Integration of Semantic XForms and Personal Web Services as a Tool to Bridge the Gap between Personal Desktops and Global Business Processes

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Abstract. A large portion of Internet advances owes the human-computer interaction and data exchange via web forms. Current complex Internet applications are demanding more advanced features that are not covered by traditional forms. New technologies such as Semantic Web and XForms are responses to today's business requirements and expectation. In this paper the possible potential of combining XForms with Semantic Web technology are explored and an integration model for enterprise solutions is presented. The new model is supposed to bridge the gap between desktops as the nodes of global business networks representing the individuals and the involved web business processes. The paper shows that combining Semantic Web concepts with XForms can provide elegant holistic solutions for lifetime data consistency, integration of personal services, and checking of data validity.

Keywords: Semantic Web, Ontology, XForms, SOA, Interoperability, Web Applications.

1 Introduction and Related Works

Over two decade history of World Wide Web, the Internet has been evolved from a unidirectional information stream to an enterprise application framework. The traditional web forms are simple interfaces that aim to transfer data between server side components and browser application. Despite the advances in design and implementation of web applications, the web development is still a frustrating task. As a matter of fact, the difficulty of developing and deploying commercial web applications increases as the number of technologies they use increases and as the interactions between these technologies become more complex [1]. One of the reasons for this complexity relies on the distributed nature of web applications. As an example consider the browser side errors that are hardly traceable to back end server modules. Another challenge in web programming is the fact that web programming languages such as JSP, PHP and ASP are inevitably mixing the HTML tags with the code that should be executed on server side. Also the proposed solution to separate the presentation content from the web application logic have not simplified the situation that

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much and has added some other complexities and generally the web programs are not easily readable and understandable for the human user.

The W3C' solution to the mentioned problem is XForms that offers separation of the form's purpose from its presentation. An XForm allows processing of data to occur using a declarative model composed of formula for data calculations and constraints. It also equipped with a view layer composed of intent-based user interface controls that are bound to the model and finally XForms provide an imperative controller for orchestrating data manipulations, interactions between the model and view layers, and data submissions. Thus, XForms accommodates form component reuse, fosters strong data type validation, eliminates unnecessary round-trips to the server, offers device independence and reduces the need for scripting [2].

Another interesting aspect of XForms is the role that it might play in the integration of desktop information (user's world) with other business processes using Semantic Web [3] technologies. More precisely, the Semantic Web should bridge the gap between user information and external processes by mapping the user resources to those needed by a specific web form. As an example consider an online e-shopping system that requires the payment information from the user. Such data should be provided by each shopping (or once per e-shopping system); however, this could be avoided by integrating the user information which reside on the user's desktop. The combination of the XForms' data model with the user ontology and the appropriate mapping it to an upper ontology will improve the logical design of application and may have more software engineering benefits too.

Meanwhile the Service Oriented Architecture (SOA), has emerged as a communication paradigm for extending the interaction between applications whereas the applications may run on heterogeneous systems. Web services allow automatic and dynamic interoperability between systems to accomplish business tasks by putting together their functionalities. Another trend that has influenced the web applications in the recent years is the Web 2.0 technology that is going ahead hand in hand with SOA. Basically Web 2.0 is much more than adding a nice facade to old web application rather it is a new way of thinking about software architecture of web applications. In comparison to traditional web applications, the application logic of modern Web 2.0 applications is more concentrated on the client side and the business processes are considered as remote services. As a matter of fact it is a step toward the cloud computing where business services are presented on Internet and developers should select and weave them together to create new compound services. The SOA's Achille's heel in our belief is its lack of the semantic description of Web Services. Without the explicit semantic context, the process of assembling “pieces of functionality” into complex business processes is still unthinkable without significant human involvement and exactly here is the point that Semantic Web can fit, to facilitate the application of web services to modern web applications that use XForms.

XForms 1.1 was announced as an official W3C Recommendation on 29th November 2007, and has attracted the attention of developers and researchers. The most interesting part of XForms is the introduction of the data models described in XML that can be used for presentation and reasoning purposes and opens the gates to lots of

possible extensions. Peng Yew Cheow et al. [4], propose a logical frame work, which maps the semantics of the XForms documents to knowledge bases in Description Logic. This framework can be used as a basis for reasoning and validity checks on XForms.

With the emergence of complex business processes, there is a growing need to embed the web forms into user's information context. In other words the generic web forms should be personalized according to user history and context information. As addressed in the previous section, Semantic Web can glue up the open world processes to user's information in a machine-processable way. Our SemanticLIFE project is an effort to realize a Personal Information Management (PIM) system using Semantic Web technologies, with the aim of creating a semantic repository of all personal data from a variety of sources like emails, contacts, running processes, web browsing history, calendar appointments, chat Sections, and other documents. This PIM system acts as a digital memory and provides the "personal profile" for acquired persons [5]. To our belief, the emergence of Semantic PIM systems plus the ever-increasing processing capability of desktops makes the integration of personal desktops into real world business processes, conceivable.

In this paper, some possible solutions based on XForms and Semantic Web are presented and the feasibility of implementation of corresponding use cases is discussed in details.

2 Methodology

As explained before the the XForms data model can play an important role to connect web forms to the back-end processes. The more known roles of the XForms' data model are:

- Providing a declarative data structure that document's visual elements will refer to.
- Decoupling data, logic from user interface rendering features of the target device (handheld, television, desktop browse, etc).
- Adding data calculations and dependency of form elements.
- Adding data types and other constraints.
- Defining the form submission parameters and behavior and also providing an XML instance data at submission time.

The focus of this paper is to explore the role where XForms' model can connect an XHTML form to other available services by using Semantic Web technologies to extend the functionalities of XHTML forms via ontologies. In the rest of this section, the feasibility of such a solution will be discussed.

An XForms model is an XML structure that is included in the header part of an XHTML document and where its elements are conforming with the documents' name spaces. Listing below shows a typical XHTML document that contains a simple data model with three elements: first name, last name and city name.

```
<html
      xmlns="http://www.w3.org/1999/xhtml"
      xmlns:sample="http://www.sampleinfo.net/"
      xmlns:xf="http://www.w3.org/2002/xforms">
 <head>
     <title>Testing XForms</title>
     <xf:model>
        <xf:instance>
           <DataElement>
              <sample:FirstName/>
              <sample:LastName/>
              <sample:City/>
           </DataElement>
        </xf:instance>
     </xf:model>
 </head>
 <body>
    ...
 </body>
 </html>
```

The interesting part of the above listing is the name-spaces that attach the definition of the model elements to a known name-space. So every element can be specified with its fully qualified URI and this URI can be selected to be identical with the name space of a domain ontology. For instance the first name item of above XHTML document has the URI of “http://www.sampleinfo.net/FirstName” and this can be assumed to be the name space of a domain ontology. As a result the form elements can be easily mapped to the relevant domain ontologies.

Web forms contain atomic elements that can be better processed in comparison to web pages and natural text. Elements that appear on a typical form usually convey a logical relationship between elements. For example if a web form contains a city name and country name, probably the city should be located in the specified country. Traditionally, such relation can be identified only by human users and the semantic of the elements' relationships is missing. With the current advances of Semantic Web technologies, the machines can also detect the concepts and their relationships. In other words the form elements are mapped to an ontology via the XHTML's embedded model. As soon as we arrive at ontology level, the application would benefit from all advantages of Semantic Web world.

For the scenarios that will follow in next section, we are especially interested in Semantic Inference and Ontology mapping. The scenarios will be classified into two main groups. First are those scenarios that are aimed to combine the web forms with business services on the web and secondly are the scenarios that are using the Semantic Desktop as a basis for connecting the user's world to web forms and customize the forms and their content data according to user's profile. The following figure shows these two methods and how the ontology is filling the gap between services and web forms.

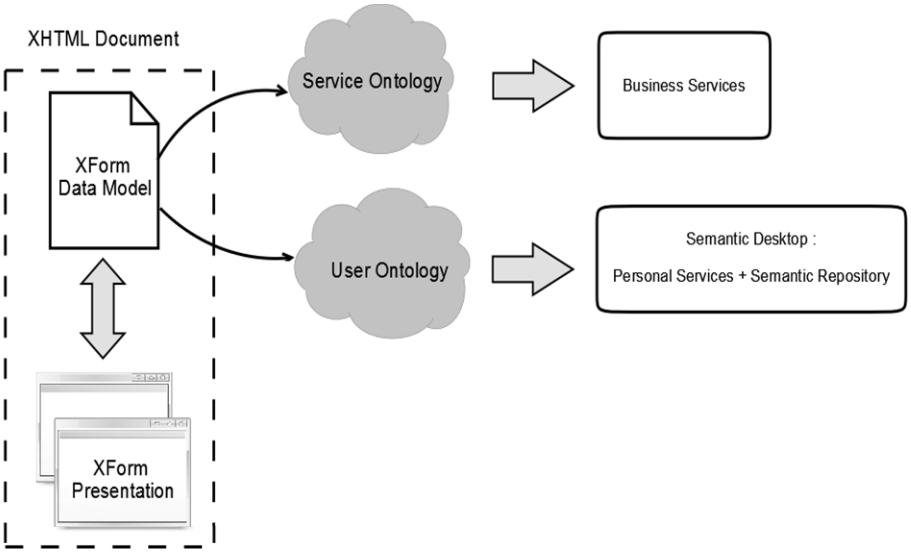

Fig. 1. XForm's Service integration methodology

3 Demonstration Scenarios

In this section some scenarios for integrating the web forms with business and personal processes are presented. Some presented scenarios can leverage the productivity of both web form end-users and web form providers/programmers. The web form end-users would be able to save time in filling out forms by connecting the forms to their Semantic Desktop using personal ontologies. They can also be warned about the information that might be inferred from the data that they submit through different forms to a specific service provider. The usage of XForms can also be beneficial for service providers and programmers because of the increasing productivity of software development processes.

3.1 Unwanted Information Disclosure

The information gathered by service providers on the Internet, might lead to the disclosure of some information which from the end-user's point of view should not be exposed to that organization. A simple example to illustrate this is date of birth. If the user prefer to disclose his/her date of birth, then he/she will probably ignore the fields that are asking directly about date of birth, however the provider can ask year, day, and month of the birth separately during a period of time and then put the pieces together and hack the date of birth.

In some cases service providers can use rules to perform reasoning and deduce new information. For example by providing the Zip code and country name, and the name of the company that has built your house the service provider can conclude the city name from zip code and country and then locate your building among a smaller set of possibilities. As a proposed solution personal ontologies can capture the user intent

and consult the history of user's interaction with a specific service provider, to avoid completion of such chains. The XForms' data model is the key for joining the web form elements to domain ontology.

3.2 Lifetime Data Consistency

In the long periods of time the user might forget the detail of his/her interactions with a service provider and submit some data that is in conflict with previously provided data. For example, user's name might be spelled differently (e.g. Special characters in European languages) and it can cause ambiguities at service provider side. An XForms' data model that is mapped to a personal ontology can help to add a consistency check before submitting the data. So the user's history can be consulted to avoid such inconsistencies.

3.3 Avoiding Multiple Data Entries

Similar Internet applications usually require a common set of data that should be provided by the end-user. For example to register in an online shop, a user needs to provide the payment information, the delivery address, etc. The Semantic Desktop can help the user by auto completion of common fields. Again the XForms' data model that is mapped to user ontology, can query the Semantic Store and extract the required information.

3.4 Integration of Personal Services

In addition to services that are available on Internet as web services, the user's desktop can also provide personal services. Semantic Desktop systems, such as SemantiCLIFE, contribute some personal services that can be used in service composition scenarios. These services are enriched with semantic information and can be queried according to service parameters and/or service intent. Personal services are distinguished with two pivotal factors: first they are closely related to the entities that are typically used in everyday life like emails, appointments, documents, etc and secondly are customized for their owner and vary not only from user to user, they also vary depending on the context of use.

To clarify the issue, consider an appointment matching service that is presented by user's Semantic Desktop. A non-semantic service will simply consult the user's calendar and says whether a specific time slot can be assigned for a meeting. The drawback of a “non-semantic” service is that the service is not able to conceive the location concept and check if the meeting is feasible according to the ontology of appointments in the days before and after. So the appointment matching service is dependent on user's and appointment's context and additionally it deals with appointment items that are highly related to user's daily desktop applications.

Personal services can be also categorized according to their internal complexity. Some services perform a simple one step action whereas more complex services may be composed of multiple actions and additional conditions and service calls. BPEL processes [6] fall under the category of more complex processes. A Semantic Desktop that supports BPEL processes might be seen as a data source that extract and process the data from different resources and hand in the useful information to external world.

As an example of a more complex BPEL process let us consider an online shopping use case (figure 2), where the shopping price limitation should be first checked against your bank account and credit information. A Semantic Desktop BPEL process is able to call external bank web services in a trusty way and calculate your shopping limit based on user's cache amount in the banks minus the planned monthly loans.

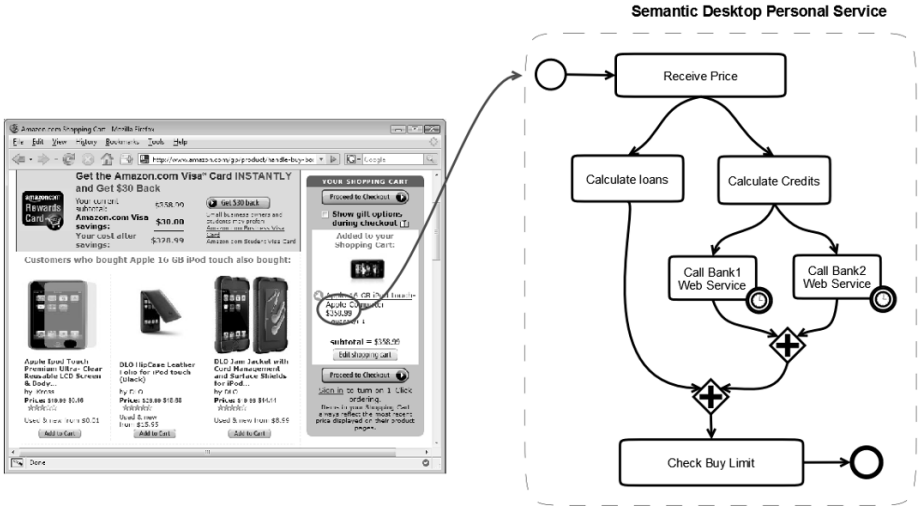

Fig. 2. Integration of Semantic Desktop Personal Services

In the Semantic Desktop environment, where services are described in a semantic way, the XForms' data model can be coupled to a personal service, via user ontology and service profiles. As a result the personal services can be connected to the global business processes and ease the user interaction with open world.

3.5 Checking the Data Validity and Data Consistency

During the development of a web application, the software designer and/or programmer should add constraints and checks to the submitted data to guaranty the data validity and consistency. Moreover adding and removing fields to the web form after the first design is a common issue. After applying such changes the data validation routines should be reviewed and adopted with new changes.

XForms might again be helpful in connecting the form elements to service and domain ontologies. First of all, domain ontology can deliver the information about validity checks that should be accomplished for the combination of the fields, appearing on the web form. Additionally the logic of the check program can be deduced from the domain ontology and enables the selection of the appropriate service from the service ontology. The XForms' logic might force the user to correct the data before submission. In this case the generated validation component that is added on the client side will contact relevant web services to confirm validity of data. In this way the data validity is checked at the very early stages of relevant business processes.

4 Conclusion

XForms as the next generation of web forms have the potential to realize a bunch of business scenarios more efficiently. Joining the structured models of XForms and the ever-increasing capabilities of desktop computers facilitates the implementation of many business scenarios. On the other hand, the emergence of Semantic Web technologies has leverage the process interoperability that in turn boosts the business processes. In this paper, the feasibility of combining the XForms, Semantic Desktops, and SOA was discussed and some possible scenarios were explored. In future we will focus on the integration of useful personal services in the Semantic Desktop environment and apply them to open world business processes via connectors such as XForms.

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