowledge. This paper advocates that many benefits can be accrued from the use of visual scenarios for the purpose of validating conceptual specifications during Requirements Engineering. To this end, the paper describes a set of scenarios which make use of three interrelated conceptual models and an architecture for visualizing them.

1. Introduction

The development of a large information system is regarded as one of the most complex activities undertaken by organizations. Boehm has reported that it costs between five and ten times more to repair errors during coding than during the requirements phase [1]. Development and customer organizations could save a lot of time and money if they could detect and correct a fraction of the errors then, rather than later. This task is supported by the process of verification and validation of requirements specifications, which basic objectives are to identify and resolve software problems and high-risk issues early in the software life cycle.

The CineVali[1] approach combines validation scenarios with animation and visualization techniques in order to validate the Conceptual Specifications produced within the requirements capture phase. The use of visualization techniques provides a dynamic view of the models, in a familiar, to the user, presentation. Multiple 2-D graphical Views, movement and color are used to provide an indication of the dynamic behavior of the specifications [2].

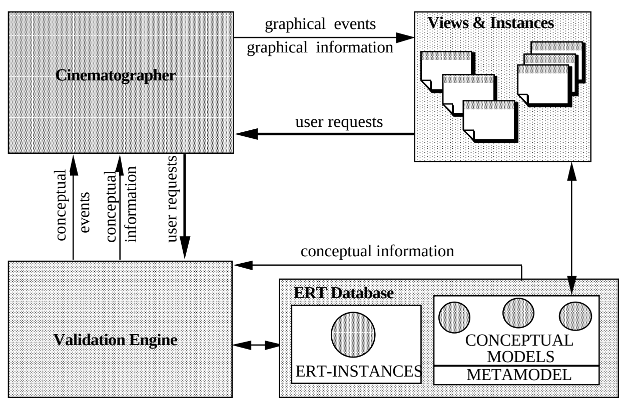

Figure 1. An Architecture for Visualizing the dynamic behavior of Conceptual Specifications.

Three are the main components of the system for Visualizing Conceptual Specifications, namely the Repository, the Validation Engine and the Cinematographer as shown in Figure 1. The Repository is common for storing the Metamodel, the Models and finally the instances of Models. The Validation Engine uses this information in order to form scenarios which will investigate the dynamic behavior and the causal relationships between the structural and dynamic components of the specification of an information

1 The CineVali project is a fully funded by the CEC under the Human Capital and Mobility program via an Individual Fellowship. The title of the project is : Cinematographic Validation of Conceptual Specifications. The word Cinematographic has a greek origin and consists of two words 'κινημα' and 'γραφικη'. The meaning of the first is movement and of the second is graphic.

system. The Cinematographer then receives this information in order to create and manipulate different Views of the information system. In this paper, we are mostly concerned with the Validation Engine and the way Validation Scenarios are formulated.

2. Conceptual Modeling and Metamodelling

The conceptual modeling language which is used for the task of application domain modeling has been developed within the TEMPORA[2] and the ORES[3] projects and provides mechanisms for three conceptual views namely a *structural* (ERT), a *behavioral* (PID) and an *active* (CRL) view [3]. In addition, the ERT-SQL language provides the means of manipulating ERT data, i.e. queering and retrieving data and it is based on the ERT Algebra [4].

The three conceptual modeling formalisms used in CineVali, are strongly interrelated and this interconnection is explicitly recognized and represented according to the metamodels of these formalisms.

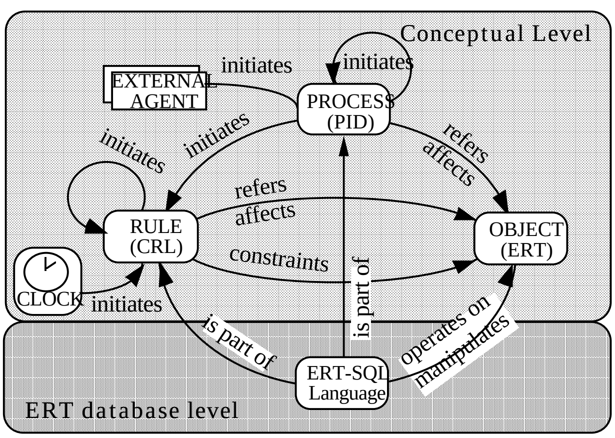

Figure 2. Interrelationships of the Conceptual Models

As illustrated in figure 2, the conceptual rule language can be used to constraint and refer or affect ERT objects. A CRL rule can be initiated by a process, or another rule, or the system clock. A process could refer to or affect an ERT object and can be initiated either by another process, or an external agent. ERT-SQL statements are part of the process and rule body, and operate on ERT objects.

3. The CineVali Scenarios

The CineVali approach takes into account the very important relationships between the conceptual modeling formalisms described in section 2. The main idea is to follow these interrelationships in order to demonstrate in a very detailed way the system's behavior. The main innovation of the CineVali approach is that the scenarios are formal and automatically generated, while at the same time their representation is one with which both the user and the analyst are familiar.

Scenarios can be expressed in three different levels of abstraction, as shown in figure 3. The first very important abstraction is that of the Conceptual and ERT database level. Secondly, scenarios could be restricted only to one conceptual model or could be intermodel scenarios, to allow intermodel checking of the specifications. Another level of abstraction is the one concerned with explanatory scenarios or with process scenarios.

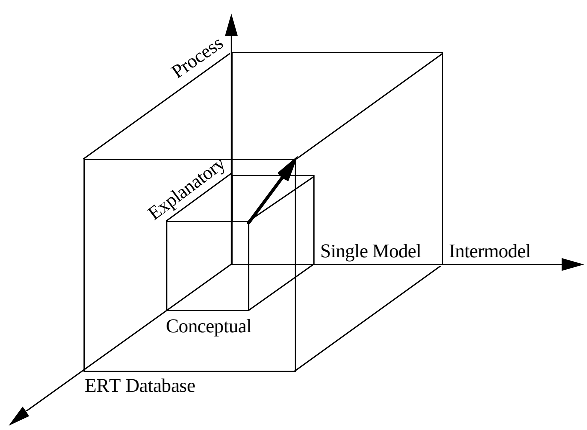

Figure 3. Levels of abstraction of Validation Scenarios

<u>Scenario 1</u> This scenario has the PID model as the starting point and the first question asked is: what will happen if event X arrives at the system. Then the processes that would be initiated by that event are found and the user could choose one to execute. In the highest level of detail the user should provide all the necessary instances to satisfy any preconditions the process has. Then the process will be executed and the ERT objects affected by it will be presented. Also the rules or

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[2] The TEMPORA project is a collaborative project between: BIM, Belgium; Hitec, Greece; Imperial College, UK; LPA, UK; SINTEF, Norway; SISU, Sweden; University of Liege, Belgium and UMIST, UK. SISU is sponsored by the National Swedish Board for Technical Development (STU), ERICSSON and Swedish Telecomm. The project is partly funded by the CEC under the ESPRIT programme.

[3] The ORES project is a collaborative project between: 01 Pliroforiki, Greece; Clinica Puerta de Hierro, Spain; Information Dynamics, Greece; Royal Institute of Technology, Sweden; UMIST, U.K.. The project is partly funded by the CEC under the ESPRIT III programme.

processes which are initiated by the output events of the executed process are given to the user, who could either terminate the scenario or continue by selecting a process or a rule from the new set to execute.

Scenario 2 This scenario is concerned with the user groups performing the tasks, and checks whether tasks are assigned to external agents properly, or whether the user groups performing the actual tasks within the organization would be influenced by the system. The scenarios start with the question : what processes are performed by external agent A, and will result a set of processes that could be initiated by a particular external agent. Then the user can either choose a process to execute or terminate the scenario.

Scenario 3 This scenario is concerned with the rules and their validation. The scenario starts with the question: how is rule R initiated, and continues by asking which particular object instances violate rule R. Then the scenario checks which ERT objects are affected or constrained by this rule. The scenario proceeds by finding the rules that could be initiated after the execution of the first rule, and the user can choose which one to execute next.

Scenario 4 This scenario validates the temporal aspects of a specification by asking the question: when is rule R initiated. The temporal event that would trigger the rule is presented to the user. After that the scenario gives two options to the user, either to check the ERT objects affected by the rule and the rules initiated by it, thus following a similar path with scenario 3, or to terminate the scenario at that point.

Scenario 5 This scenario has as starting point the ERT model and asks the question: what rules constrain object E. Therefore, with this scenario the user is presented with a set of rules that apply to a particular ERT object and can assess their correctness in terms of how weak or strong the constraints are.

Scenario 6 We use the same number to denote a set of scenarios rather than a specific scenario. All the scenarios of this set use backward reasoning to answer the question : Why X, that is why process X is initiated, why rule X is triggered or why entity X is affected. This set of scenarios involves finding by backtracking the reason and then creating a scenario of type 1, 2, 3 or 4 to demonstrate to the user the way the system arrive in situation X.

4. Conclusions

In the past decade the rapid decline of graphics-related hardware costs has made possible the introduction and effective use of visual environments [5]. In the context of conceptual specifications, visualization involves the animation of the behavior of a system and a visual interface reflecting the results of events upon the graphical components of the specification. We have presented the CineVali approach, which involves the use of Validation Scenarios and animation techniques, to provide an indication of the dynamic behavior of the conceptual specifications.

A early prototype of the CineVali has been used to visually validate the TEMPORA Case study. In particular, three graphical Views, namely the PID, ERT and CRL view, have been used. Each View has a graphical vocabulary to visualize part of the conceptual models and a set of methods to respond to any interesting event that is encountered during the execution of a validation scenario. Each View is associated with a physical window to display all the graphical information and changes occurring during the animation. Also all Views have a set of general methods, in order to automatically re-size or re-draw its window whenever it is necessary. Our research efforts are focusing in providing a visual environment that will exploit even further the generative powers of the user's visual perception.

References

[1] Boehm B.W., Verifying and Validating Software Requirements and Design Specifications, IEEE Software, Vol. 1, No. 1, January 1984

[2] Lalioti V. and Loucopoulos P., Visualisation of Conceptual specifications, Information systems Journal, Vol. 19, April 3, 1994

[3] Theodoulidis, C., Loucopoulos, P.,Wangler, B., A Conceptual Modelling Formalism for Temporal Database Applications, Information Systems, Vol. 16, No. 4, 1991

[4] Karvelis G., An Algebra and a Query Language for the Entity Relationship Time Data Model, MSc. Thesis, University of Manchester, 1993

[5] Brown, M.H., Perspectives on Algorithm Animation, CHI'88: Human Factors in Computing Systems, Washington, D.C., 33-38

[6] Myers, B.A., Visual Programming, Programming by Example, and Program visualization: a Taxonomy, SIGCHI '86 Conference on human Factors in computing Systems, ACM, 59-66.