Goal oriented Requirement Analysis for Web Applications

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Goal oriented Requirement Analysis for Web Applications

Shailey Chawla and Sangeeta Srivastava

Abstract—**Web applications have mushroomed a great deal from static web pages to interactive web services. It has thus become important to engineer these applications methodologically. Goal integration from the early stages maximizes the product quality and prevents giving "requirements" amiss. We propose a Goal based Requirement Analysis for creating the web application. Both functional and non-functional requirements have been studied specific to the web applications. The requirements can be analysed according to the type of application being constructed. The web classification model aids in the understanding of web applications.**

Index Terms—**Goals, requirements, web classification, web engineering, goal oriented requirements engineering.**

I. INTRODUCTION AND MOTIVATION

Goals are the objectives whose satisfaction requires the cooperation of the active components in the software and its environment. Goals may refer to functional concerns or quality attributes. A functional goal typically captures some desired scenarios; it can be established very clearly. Functional goals are used to build operational models such as use cases, state machine models, and the like. A quality goal typically captures some preferred behaviors among those captured by functional goals; in general it cannot be established in a clear-cut sense. In other words, Goals combine functional and non-functional Requirements. Functional Requirements are easily envisioned, the non-functional requirements can't be established or visualized with clarity but they are desirable requirements. The non-functiional requirements have significant impact on the Web web system projects[1]. The Goal oriented Requirement Engineering for web applications is therefore important. In a GORE process, quality goals are used to compare alternative options and select preferred ones, and to impose further constraints on goal operationalizations. Goal-oriented requirements engineering (GORE) is concerned with the use of goals for eliciting, elaborating, structuring, specifying, analyzing, negotiating, documenting, and modifying requirements [2]. Goals and scenarios are thus intrinsically interrelated, and RE activities may be articulated on them.

During the requirement engineering process the business and technology issues are tangled in such a way that these can't be considered in isolation and an integrated approach is required for web system development. The content in the websites has to be provided in an organized manner so that they can be usable. The commercial websites are

constructed after careful analysis of competitive or similar websites using Web mining approaches [3]. Whatever the kind of websites, their development has to be based on an integration of the goal of the website and the technical issues. It becomes important to take notice that web community is enormous in size and several families of web applications exist which may be classified according to different criteria like domain, goals, content etc. The transistion from conceptual model to requirements engineering is a major step towards building a good web application[4]. However, a classification base on which the models for requirement engineering can be applied doesn't formally exist.

Goal oriented Requirement Engineering for web applications has been explored in [5]-[8]. They partly cater to the web applications. The work in this paper is in continuation of [9], wherein the Web Classification Model was proposed. We explore how this model aids in requirement analysis keeping in mind both functional and non-functional requirements. The next section explains different web application requirements and how they can be specified.

II. WEB APPLICATION REQUIREMENTS

For web application development, the requirements can be mapped with the web category from the multidimensional classification model and accordingly manifestation of requirements will be done. The web application requirements can be categorized as follows as specified in [10]:

A. Functional Requirements

The requirements that must be exhibited by the system in order to be complete. The functional requirements can be sub-categorized into the following:

Data Requirements: The contents or subject matter of the web site can either be *fixed* i.e. content is same from the server side or *variable* which means the content can be changed for different users by the server or the user himself. Formally, D is the set of Data Requirements s.t

D={Fixed, Variable}

Interface Requirements: The presentation of the website for delivering its information or services can be accomplished by three ways:- text, multimedia or form. Multimedia includes all kinds of media files, image files, audio files etc. The purpose of form in the interface is for receiving user input and interaction. This can be represented as

I={text:string, multimedia:set, form:html}

where multimedia is a subset of {image, video, audio}

Navigational Requirements: The navigation through the web pages can be performed via hyperlinks or form elements. Form elements like buttons, drop down menus, submit buttons can also be used for navigation. Formally,

navigation requirement set, N can be specified as

N={hyperlink:string, hypermedia:multimedia, form:html}

Personalization Requirements: The web applications can be personalized according to users profile/ intersets either by the user himself or the server based on the past behavior or web mining techniques. In the context of semantic web, meta search plays a very important role in personalization requirements. We can describe this as a set P.

P={user, server, metasearch}

Transactional Requirements The users might need to access the database for its applications. These requirements appear when there is some user operation that requires some action/change on the server side. The transaction can be for getting information from the database or financial. In context of the semantic web, meta-database can also be accessed for retrieving certain linked information.

Example:For financial transactions like for purchase of products from a website , we have to specify the list of products purchased along with their quantity and price, total amount and the payment mode. The payment mode can be either through credit card, net banking or the user may opt for Cash on Delivery. This can be specified as follows:

f={s_list : set, amount: numeric, mode: set}

where

s_list={product_id : string, quantity : numeric, price : numeric}

mode={creditcard : numeric || netbanking : link || COD : boolean}

The database transactions can also be specified as

DT = {name: string, location: string, query: string}

Thus for representing the transaction requirements, set T can be used

T={database : set, financial : set, meta-database : set}

Any web site must exhibit a combination of the functional requirements. If FR denotes a set of functional requirements, then any website W having functional requirements say fr can be denoted as

fr ⊆ { FR | FR ={D ∪ I ∪ N ∪ P ∪ T} }

B. Non-Functional Requirements

The softgoals or non functional requirements are the constraints or the quality parameters that are desirable from the system. Assuming quality parameters are represented by set $Q=\{q_1,\ldots\ldots,q_n\}$ and $T=\{t_1,\ldots\ldots,t_n\}$ be the set of threshold values for the corresponding quality attributes. Non functional requirements or softgoals can be represented by a set G.

$G = \{ q - t \mid q \in Q \& t \in T\}$

Any web application to be developed can be first categorized according to the classification model and its requirements can also be explored as mentioned above. Hence, a web application W can be created with a set of requirements R such that its functional requirements can be specified as a subset of FR and non functional requirements expressed as a subset of G.

$R \subseteq \{FR \cup G\}$

The next unit describes the web classification model proposed in [9] with the application of the model according to web application requirements.

III. WEB CLASSIFICATION MODEL

The websites can be categorized according to the following criteria Fig. 1

a) **Content**: The content here refers to type and management of the content.

b) **Service:** The service the website is rendering and the goal is the criteria here.

c) **Technology:** The design and publishing techniques also keep evolving. This criteria classifies websites according to **the** technical aspects.
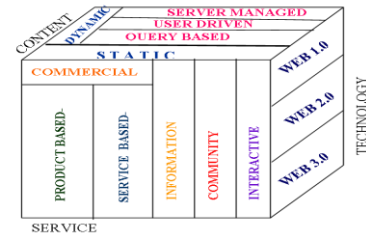

Fig. 1. Web classification model

A. CONTENT

The content on the web application can be classified broadly as static or dynamic in terms of the change in content. Most of the internet pages existing nowadays are dynamic in nature. Further refinement on how the change in content is managed results in further categorization also expressed in Table I.

TABLE I: REQUIREMENTS IN CONTENT DIMENSION

CONTENT		FUNCTIONAL REQUIREMENTS					GOALS /NFRs	REMARKS
		D	I	N	P	T		
DYNAMIC	Query based	Var-iable	Text multimedia form	Link, form	Server, User	Database	Relevance, precision, Recall, Flexible	Search engines
	Server managed	Va-riable	Text multimedia	Link	Server	n/a	Interesting Organized User friendly	News websites
	User managed	Va-riable	Text Multimedia form	Link, form	User	n/a	Flexible Adaptable Light weighted	Blogs
STATIC		Fixed	Text multimedia	Link	n/a	n/a	Clarity Readability	Personal Websites

Managed at the server: The content of the web site is managed at the server. Owing to the changeable nature of the content the content keeps on changing. Example of such web pages are stock market websites, weather or news websites.

User driven: the content of the web pages is managed by the users. Community websites like discussion forums, usegroups, chatrooms, socializing websites are very good examples of such web pages. Here except for the basic design of the web sites the contents are managed by the users. Also personalized pages provided by various portals like yahoo and google (aka igoogle.com) are also user driven.

Query based web sites: the content of the web page in

this case is in response to the query posted by the user. The main example being the search engine. Within other websites also like shopping or information oriented websites some web pages are a result of query based interaction with the user.

B. SERVICE

The second criteria for classifying the website are goal with which the website is being created. The purpose of web application development and the utilization of the web site come under this perspective. The utilization is classified as follows Table II.

TABLE II: REQUIREMENTS IN SERVICE DIMENSION

SERVICE		FUNCTIONAL REQUIREMENTS					GOALS /NFRs	REMARKS
		D	I	N	P	T		
COMMERCIAL	Product based	Variable	Text Multimedia, form	Form Link	Server, User	Financial Database	Security quality reliab-lility usability speed of delivery	Shopping web sites
COMMERCIAL	Service based	Variable	Text multimedia form	Form, link	Server, User	Financial Database	Security, reliability, user friendly	Banking Stock market
INFORMATION		Fix ed	Text multimedia	Link	Server, User	Database	Clarity, User friendly, Trust	Personal websites
COMMUNITY		Variable	Form, multimedia text	Link, form	Server, user	Database	Security, personalization	Blogs Social networking sites Newsgroups
INTERACTIVE		Variable	Multimedia, form, text	Link, form	User, server	n/a	User friendly, personalization, fast response time	Gaming websites

TABLE III: REQUIREMENTS IN TECHNOLOGY DIMENSION

TECHNOLOGY	FUNCTIONAL REQUIREMENTS					GOALS /NFRs	REMARKS
	D	I	N	P	T		
WEB 1.0	Fixed	Text, Multimedia	Link	n/a	n/a	User friendly	Html based websites/ without interaction
WEB 2.0	Variable	Form, text, multimedia	Link, form	User, server	Database financial	Personaliz-ation, Utility, usability	Interactive websites
WEB 3.0	Variable	Form, text, multimedia	Link, form	User, server, Web Crawler	Linked web data database,	Personalization, Linking/networking	Xml, Rdf, owl, Semantic web publishing

a) **Information** The main purpose of web application is to provide information. The information can be in any format including multimedia or textual. Information can be received in response to queries like search engines. The personal or corporate web pages that only provide information about some entity also come under this category. Website containing articles from magazines,

newspapers or any domain knowledge also fall in this class.
b) **Commercial** All e-commerce web sites have a **commercial** motive. The business here can be based on either product or services. Shopping web sites come under the product based business. Banking, stock market websites are service based businesses. Most of the

commercial websites involve transaction oriented interaction, where in there is transfer of money through some means.

c) **Community** The community web sites provide **platforms** for socializing, discussions forums, blogs, networking etc. These are for bringing people around the world closer who share common interests.

d) **Interactive** These web sites are for live interaction, though other website categories also have some form of interaction but it has been kept as separate category keeping in mind the web sites being build specifically for live interactions like online gaming, video conferencing wherein people from different parts of world can play the same game. Also the response of the web site is spontaneous for various actions.

C. TECHNOLOGY

The third criteria have been chosen to classify the websites according to the techniques used for publishing and installing the websites. Depending upon the usage of the website the technology of its creation also differs. Also with time the technologies have evolved and the way internet is used has also made a magnificent shift. The websites fall under the category of the categories Web 1.0, Web 2.0 or Web 3.0[13][14][15] (Table 3). These three terms represent the evolution of web in terms of technology and usage.

a) **Web 1.0** – That initial world wide web era was all about read-only content and static HTML websites. People preferred navigating the web through link directories of Yahoo! and dmoz. The applications here are native internet applications using HTML, XHTML, and basic javascript and vbscript etc. Web 1.0 is a retronym that refers to the state of the Web, and any website design style used before the advent of the Web 2.0 phenomenon.

b) **Web 2.0** – This is about user-generated content and the read-write web. People are consuming as well as contributing information through blogs or sites like Flickr, YouTube, Digg, etc. The line dividing a consumer and content publisher is increasingly getting blurred in the Web 2.0 era. The websites in category involve rich internet applications. A rich Internet application (RIA) is a Web application designed to deliver the same features and functions normally associated with desktop applications. The technologies used are flash, java etc.

c) **Web 3.0** – This is a new concept. This will be about semantic web (or the meaning of data), personalization (e.g. iGoogle), intelligent search and behavioral advertising among other things. The **Semantic Web** is the extension of the World Wide Web that enables people to share *content* beyond the boundaries of applications and websites. It has been described in different ways: *utopic vision*, *web of data*, or a *natural paradigm shift* in our daily use of the Web. The term was coined by Tim Oreilly who coined the term web 2.0 as well in a talk. Active research is going on in this area for converting the World Wide Web into a semantic web database, this will increase the utility of web manifolds.

IV. GOALS AND WEB APPLICATIONS

To capture declarative, behavioral and interactive aspects of systems, goal-oriented requirements analysis have been proposed [11]. Rather than just focusing on the Functional requirements in the initial phases, if goals are taken into consideration then the product achieved will be more closer to the user's expectations. Analysis of Goals that include both Functional and non functional requirements and the long term motives of the stakeholders allow exploration of alternatives, decision spaces, and tradeoffs by considering questions such as "why", "how" and "how else" instead of only considering functional concerns. A non functional requirement is an attribute of or a constraint on a system[12]. According to the work in [12], the attributes can be performance requirements like timing, speed, throughput or specific quality requirements like reliability, usability. The constraints can be physical, legal, cultural, interface related etc. The amalgamation of Goal oriented requirement engineering with web applications has enormous benefits. It is apparent that web applications are a necessity for every business. The incorporation of goal oriented approach for engineering such applications will reap assorted benefits and the final product will be fairly closer to the stakeholders expectations. There are models for building business applications like in [2], [5].

The above web site classification model helps in identifying the type of website that the user is asking for. The website category can be chosen for all the three dimensions according to the requirements. The web applications can be a hybrid category as well. The requirements listed according to the web category provide a basic framework for the requirement analysis. The non functional requirements that are more important in that category are also listed. This formulation helps the user also to clarify in their minds what they want.

Example: An Educational Institute Web application has to be developed that provides information about various courses running in the institute and other details like faculty, infrastructure etc. The web applications might have one or two web pages for accepting applications from students or job opportunities. The organization might even like to have an internal email or notice board system in form of web application.

After understanding the basic requirements, the Requirement Engineer might take help of the Web requirement classification model. The details can be furnished as Table 4. The example shown here is very basic, but eventually work can be done to create templates for each kind of category and web designers will have great help in choosing the requirement models, if required merging them and designing the web applications.

TABLE IV: REQUIREMENTS FOR EDUCATIONAL WEB SITE

Dimension/ Requirements	D	I	N	P	T	NFR'S
CONTENT Dynamic/server managed	variable	Text, multimedia, form	Link, form	n/a	n/a	Interesting, Organized, user friendly
SERVICE Information						
TECHNOLOGY Web 2.0						

V. CONCLUSION AND FUTURE WORK

We have presented a framework for goal analysis for Web

application development. The analysis is coherent with the web classification model. Also, its being established that integration of goals with web requirement engineering would improve the quality and usability of web applications. Future work includes development of a goal oriented requirement model that suffices all kinds of websites provided in the classification and develop its tool support for engineering it automatically.

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