

An Efficient Model for Developing Semantic Web Applications

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Abstract: The emergence of semantic web technology gave rise to the improvement of current web designing methods. Current designing methods provide a development approach for designing web applications that are only human understandable. To make the web contents machine understandable, some semantic approaches are required. Semantic web Design methodologies use ontology languages such as RDF, OWL to represent information internally. These ontology languages captured semantics, allows to explicitly expressing the semantics of different models, as well as the semantics of the represented data.

In this paper, Analysis has been made on three Semantic web engineering methods (e.g WSDM, SHDM, HEERA) that are being used for semantic web applications. HEERA is a model driven technique using various models such as integration model or application model for different aspects (Hypermedia aspects) which are involved for designing a web application. We have also presented the conceptual model of SHDM that also adopt model driven approach. A set of parameters is taken to compare the different attributes of three methods. An efficient model has been proposed for development of a semantic web application.

Key Words: Web technology, ontology, Semantic web.

1. Introduction:

In past the web development process included the web technology that could not meet the complete requirement of users. In searching the information a lot of information appeared which the user did not concern. The early web sites were just static pages but now the situation has been entirely changed by the development of current web to semantic web .To keep up the growing need of users rapid changes regarding obtaining relevant information have been developed [1].

Semantic web engineering methodologies [3] involve making a web more meaningful, more understandably by the machine. Semantic web

also meets the requirements by understanding the contents of web application. In the process of semantic web development, different methodologies involved to develop a system more intelligent and could meet the user requirements.

Semantic web Design methodologies [4] use ontology languages such as RDF, OWL to represent information internally.

In this paper we have discussed a detailed comparison of different semantic web engineering methods such as WSDM, WEESA, HEERA [10] that are more suitable to design semantically web application. In section 1, we have presented the basic difference of currently existing web and the semantic web while section 2 contains a brief description of the different Semantic web engineering methods [6]. A new proposed model is presented in section 3 while section 4 contains a comparison of different methods. Testing & Evaluation has been

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explained in section 5, and paper is concluded with future work in section 6.

2 Related Work

Current Web is a collection of different linked web pages having different information [10]. When User search information from these hyperlinked pages by using different keywords most of the irrelevant information linked appeared which user does not concern. In fact, the keywords are not semantically designed to search relevant information. The User has to read the relevant information from these web pages. Some time user has to use search engine hundreds of time to reach the relevant information but only few of them can be reached through traditional search engines.

There are various useful resources on the web which are useful for our daily needs, but these are very difficult to search in the currently existing web because they are not annotated properly by metadata. Current web provides huge amount of information in the form of linked static pages. Web is also a collection of resource and all resources in current web could no fully used. The information searching, accessing, utilization of resources, interpreting and processing from current web is time consuming because to reach the exact information a lot of time search engine uses.

2.1 Semantic Web

Semantic web is the extension of the current web. It is the web of ontology that encompasses the actual contents along with formal meanings. [2]

Semantic web includes information space in which the information is presented in special machine readable and understandable languages (Ontology). It is also called the web of formally

and semantically interlinked data. Different semantic languages such as OWL, RDF [9] are used that make the information more semantic and well defined (recommended by w3c) [6].

Searching, accessing and extracting specific information is easy in the semantic web. The semantic web search is efficient, scalable and deliver high quality results. It also solves the problem of complex information needs from heterogeneous as well as large and increasing volume data.

Semantic web allow the people to create different data stores on the web, develop different vocabularies and write rules for handling of data. Linked data are powered by different semantic web techniques such as OWL, SPARQL and RDF [9]. The main objective of semantic web is to enable computers to do more useful work and to develop secure system that can support powerful interaction of the computers on the network.

2.2 HEERA:

Hera [3] is model driven web design method for developing web information system (WIS).Based on the principal of separation of concern its distinguish three steps conceptual design, navigational design and presentation design. The Hera methodology defines three layers in which modeling occur.

2.2.1 The semantic layer:

This layer defines the content in the conceptual model. This content can be originate from the database or any other external source like search engine. All this information is combined in integration design.

2.2.2 Application Layer:

This layer describes the navigational design in terms of navigational model. This model is view

on the conceptual model that describes the requirements of the particular user.

2.2.3 The presentation Layer:

This layer defines how the web contents are presented to the user in terms of presentation model.

Heera uses RDFs to relate the conceptual and application model. The mapping between these two models is done through RDF Query language (RQL) [9]. It uses XSLT transformation on entities from conceptual model.

3. Web site Design Method (WSDM)

WSDM [1] is one of the first website design methods. Later on this method was adopted for semantic web applications. Main objective of this method was to separate design issues by providing a systematic, multiphase design approach. This is an audience driven approach. WSDM has five development phases. These phases are:

- Mission Statement
- Audience Modeling
- conceptual Design
- Implementation Design
- Design.

Mission Statement is OWL Ontology for data. During Audience Modeling phase, modeling of the audience class, their characteristics and requirements are modeled. During conceptual Design Phase, concepts and relation between these concepts are modeled by using the object chunks. Conceptual design models are completed during the implementation phase. Design phase is further divided into three sub categories such as:

- Site Structure Design
- Presentation Design

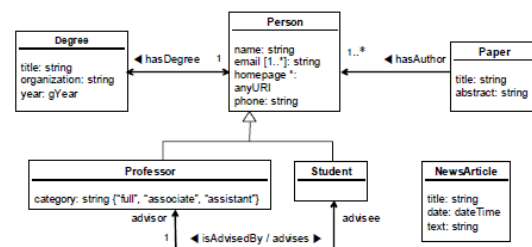
- Data Source Mapping



Figure#2 Overview of WSDM [11]

3.1. Semantic Hypermedia Design Method (SHDM)

SHDM is Semantic web approach used to design and implement web application. This approach emphasize on interface model and its implementation. It is a model driven approach which has five steps to design web application. In first phase, Requirements are collected. Second step is Conceptual design that is basically object style OWL model in which domain and range is defines. The main objective of Navigational model is to organize the hyperspace to consider users and profile. Navigational model is developed that is based on conceptual model which defines navigational vision of the conceptual structure that specifies which information will be processed. This phase also specify how objects are



Figure#3: A simple conceptual model of Semantic Hypermedia Design Method [12].

Views on the conceptual objects. In proposed ontology development methodology three activities are done including (specification, design, formalization). The next step is Design phase which is also called as backbone of the application. Design phase further refine and reduce formalization efforts which makes Web application more manageable. The report generated by specification phase is used by this phase and then this phase also converts it into RDF model which encompasses triples using the format.

3.2. Generation of semantic Annotations:

In semantic web, in order to facilitate the specification of semantic information and generation of semantic annotations, web content are annotated with semantic information. OWL ontology is used to design different models and to perform data and functionality modeling.

3.3. SW Languages: The SW languages are languages used by different methods to save the semantic information about web contents.

3.4. Layered Architecture: A layer is a logical structuring mechanism for the elements that make up the software solution.

3.5. Methodology: It is usually a system of guideline for solving a problem, with specific components such as phases, tasks, methods, techniques and tools.

3.6. Follows SE principle: Software engineering principles includes SOC, incremental development, generality etc. Above table compares all methods whether they follow these principles or not.

3.7. Semantic Annotations For: Semantic annotations for web contents can be generated for both types of pages static or dynamic pages. Above table tells which method generates semantic annotations for what type of pages.

3.8. Localization of web site. It is the process of adapting an existing website to the local language and culture in the market. Only WSDM provides facility to localize website according to local language and culture.

3.9. Reuse of Ontologies / RDF: Different semantic web artifacts of ontologies and RDF may or may not be reused in design methods.

3.10. Classification of Users: Classification of target users according to their interests and requirement is done for a website.

4. Proposed Methodology.

The main purpose of the TAJ model is to provide an efficient approach for designing of web semantic applications. This method provides both machine as well as human understandable contents. It has two parallel pipelines running simultaneously. One pipeline is for web pages generation which is run by a web engineer and second pipeline is for ontology generation which is maintained by ontology Engineer.

This model has five phases. These phases are Analysis, Design, Implementation, Integration and Testing & Evaluation.

4.1 Analysis Phase:

In this phase all necessary requirements are listed for the specific semantic web application development which fulfills all the requirements of the customer. Target users of the application are identified and their classes are defined. Web Engineer and Ontology Engineer work closely to avoid any heterogeneity in within the domain.

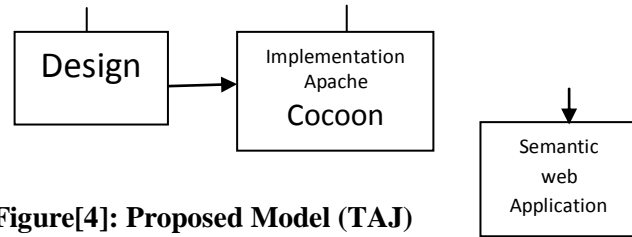
Analysis

4.2 Design Phase.

Web ontology model is prepared based on the formal description of model produced in analysis phase. A new ontology is generated by examining the similar existing ontologies. RDF model is also generated at this phase.

4.3 Implementation

This phase uses the Apache Cocoon java framework for the development of Semantic web applications. Apache cocoon uses pipeline approach. It consists of **Generator, Transformer and a serializer**. An HTTP generate request to the pipeline Generator to read XML. Generator produces output which is stream of SAXs Events. These events are again input of Transformer which performs some transformation (e.g. XSLT) and the output of this Transfer phase is again SAX events. These SAX events are again input to Serializer. The final output is an HTML page which is a character stream of client consumption.



Figure[4]: Proposed Model (TAJ)

5. Integration

In this phase output of both pipelines (Web pages Generations and Ontology Generations) is combined to produce a single output.

6. Testing & Evaluation

Testing and evaluation is performed to check whether the product is according to the requirements or not. Output of this proposed model will be both human as well as machine understandable.

Documentation is carried out parallel at each phase in this Semantic Web Applications Design approach.

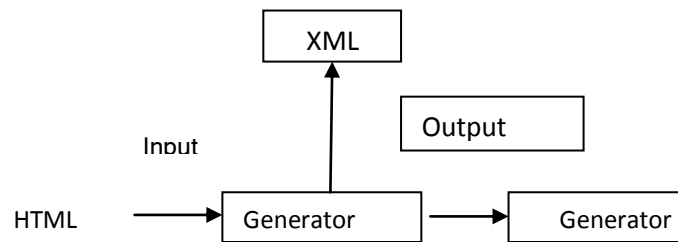
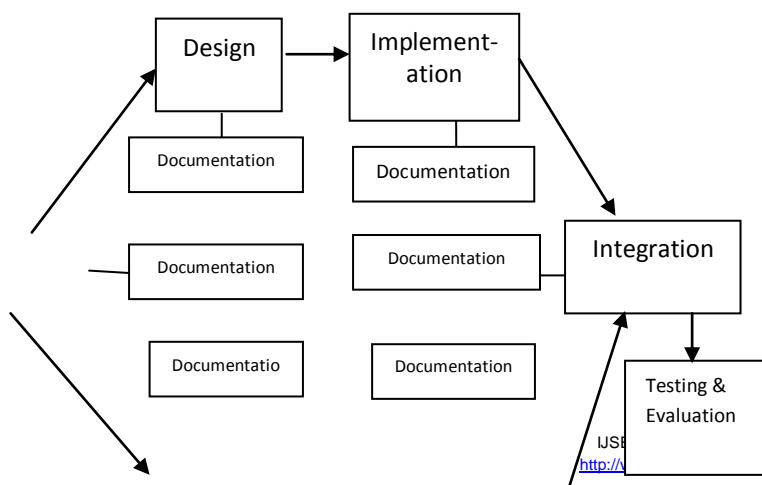


Figure [5]: Proposed model using Cocoon Approach

Comparison of Web Design Methodologies

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Parameters/Methods	WSDM	HERA	SHDM	TAJ(Proposed Model)
Phases/Modules/Steps	5	2	5	5
Development Approach	Web-Engineering	Web-Engineering	Web-Engineering	Web -Engineering
Extension	Extension of OOH approach	Ontology based approach	Ontology based approach	New Method
Layered Architecture	Yes	Yes	No	Yes
Methodology	Audience Driven	Model Driven	Model Driven	Model
Follows SE principle	Yes	Yes	Yes	Yes
Generation of Semantic Annotations	During Implementation	During Implementation	During Implementation	During Implementation
Semantic Annotations	Static/Dynamic pages	Static/Dynamic Pages	Static/Dynamic pages	Static/Dynamic pages
Localization of web site	Yes	No	No	Yes

Reuse of Ontologies / RDF	Yes	Yes	Yes	Yes
SW Languages	OWL	RDF, RDFs	DAML+OIL, OWL, RDF, RDFs	RDF+OWL
Classification of User	Yes	No	No	Yes
Set of Tools	-	XSTL	Ontology Editor	Protégé
Support Integration of Heterogeneous Data Source	No	No	No	No
Conceptual Mapping Method	Manual	No	No	Manual
Strength	<ul style="list-style-type: none"> • Supports dynamic customization at run time • Web can be managed using GUI • Provides different views for different types of devices 	<ul style="list-style-type: none"> • Model different aspect of website • Uses RDF • Supports pre generation of HTML pages at run time 	<ul style="list-style-type: none"> • Documentation during different phases • Uses RDF, RDFs, OWL • Supports pre generation of HTML pages at run time 	<ul style="list-style-type: none"> • Documentation at Each phase • Use RDF+OWL
Weakness	It does not care of specific design Model	No concern about Audience	No concern about Audience	It do not care Audience

Table[1]:Comparison

7. Conclusion & Future Works

We have made a comparison of different web engineering methods (HEERA, WSDM, and SHDM). HEERA is a model driven technique using various model (e.g integration model, application model for different aspects (e.g Hypermedia aspects) which involved for designing a web application. We have also presented the conceptual model of SHDM that also adopt model driven approach. During studying different semantic web engineering techniques we learnt and conclude that WSDM is a classical approach for designing annotated

websites for semantic web application. On the basis of comparison a new efficient proposed model has been developed which is useful for both human as well as machine understandable. This proposed method uses Apache Cocoon framework for the implementation.

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