A Requirements Analysis Approach for Web Engineering

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Abstract. We propose to improve the Web engineering methods by incorporating the concepts of Goals, Aspects and Scenarios. As a result of their dynamic nature, perceptive interface features, large and heterogeneous audience, and navigational access to information Web based applications are engineered differently from other Information System. Our approach works closely with the Web specific functional and non-functional Requirements and delivers models with lesser conflicts, better choice amongst alternatives and handles crosscutting concerns for modeling personalization and non-functional requirements. We have enhanced and extended User Requirements Notation to meet the Web specific needs. We also propose a systematic approach for automatically constructing the Web specific GRL diagrams.

Keywords: Web Engineering, Goals, Aspects, Scenarios, User Requirements Notation, Requirements.

1 Introduction

Web applications are engineered differently as they involve multiple stakeholders, and the size and purpose of the applications are also varied [1]. These unique characteristics of Web applications have led to evolution of Web Engineering approaches that explicitly focus on web oriented analysis and design of Web applications. These approaches have focused on issues like navigation, presentation etc. that are important for Web application development. However, they fail to capture other issues like adaptability, softgoals etc that meet the real goals and expectations of the stakeholders. As a result even though the web application looks assuring and attractive yet it might not be able to cater to individual user needs, goals and expectations. These lacunae lead to increased costs and maintenance problems in the project. Web applications need all the more attention here because of heterogeneous customers, dynamic behavior and vast reach in contrast to the traditional applications, where the users are known and their expectations can be easily captured.

In recent times, Goal oriented Requirements Engineering [2][3] has become very popular for analyzing the requirements in depth and capturing the stakeholders needs and goals from the software application. According to Lamsweerde , Goal-oriented

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requirements engineering (GORE) is concerned with the use of goals for eliciting, elaborating, structuring, specifying, analyzing, negotiating, documenting, and modifying requirements[3]. It has been also established that stakeholders pay more attention to goal models compared to the UML models because they can relate to the concepts more closely. Some work has been done by researchers [4][5][6][7] on web engineering approaches taking into account the Goal driven analysis, but many concepts of goal driven analysis like design rationale, conflict resolution, goal prioritization have been surpassed and not taken in totality. Analysis on Goals in web engineering is discussed in [8]. In parallel to Goal and Scenario based approaches mainly [9], there has been lot of active work going on in Aspect oriented Software Development[10]. Aspect orientation separates all features of a program and modularizes all of them.

2 Background and Motivation

Various Web Engineering approaches have been discussed in detail in [11][12]. A detailed work on Goal based Web Engineering has been done predominantly in [12] and [14][15]. Both these approaches have enhanced web engineering by incorporating Goal driven analysis using i*[13] approach. The work done in above approaches is application of GORE in Web application development and then transformation to a web design approach.. Our approach also integrate goals and scenarios, we go further and extend the User Requirements Notation[9] for modeling requirements in developing Web applications. User Requirements notation is currently the only standard that handles goals and scenarios together. We also incorporate an extension of URN i.e. AoURN[19] (Aspect oriented URN), for analyzing the crosscutting concerns in Web requirements domain like the Personalization concern and Non-functional Requirements concern. In the next step we map these user requirements using Goal requirements language (GRL) into GRL diagrams that primarily deals with ambiguous requirements and goals. GRL notation is based on i* approach[13] for handling stakeholder's intentions and NFR framework[16] for evaluating and analyzing the goals. UCM stands for Use case Maps that depict the walkthroughs or the scenarios for different use cases and goals. Our approach helps the requirements engineer to elicit and analyze the goals and requirements with the stakeholders. Also it automatically creates the requirements analysis diagrams, specific for comprehensive analysis of Web application. We also study the softgoals in detail for any conflicts in concern interaction graphs. The overall outline has been explained in [17] see Fig.1. We have worked here with the non-functional requirements such that they are integral to the system and they affect the system at every step and area. Web Functional requirements have been classified by many web engineering approaches [18], keeping that constant we had also extended the classification for non-functional requirements in[17].

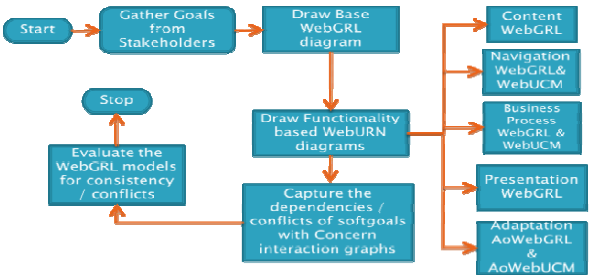

Fig. 1. Requirements Engineering methodology for Web application development

3 The Requirements Analysis Approach for Web Applications

Our approach will help the requirements engineer for elicitation of the goals from the stakeholders and also do the systematic analysis of the same. The approach will consist of a series of algorithms, in the first step a Level 0 WebGRL diagram would be drawn where Web specific goals and softgoals would be defined and sub goals found. The next level of diagrams would be the detailed analysis of each kind of functional requirements like navigation, content, personalization etc. For each of these, information would be taken from the base WebGRL diagram and further elicitation would be done from the stakeholders by the requirements engineer. For constructing Base WebGRL diagram, we have extended the basic GRL notation[9] for according to our web requirements classification symbolized different requirements. From the following set only one can be a chosen for a particular node.

enum GRLNode={Goal, Softgoal, task, resource}

There would be links connecting the nodes, that can be represented as the Link set with four members, the link ID which is the unique identification number, Linktype, to and from which are the pointers to the nodes. The Linktype is represented as <<enumeration>> because only one type can be chosen. The decomposition link can be either AND or OR. The contribution link would also have contribution weights shown in the set below.

Link={ ID, Linktype, to, from }
enum Linktype={{Decomposition,DecompositionLink}, ,{Contribution,Contribution_weight}, {correlation,contribution_weight}, means-end, dependency }
enum DecompositionLink={And,Or}
enum Contribution_weight={make,help,some+,unknown,some-,hurt,break }

The primary input to the algorithm are the goals that are described in the following set.

Goal={ID, Name, incoming_link, outgoing_link, Ftype}

The ID would be the unique identification number for the Goal, it may be automatically generated for each new entry of goal. The Name would be entered by the Requirements Engineer, the incoming and outgoing links mentioned here represent any kind of Linktype mentioned in the above paragraph, initially set to NULL. The Ftype signifies the type of Functional Goals, described in the next paragraph. The sub goals mentioned by the requirements engineer have to be put into the relevant web functional category as shown in the following set Ftype.

enum Ftype = {Content, Navigation, Business Process, Presentation, Personalization}.

The superset Stype indicates the set of different softgoal categories. At the Base WebGRL diagram level, all the non-functional requirements except the non-functional requirements specific to the functional requirements will be specified. The non-functional requirements specific to the product, organization, Actor's expectations, Legal, Environmental, Project specific non-functional requirements / constraints have to be identified at this level. The sets defining them are shown below.

Stype={Product_stype, Org_stype, Actor_stype, Legal_stype, Env_stype, Project_stype}
product_stype = {Usability, Conformance, Security, Efficiency}
Org_Stype = {Organizational objectives }
Actor_Stype={User friendliness, Empathetic, Understandability}
Legal_Stype={conformance to standards, legal issues}
Env_Stype={compatibility, sustainability}
Project_stype={Resource Constraints, Cost, Human Proficiency}

The softgoals mentioned above are specified along with the softgoals relevance, that will further help in prioritizing, conflict resolution and choice of alternatives. For each of the sets shown above, would have a corresponding set describing its details. For a specific Web application, the attributes of the softgoals can also be cited. One softgoal can have 0 to many attributes. Softgoal relevance can be zero if the softgoal is not relevant, one or more if the softgoal is relevant.

Softgoal= {ID, Name, Attribute, incoming_link, outgoing_link, Soft_relevance}
Soft_relevance={Indispensable(5), Very critical(4), Critical(3),Moderate(2), Little(1), not relevant(0) }

The resource or tasks can be represented with the following information:

Resource={ID, Name, incoming_link, outgoing_link}
Task={ID, Name, incoming_link, outgoing_link}

3.1 Algorithm for Construction of Base WebGRL Diagram for a Given Problem

1. Input the primary < Goal>(s) for creation of this web application.
2. For each primary <Goal> plotted in step 1
    a. Input from user if goal can be further decomposed to subgoals
    b. If yes, input the sub<Goal>(s), with its <Ftype>.
    c. Set outgoing link of the primary goal as decomposition link(AND/OR).
3. For each sub <Goal> entered in step 2
    a. Input from user if the goals need further refinement.
    b. If yes, input the subgoals as <Goal> with its <Ftype>
    c. Set the <link> between the parent and the subgoal.
    d. Do the subgoals mentioned here need further refinement, if yes go to step 'a' else exit from the loop.
4. For each sub-member of the super set <Stype>
    a. enter the soft_relevance for each softgoal.
    b. If soft_relevance > 0
    c. Then Input the attributes for the softgoals, along with the incoming or outgoing links.
    d. Also update the incoming / outgoing links of corresponding goals.
    e. Do the attribute need further refinement,if so go to step c.

5. Do any of the softgoals mentioned in step 4 and 5, need further refinement to goals / softgoals.
    a. If yes, input <Goal> or <Softgoal> and update the links.
6. Specify if softgoal/goal need to be operationalized to tasks.
    a. If yes, specify the task, the means_end link, any other relation with other goals, incoming link, outgoing link and represent it with hexagon.
7. If need of resource, mention it with its relation to the hard/softgoals.

4 Online Bookshop Example

We take the example of an online book shop to describe our approach. The following goals and softgoals are gathered in initial meeting with stakeholder:-

Goals a)Primary goal- Sell books, b)Provide information about books, c) Facilitate payments, d) Maintain customer details

Softgoals-a) Increase profit by retaining old customers and attracting new customers, b) Provide secure means of financial transactions, c) Build a user – friendly web application, d) The web application should be easy to maintain.

Base WebGRL diagram for Online Book Shop example is as shown in Figure 2.

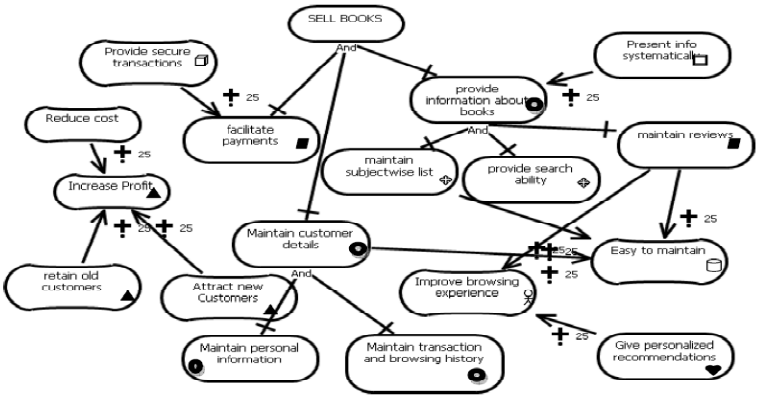

Fig. 2. Base WebGRL diagram for Online Book Shop using enhanced notation from[17]

5 Conclusion and Future Work

In this paper we have presented an approach that improves the Web Requirements Engineering methods by integrating the concepts of Goals, Scenarios and Aspects. The algorithm presented would assist the requirements engineer to clearly elicit and analyse requirements that would reduce the conflicts, minimize maintenance issues and also provide design alternatives. The algorithm here draws the first WebGRL diagram that depicts the application outlook in future. Our future work includes transformation and further refinement from Base WebGRL diagram for each kind of web-specific functional requirement in the second level to do exhaustive study of the system.

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