A semi-automated approach to adapt activity diagrams for new use cases

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Context: Web engineering methodologies generally assign a crucial role to design models. Therefore, providing a model reuse approach is very interesting since it reduces development costs and improves quality. Current works on model reuse mainly focus on retrieval of the promising reusable assets, and much less is done regarding adaptation of the retrieved assets. This research proposes a semi-automatic approach for adaptation of UML activity diagrams to new use cases.

Objective: UML use case diagrams and activity diagrams are traditionally used for the brief and the detailed specification of the functional requirements. Since many web applications have similar functionalities, and hence similar functional requirements, this research proposes an approach to take a use case diagram as input and semi-automatically create corresponding activity diagrams by adapting existing activity diagrams.

Method: The proposed approach includes five main components: (1) a model repository, (2) an ontology repository as a source of domain knowledge, (3) an algorithm for annotating activity diagrams, (4) a similarity metric for retrieval of similar use cases, and (5) an adaptation algorithm for creating activity diagram of a new use case from an existing activity diagram. The proposed approach uses the semantic web data model as the underlying representation format.

Results: The initial experiments show that the proposed approach is promising and it provides an average reuse percent of 76%. However, it has still some weaknesses like being much dependent on the quality of the model repository and having low tolerance in case of inconsistency in the model repository.

Conclusion: Enabling model reuse in the early stages of a model based development approach is very important in reducing development costs. This paper proposes a semi-automatic approach to reuse activity diagrams through their adaptation for new use cases. The approach is demonstrated to be promising although it has still some limitations.

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1. Introduction

Web engineering is a software engineering discipline focused on the systematic and quantifiable methods for developing and maintaining web based systems [46]. It has emerged since the traditional software engineering practices are not adequate for handling specific characteristics, complexities and requirements of web applications [45].

Different web engineering methodologies are proposed during the last two decades. They are mostly evolved to follow the Model Driven Development (MDD) [42] approach [1]. In other words, the designer is required to create initial models of the web application in a well-defined format, and then these models are automatically or semi-automatically transformed to other types of models or even to the final executables. Despite their benefits, these model-driven approaches have the problem that development of each new web application implies creating a probably large set of models from scratch. The main solution to this problem is model reuse, i.e. reusing models of similar existing web applications for creating models of the new one.

Among the different types of models, functional requirements models are of much importance since they specify the fundamental behaviors that should be provided by the system [66]. A traditional way of specifying functional requirements is to use UML use case diagram for brief specification, and UML activity diagrams for detailed description of each use case [59]. While creating the brief specification is simple, creating the detailed description of each use