

## EXTENDING W2000 FRAMEWORK TO DESIGN PRESENTATIONAL ASPECTS OF WEB APPLICATIONS

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### **Abstract:**

*The Unified Modeling Language (UML) has been accepted as a de facto standard for modeling an artifact of the system. Recently, there are many initiatives that have been done on UML-based modeling system such as in real time systems, management information system, web based and hypermedia applications. This paper presents a UML profile for modeling presentational aspects of Web applications by using an extended of W2000 Design Framework that blends together the UML and Hypermedia Design Model (HDM). UML has been chosen because of its being a standard, its graphical and intuitive representations, and its extensibility for representing domain-specific notations. The HDM is a hypermedia model recognized as the ancestor of a family of several design models. This work is part of the using an extended W2000 framework for developing hypermedia for Web or generally, Web applications design. The approach has been demonstrated by designing the presentational aspect of e-marketing for the house developer enterprise. As a result, we have proposed the comprehensive enhanced framework by providing a presentational aspects of the system to the original framework. This framework is very useful for designing Web applications by utilizing the advantages of UML and HDM.*

**Keywords:** UML, HDM, hypermedia, Web application, Web design.

### **1.0 Introduction**

Web applications provide users with information and navigation facilities to access information systems and also provide them with functionality to manipulate this information. The development of Web applications requires abilities to choose multimedia contents, to define an adequate structure, to design presentational elements and to select the right implementation technique. The Web application development is a new and still evolving discipline, for examples, the hypermedia applications for the Web, are mostly the result from an ad-hoc implementation, growing usually from small to large applications and becoming very soon difficult to maintain [4]. Compare to traditional, Web-based hypermedia applications, not only navigate, but also activate operations and transactions, the hypermedia structure itself may evolve, as the application evolves and different users may have different visibility of the information and different capabilities for the operations [1].

With the advent of the World Wide Web (WWW), hypermedia and information system, traditionally far apart, are converging to define a new area of interest. Therefore, during the last few years many methods for hypermedia and Web applications design have been proposed; see [3] for an overview. Most of them are not based on the UML, and they utilize entity-relationship diagrams, OMT (Object Modeling Techniques) or their own notation and techniques. For the purpose to have benefit from UML, this paper presents a part of work in using the extended W2000, a framework for designing Web applications based on two preexisting assets; UML and HDM. The original framework as proposed in [1] have been extended in [2], in particular focus on extending the framework with the approach to address presentation design issues for modeling Web applications. UML has been chosen as a de facto standard for modeling object-oriented systems, widely used by the software engineering community [12]. UML provides a set of diagram types that enable system designers to visually model a wide variety of systems. It is a well-known standard, accepted by most software developers and also supported by many case tools. Whereas, HDM is a hypermedia model recognized as the ancestor of a family of several design models.

This paper is organized as follows: Section 2.0 provides an overview of the UML. Section 3.0 presents an overview of extended W2000 framework, which includes the background, the need for an enhancement and the features of the framework. Section 4.0 explains an overview of the presentational design. The explanation of this section is a main contribution of the paper and the result is demonstrated by running simple example of Web application which is provided in the next section. In section 5.0, a simple example of presentational design of Web application is given. In the last section, some conclusions and further works is outlined.

## 2.0 Unified Modeling Language

The UML has gained broad industry acceptance as the industry standard language for specifying, visualizing, constructing and documenting the software system and its components. The UML is a graphical language with sets of rules and semantics [13]. It can be used to model different kinds of systems: software systems, hardware systems, and real-world organizations. It can be utilized to easily simplify the complex process of software design, in making a "blueprint" for construction. The UML defines the main graphical diagrams, which are suited to model structural and behavioral aspects of a software system. They are including class diagram, use case diagram, sequence diagram, collaboration diagram, activity diagram, statechart diagram, component diagram and deployment diagram. The UML class diagram is the main static structure analysis diagram for the system. It illustrates the structure of the system with relationships between classes and inheritance structure. The class diagram is developed through use-case, sequence and collaboration diagrams. The use-case diagram is used to capture information on how the system or business works or in other words what the functionality of the system. In the UML sequence diagram is for dynamic modeling, where objects are represented by vertical lines and messages passed back and forth between the objects are modeled by horizontal vectors between the objects. The UML collaboration diagram is an alternative view of the sequence diagram, showing in a scenario how objects communicate with one another. The statechart diagram, is another form of dynamic modeling, which is focus on the events occurring within a single object as it responds to messages. An activity diagram is used to model an entire business process. Thus, an activity model may represent several different classes.

UML provides a general extension mechanisms that can be used to defines specific stereotypes to model specific aspects of the system such as conceptual, navigational or presentational models. UML extension is a predefined set of Stereotypes, Tagged Values, Constraints and notation icons that collectively extend and tailor the UML for a specific domain or process [12]. Stereotypes represent a built-in extensibility mechanism of the UML and can be illustrated by using guillemets, "<< >>". User-defined extensions of the UML are enabled through the use of stereotypes and constraints. The UML is broadly applicable without extension, so companies and projects should define extensions only when they find it necessary to introduce new notation and terminology. There have been a number of initiatives to extend UML to new application areas, including Web systems and databases. Some of these efforts have been carried out by OMG (Object Management Group), individual researchers and individual companies such as Rational and some have done by others.

## 3.0 An Extended HDM2000 Framework

The advent of WWW has enabled a new term: Web application, entered in Information Communication Technology (ICT) vocabulary. At early stage, the development of Web applications in the case of personal homepages or tiny information systems could be seen as an easy job. Such applications are normally written once and probably never modified; directly implemented without taking into account aspects such as presentation or navigation design. The next stage, developing Web applications is emphasis to implement the business logic of the applications. This stage shows the Web applications is used to implement business logic, manipulating information and its use changes the state of the business. Therefore, the most important models of the system focus on the business logic and business state, not presentation and navigation details.

Currently, Web applications address a potentially huge variety of different users with different functional, navigational and presentational requirements. For instances, Web-based hypermedia applications require the ability of organizing large structured or semi-structured contents in a non-linear way, and of defining the multiple navigation paths across them. Another example, for an e-commerce system, it requires the ability of specifying the functional and evolutionary aspects. The e-commerce Web-site should provides browsing capabilities, users can bookmark the products of interest, move products in their cart, evaluate the total and providing additional information before completing the buying transaction. The evolution of Web application shows that it requires the comprehensive framework for designing and implementing the applications; the framework should be complete, covers not only functional issues, but it also will cover the presentation and navigation details.

Based the above consideration, we can conclude that Web application design is increasingly become more complex task and need for integrating of hypermedia concepts, information structuring and implementing of complex business or functional requirements modeling. Thus, it requires the integration of many different methods and techniques for designing the reliable Web applications. Unfortunately, the design methods, models, from hypermedia and software engineering cannot just be borrowed and piled up from other methods in straightforward way, but they must be integrated to create a viable and usable conceptual framework. For this reason, this paper demonstrates the using of an extended W2000 framework for designing Web applications, which focus on modeling presentational aspects of the system. This is a part of previous work as described in [2] which is based on original framework as introduced in [1]. The original framework do not support the presentational design facilities, so, it has lead the work for extending the framework, which is carried out as described in [2] but for different case study.

The extended W2000 framework is an integrated framework that blends together the UML and the last version of HDM as explained in [14]. The HDM was the first design model proposed for hypermedia applications and inspired, among the others, Object Oriented Hypermedia Design Method (OOHDM), Relationship Management Methodology (RMM), Web Modeling Language (WebML) [1]. As a result, the HDM is recognized as the ancestor of a family of several design models. UML has been chosen because of its being a standard, its graphical and intuitive representation, and its extensibility for representing domain-specific notations. The integration between HDM and UML consists in: a) Defining several stereotypes and customizations of diagrams to render HDM with UML [1], b) Specifying guidelines to use UML as a way to specify some of the dynamic and operational aspects of Web applications [1], c) Refining use case diagrams to describe high-level user requirements, related to both functional and navigational aspects [1], d) Extending the framework which considers the interface or presentational design activities by using rendered UML-HDM diagrams [2]. The figure 1.0 shows the original W2000 framework and in figure 2.0 illustrates the extended W2000 framework that organizes the design activities in a number of interdependent tasks as summarized with the conceptual framework. Each activity produces a model which describes some aspects of the Web applications.

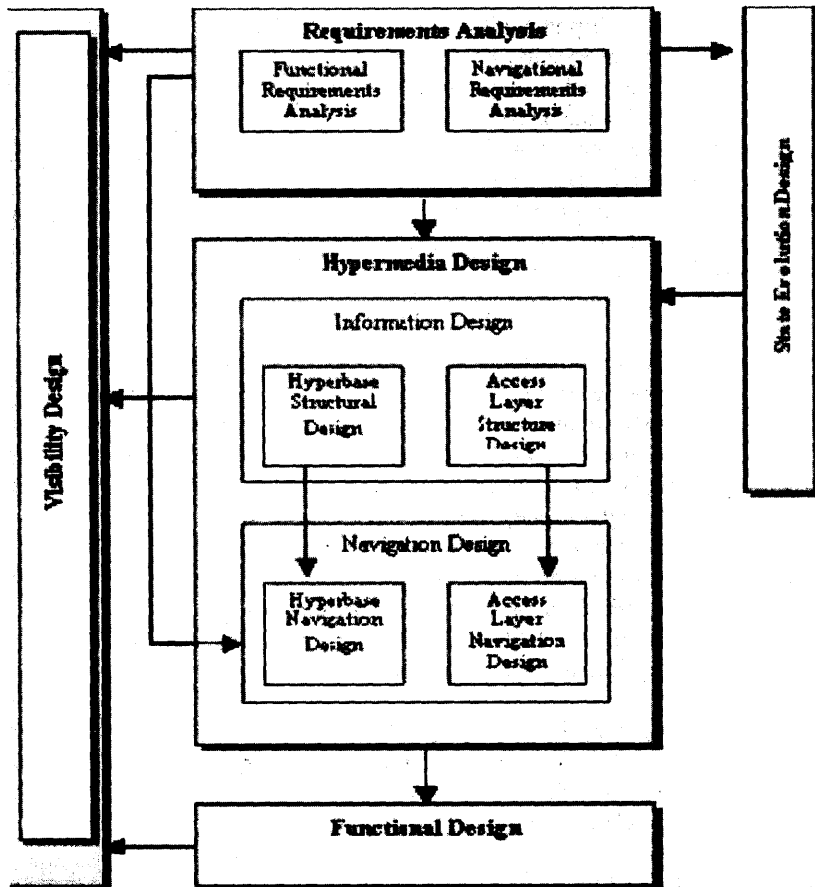


Figure 1.0: An Original W2000 Design Framework

From the figure 1.0, it is clearly shown that the framework does not address the presentation design issues in designing Web application. For this reason, we have concentrated to improve this framework as presented in figure 2.0 by customizing and adapting the work as proposed in [4,5,7,8].

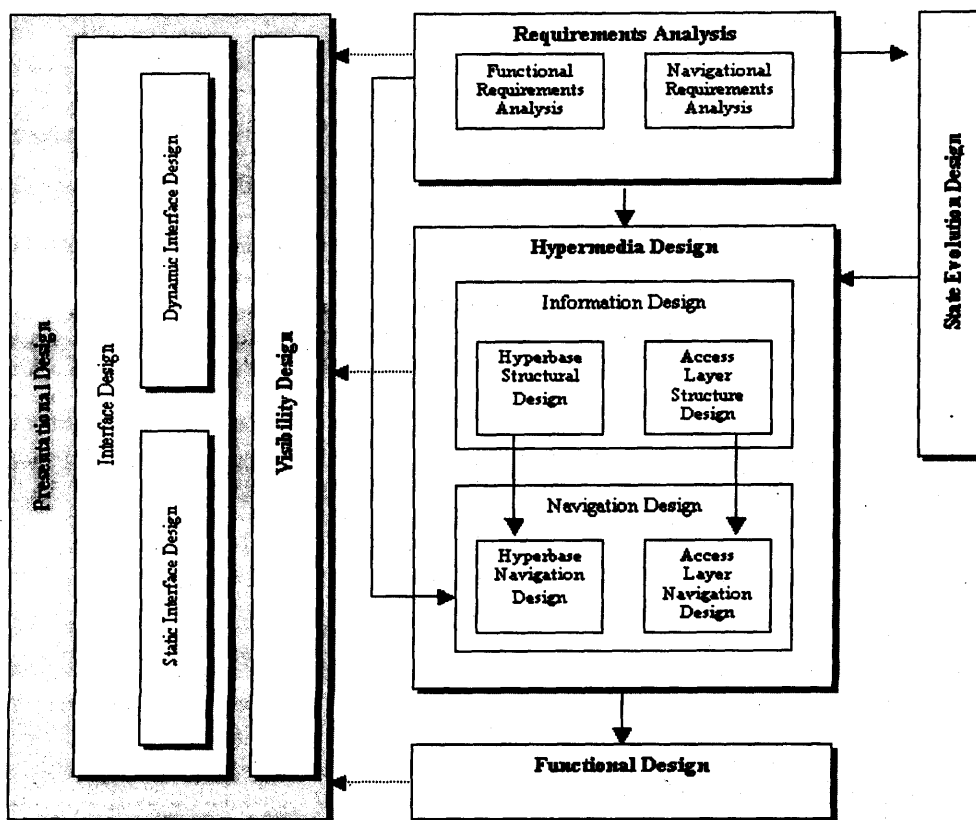


Figure 2.0: An Extended W2000 Design Framework

Each block of the framework as given in figure 2.0 identifies a design activity. **Requirement analysis:** It extends “conventional” requirements analysis to hypermedia applications. It consists of two sub-activities, including navigational and functional requirements analysis [1]. This stage presents not only capturing the functional requirements but it is extended to capture navigational requirement. Both activities borrow UML use-case diagrams to clearly represent their result. **State evolution design:** It supplements requirements analysis and defines how the application contents evolve. This activity is optional, but it is useful only for applications with complex behaviours [1]. To present the evolution of application contents, it can be represented straightforward way by using UML statecharts diagrams. **Hypermedia design:** It consists of information and navigation design. The information design specifies and organizes the application contents [1]. According to HDM, the hyperbase structured design structures the “core” information that must be available to users. The access structure design organizes the contents into higher-level structures. The navigation design defines how users can navigate the information elements and access structures [1]. All delivered diagrams are based on UML class diagrams, tailored with appropriate stereotypes. **Functional design:** It specifies the main user operations of the application. Designers have to provide scenarios for all the main activities in functional use-case diagrams. Being able to explain how identified information objects cooperate to complete an operation is twofold: it is check on the completeness of the hyperbase design and identifies all operations that must be associated with selected objects [1,2]. Extended UML interaction diagrams can be borrowed to describe how the information objects identified, cooperate to provide functional services. **Visibility design:** It is a key features of many Web applications. Different users, in general, have a different perspective of the application, its contents, and operations. The purpose of visibility design is thus to specify which operations, information structures and navigation paths must be visible to whom [1].

#### 4.0 Presentational Design

The presentational design supports the modeling of an abstract user interface, showing how the navigational structure is presented to the user. To achieve this purpose a static and a dynamic interface or presentational model is built [9]. Presentational design means defining the way how navigational nodes will appear, selecting user interface objects to activate navigation, and determining which interface transformations will take place [8]. The presentational model is a rough design of the user interface; decisions about details such as size, colour or font of user interface elements are taken when developing the prototype. In order to enhance the framework, we just propose the layout of user interface without details consideration. This may provide hints, for example, on the position and the size of the user interface elements relative to each other. Therefore, we have introduced a static interface design and a dynamic interface design as shown in figure 2.0 which are borrowed from [4,5,7,8] when improving the framework as defined in [1].

From the figure 2.0, the presentational design consists of static and dynamic presentational model. The static presentational model can be represented by UML composition diagrams or UML class diagram that describe how the user interfaces are built. A user interface object can be either a primitive user object like text, image and button, or a composition of user interface objects. There are new stereotypes that can be introduced according to the extension mechanism provided by UML to illustrate these user interface objects. These stereotypes are `<<anchor>>`, `<<text>>`, `<<image>>`, `<<audio>>`, `<<video>>`, `<<form>>`, `<<button>>`, `<<collection>>`, `<<anchored>>`, and `<<anchored collection>>`. These stereotypes are comprised by instances of presentational class, which as a containers to comprise these modeling elements. The presentational class is defined as Stereotypes, `<<presentational class>>`.

The dynamic presentational model uses UML statecharts to define the reaction of the user interface objects in the static presentational model on external user events, like mouse movements, mouse clicks and keyboard presses, as well as on internal events like timeout, activations and deactivations [5]. For example, a video user interface object may choose to start playing when it receives activate and to stop when it receives deactivate. Figure 3.0 illustrates how to specify "hide and show image" as simple example using UML statecharts in modeling dynamic presentational models.

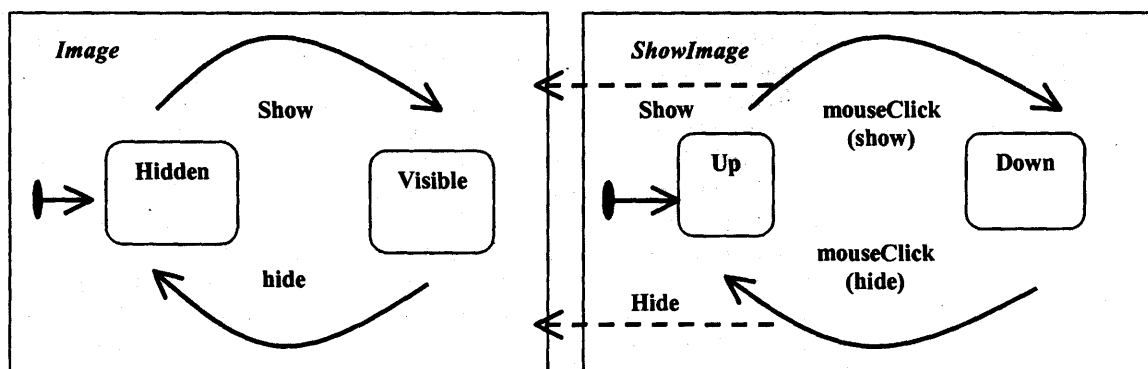


Figure 3.0: UML Statechart describing the operation of the ShowImage button

#### 5.0 Example Application

As a running example to illustrate the part of design process, we use an e-marketing Web site for the house developer company. This Web site offers general information about the company itself, advertisement information about the products (house), which is the house to be launched and sold, and their relationships to customer orders, and feedbacks. The Web site also provides the administration facilities such as checking order, maintain information orders, and review the customer's complaints. HDM organizes the hyperbase information in entity types and semantic association types [1]. An entity type describes a class of information objects perceivable by users [1]. For example, the customer requires order, information about

products, and company profile. These information objects can be perceivable, and evolved within the application. In figure 4.0 shows example of dynamic presentational design for presenting the information about the house through simple slide show. The design of this part illustrates a layout of dynamic elements of application for representing information objects, in this example is product.

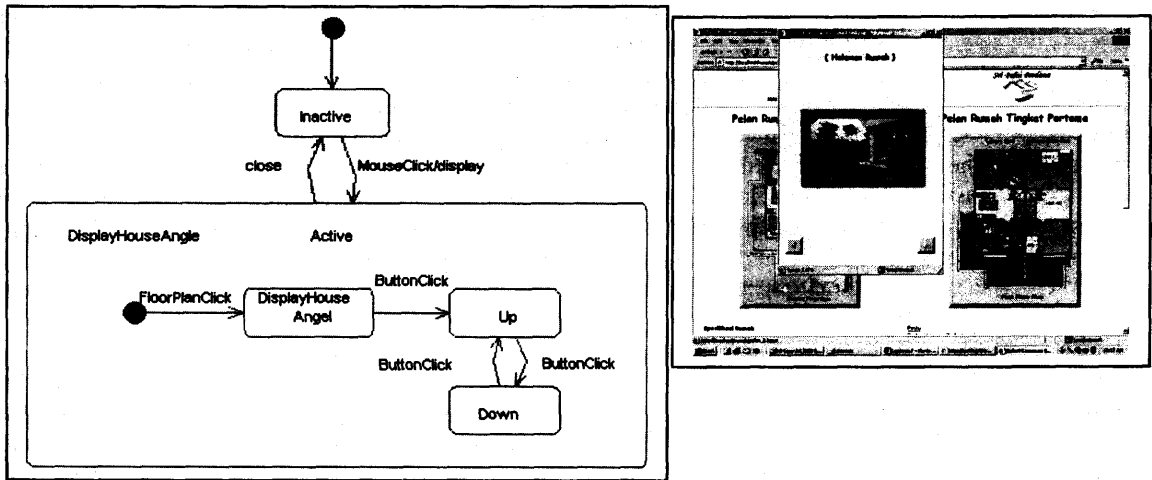


Figure 4.0: UML Statechart describing the operation of the “slide show”

Figure 5.0 illustrates a static presentational design of the application. The design represents the layout of static elements of the application. These elements includes `<<anchor>>`, `<<text>>`, `<<form>>`, `<<>window>>` and `<<animated image>>`, which are described by using UML extensions mechanism provided by Stereotypes. The `animated image`, is a new stereotypes introduced in this paper to represent the specific types of image, in this example is animated image. In fact, it is derived from `<<image>>` as defined in [4]. We have also proposed the similar stereotypes to represent the attributes of form, as similar being used in [15]. We have also borrowed a stereotype, `<<JavaScript Object>>` as defined in [15] to illustrate the Java Script object in the application for running the “announcements”.

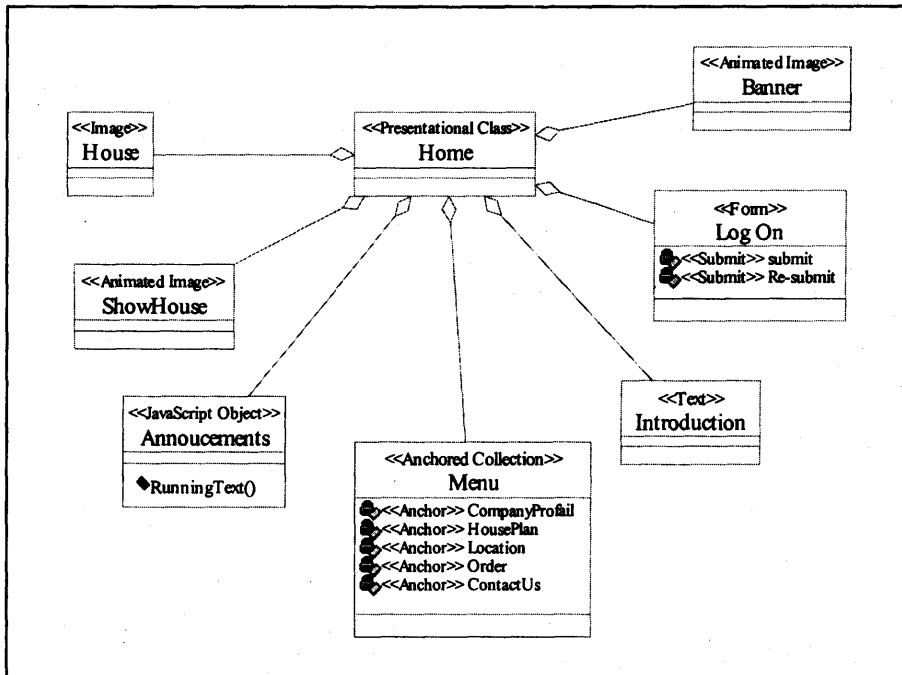


Figure 5.0: UML Class Diagram describing the static presentational design of the “Main Page”

## 6.0 Conclusions

The presentational model is a rough design of the user interface; decisions about details such as size, colour or font of user interface elements are taken when developing the prototype. However, the layout of user interface without details consideration may provide hints, for example, on the position and the size of the user interface elements relative to each other. This paper uses W2000 framework as introduced in [1], and extends the framework to support the presentational design aspects of the Web applications by introducing the an extended W2000 framework as proposed in [2]. The work described here is part of works as explained in [1,2], which focuses on designing the Web applications. The presented framework, is an UML-HDM integrated framework which is completely provide the guidelines for the design of Web applications. The study is conducted with the underlying assumption that Web applications are complex in their nature, so that, their design tasks are also to be difficult. We can conclude that Web applications design requires the integration of two distinct but interrelated activities: hypermedia design and functional design. Hypermedia design not only focuses on information structures and navigation paths, but also it should cover the presentational aspects. For the functional design, it focuses on operations or business logic of the application itself.

The extended framework as proposed in [2], has completed the framework as defined in [1] in providing comprehensive framework for modeling Web applications. In fact, this framework is the first approach that has been proposed in integrating UML and HDM for Web applications design. The differences between the original and the extended framework is summarized and represented in table 1.0. From this table we can see there are some improvements that make it to be comprehensive framework.

**Table 1.0: Differences Between Original and Extended W2000 Framework**

	Present	Original
Presentational Aspects	Yes, by introducing static and dynamic presentational models	No.
UML new extensions	Yes, specifically for addressing presentational issues.	No.
Static Presentational Design	Yes, by applying UML Class diagram for representing HDM entity diagram.	No.
Dynamic Presentational Design	Yes, by applying UML Statechart diagram in HDM diagram	No.
Hypermedia design	Yes, as the original framework is.	Yes
Navigational Design	Yes, as the original framework is.	Yes
Requirement Analysis	Yes, as the original framework is.	Yes

In this work, UML has been chosen because of its being a standard, its graphical and intuitive representation, and its extensibility for representing domain-specific notations. Whereas, the HDM is a hypermedia model recognized as the ancestor of a family of several design models. This is because it was the first design model proposed for hypermedia applications and inspired, among the others, OOHD, RMM, HDMlite, WebML [1].

Our future work will concentrate on refining the techniques and notations presented in the framework. It will include on refining the overall implementation of the framework when have a large base set of case studies. Another work, this framework would require the suite of design tools which was previously based on the original HDM, to support all steps of extended W2000.



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