USING XML TECHNOLOGIES IN SYSTEMS ANALYSIS & DESIGN PROJECTS

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Abstract

Extensible Markup Language (XML) is rapidly emerging as the standard for exchanging business data on the World Wide Web. For the foreseeable future, however, most business data will continue to be stored in relational database systems. This paper discusses the emergence of XML and the benefits of its use in conjunction with relational database management systems in the development of a web application in System Analysis & Design courses. We will begin with a brief overview of the application and its architecture and will then discuss the various XML technologies that have been used (XSL, XSLT, XML Schema, and XQuery), as well as our experiences with each. The authors will explore the relationship between native XML databases and relational databases. Finally, the authors will discuss whether XML technologies are robust enough to completely replace relational systems and the benefits/detriments of such a replacement.

Introduction

This paper discusses the lessons learned from using various XML technologies (XSL, XSLT, XML Schema, and XQuery) in the development of a web application in a System Analysis & Design course. We will begin with a brief overview of the application and its architecture and will then discuss the various XML technologies that have been used, as well as our experiences with it.

The Application

Application Overview

The application we will discuss in this paper can be described as a web based timesheet entry system and material receipt-reconciliation system available via mobile devices.

Background

RCH Builders is a large custom home builder in the Minnesota, Iowa, and Wisconsin tri-state area. Currently, RCH builds 500 custom homes each year, each home valued between $350,000 and $1,000,000. Over the past 5 years, the company has realized 200% growth and predicts another 100% over the next 3 years. RCH currently employs over 1250 employees.

Because of RCH's rapid growth it has become increasingly difficult to disseminate to and retrieve information from hundreds of jobsites being worked on concurrently by RCH staff. Two pieces of critical information, labor costing and site inventory, have become time consuming to gather, inefficient to utilize for jobsite decisions and inaccurate for accounting purposes.

The labor costing process is made up of two major components, time entry from the field and budget reporting from the corporate office. Each is a manual process which is time consuming and error prone.

While carpenters are responsible for recording time on paper, Foremen are responsible for collecting and auditing hard copies of time sheets and submitting to general accounting at corporate headquarters. Accountants then audit for accuracy, code entries, and input into the general accounting system. The process of time sheet entry could take from 12 hours a week at a small contractor to 40 hours for larger firms. The current entry form consists of several different methods of job accounting and numbering. If an error exists in a carpenter’s time sheet, extra time is added for reconciliation. In addition, job numbers are now not clearly communicated to each employee, which makes accurate recording difficult.

Job reporting is currently not possible from the field unless a hard copy of a report from the accounting system is given to the foreman. Without this information readily available, Foremen are not able to make critical decisions that affect the homeowners’ budget, such as. In addition, because of the problems inherit in the time reporting process; reports given to the foremen are often too out-of-date to be of any use.

Jobsite inventory also poses problems in the construction process. Typically, a foreman will accept materials on-site and the confirmation of that receipt may not be known to accounting for several days. In addition, packing slips from shipments may be lost or destroyed and not available for reconciliation of invoicing. Job tracking is difficult when the accounting office does not immediately know what materials have been delivered and what have not.

We designed and implemented a web based timesheet entry system and material receipt-reconciliation system available via mobile devices from the field is developed to eliminate the problems listed above. The two systems will be integrated with RCH’s current general accounting and purchasing systems.

The benefits received from an investment in such systems include the reduction of errors in costing and inventory management, increased efficiency in gathering and disseminating information and increased availability of accurate information for critical decisions. In addition, these systems would give RCH a groundwork that opens the capability to serve our clients better in the future by potentially giving them real time access to information related to their construction.

Application Design

Figure 1 below shows the core classes of the application. The class diagram provides the developer with an object oriented interface. There are five classes in the application: TimeEntry, Employee, Payroll, Job, and Management. Notice that the Employee, Payroll, and Job classes are inherited from the TimeEntry class. The Management class is inherited from both the Employee and the Job classes.

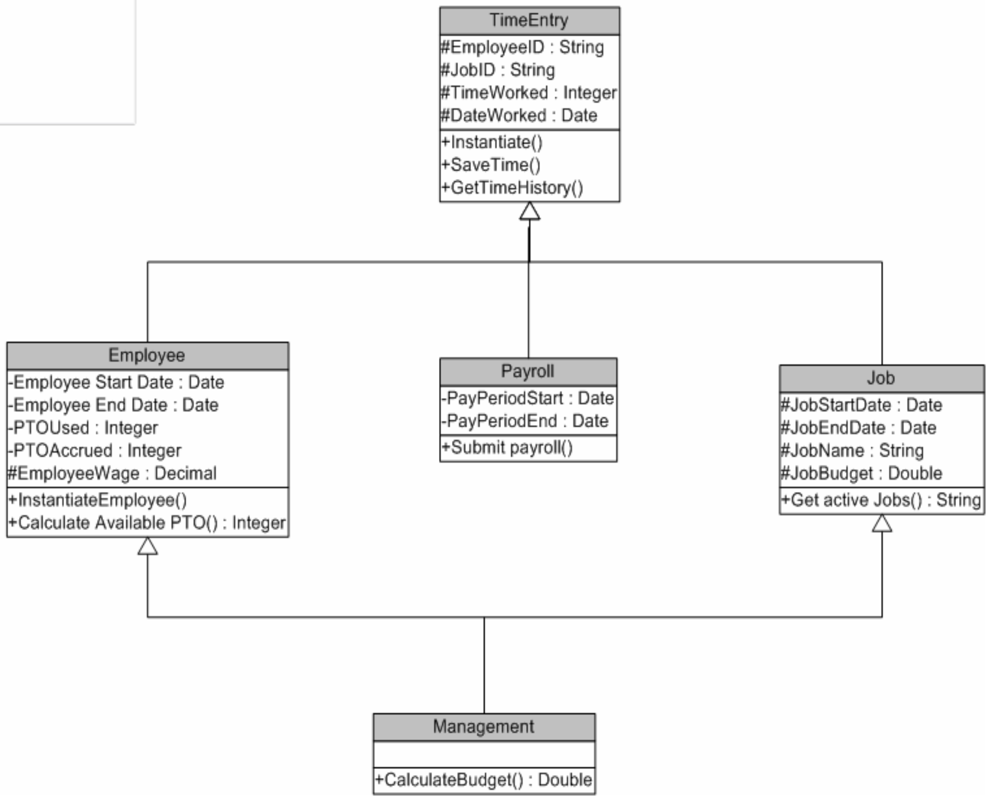

Figure 1: Class Diagram

Application Architecture

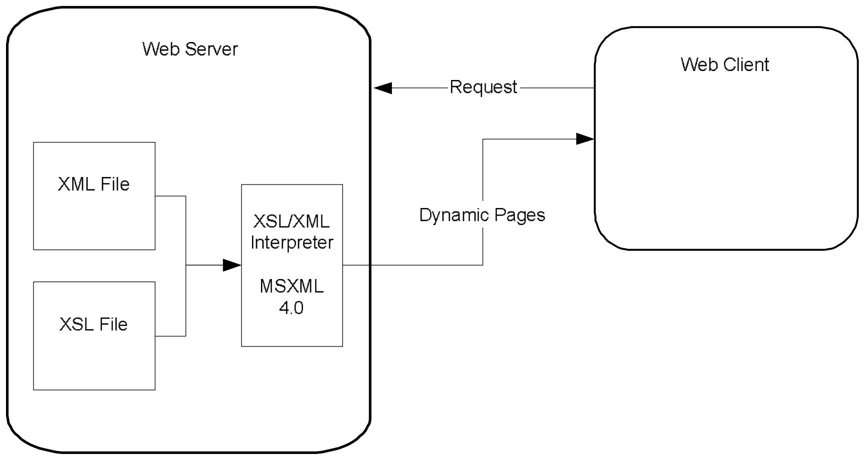

Figure 2: Application Architecture

Figure 2 above describes the overall application architecture, showing both the client and the server side

The visitor's Web browser requests the Web page using a standard URL. The Web server software such Apache or IIS, recognizes that the requested file is an ASP script (Figure 3), and so the server interprets the file using ASP plug-in, before responding to the page request. The ASP page then instantiates, and passes parameters to, the MSXML 4.0 interpreter object, including the appropriate XML document and the corresponding XSL document(s) that will be used to translate the XML document. The XML interpreter responds by sending the requested content. The XML interpreter outputs the content as part of the Web page. The XML interpreter plug-in finishes up by handing a copy of the HTML it has created to the Web server. Finally the Web server sends the HTML to the Web browser as it would a plain HTML file (figure 4), except that instead of coming directly from an HTML file, the page is the output provided by the XML ISAPI filter.

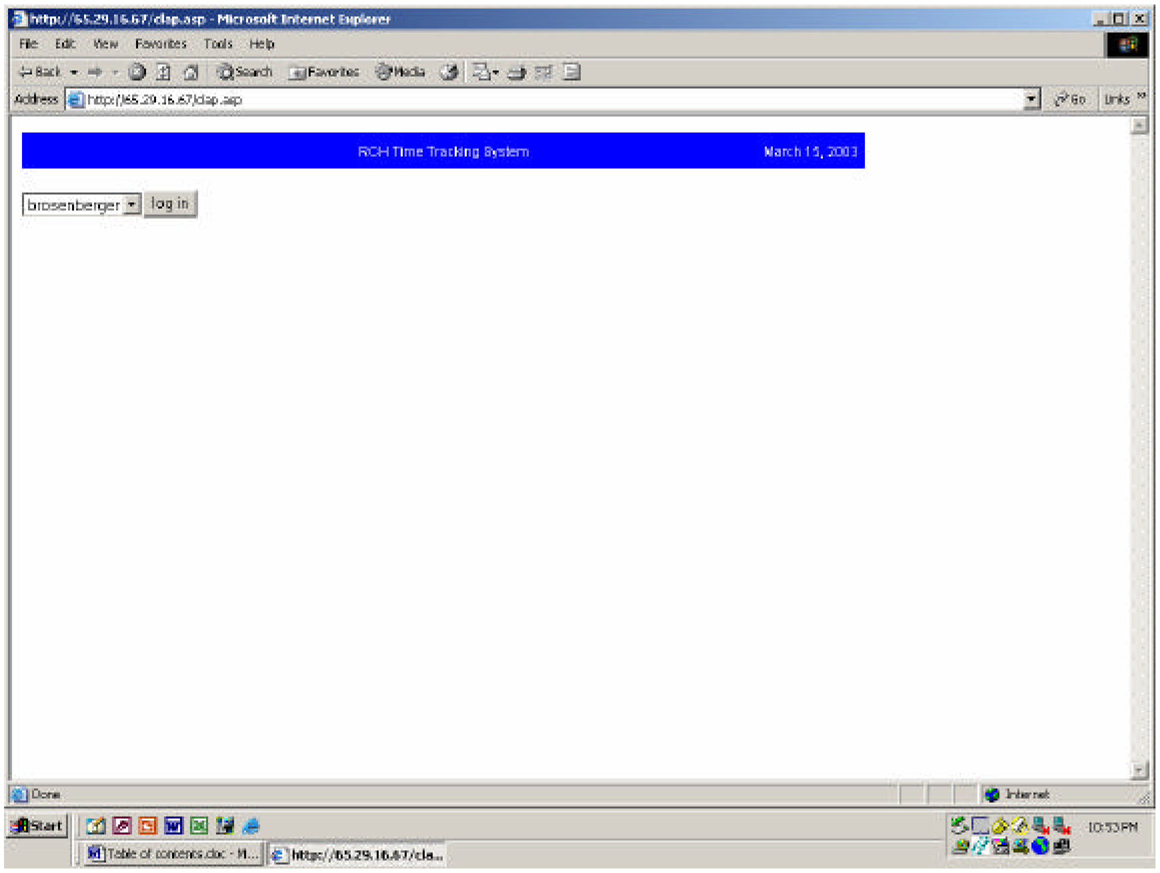
http://65.29.16.67/clap.asp - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
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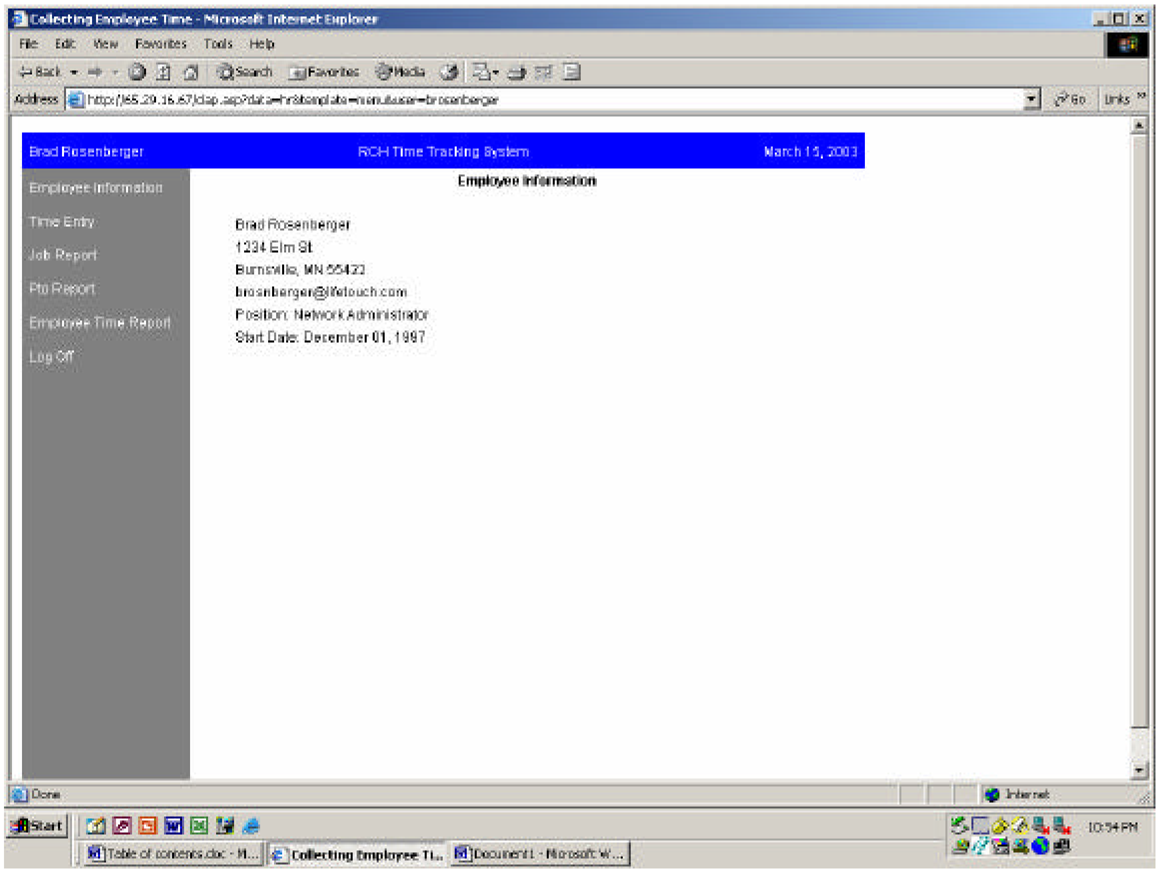
Figure 3: User Interface


Collecting Employee Time - Microsoft Internet Explorer
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Brad Rosenberger
RCH Time Tracking System
March 15, 2003
Employee Information
Time Entry
Job Report
Pto Report
Employee Time Report
Log Off
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Internet
Start
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Employee Information

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Position: Network Administrator
Start Date: December 01, 1997

Figure 4: Employee Information

XML Technologies

One of the challenges of working with an XML document is presenting the XML data in a useful format, for users of the Web. The method we chose is the Extensible Style sheet Language (XSL). One of the components of XSL is XSLT (Extensible Style sheet Language Transformation). XSLT is used to transform XML content into a presentation format. In our project we used XSLT style sheets. The fact that all the application's data is available in XML leads to the obvious decision to use XSLT for printing and report generation.

Among the important things that we faced during the implementation phase is the parsing of the XML Schema documents describing the various object classes and to build an efficient object-based representation of them. One of the major contributors was the querying of XML Schema documents with XPath expressions. XPath expressions allows for quickly finding the element associated with a specific class attribute or relationship.

XSL lacks certain functionality, namely a method for manipulating dates to determine spans of time. We used DTD’s and namespaces to extend the language by using an open source package from exslt.org. The exslt package included both date and math functions that were utilized effectively to accomplish the goal of the application. XML proved to live up to its name by being easily extensible.

Classic systems analysis and design methodologies translated well into the new paradigm of XML technologies. The Entity Relationship Diagram proved an excellent model for creating the XML source files. Data flow diagrams and class diagrams remained useful for mapping out the functions we needed to create in XSL.

Describing Queries

All queries within the application are described in XML syntax. The result of a query is an XML document. Queries are used in forms, they are used internally by the application logic and they are used for user-defined queries. However, users do not write their queries in XML. Users can formulate their queries in a Query-by-example style through the browser. The user queries are then transformed into XML and sent to the server. On the server, the XML query syntax is not executed directly, but transformed into the underlying system's native query language, which in our case is XSL.

Conclusions and Outlook

Building a complex application completely based on XML technologies can be done successfully. However, there are many things that must be considered to lead such a project to successful completion. Like HTML, XML documents are text files. Therefore, an XML author needs no more than a simple text editor, like Notepad or vi to get started. There are more sophisticated XML editors available that may make it easier to design a document, but they are not required. After the XML document is created, it needs to be evaluated by an application known as an XML processor, or XML parser. Part of the function of the parser is to interpret the document's code and verify that it satisfies all of the XML specifications for document structure and syntax. XML parsers are strict. If one tag is omitted or a character is lowercase when it should be uppercase, the parser will report an error and rejects the document. This may see excessive, but that rigidity was built into XML to correct the flaw in HTML that gave Web browsers too much discretion interpreting HTML code. The end result is that XML code accepted by the parser is sure to work the same everywhere. In our project we used a parser developed by Microsoft called MSXML.

We believe that XML is something of a hybrid. XML is probably most similar to object databases in data modeling, inasmuch as it also consists of nodes, and nodes can contain heterogeneous data. On the other hand, the degree of heterogeneity of nodes depends a lot on the particular DTDs or schemas used to define the structure of an XML document.

Writing this application is currently not possible using strictly XML technologies. For instance, ASP was used in writing any data input from the user to XML documents. The Microsoft XML parser that was used also required ASP to create and manipulate the MSXML object at run-time. In addition, the current implementations of the XML standards, like MSXML 4.0, require extensibility via packages like exslt.org in order to be as developmentally efficient as existing scripting languages, such as PHP, JSP or ASP.

XML is an extremely versatile data *transport* format, but despite high hopes for it, XML is mediocre to poor as a data *storage* and *access* format. It is not nearly time to throw away your (SQL) relational databases that are tuned to quickly and reliably query complex data. So just what is the relationship between XML and the relational data model?

The problem for many XML-everywhere (and XML-only) aspirations is that at the core of an RDBMS are its *relations* -- in particular, the set of constraints that exists between tables. Enforcing the constraints is what makes RDBMSs so useful and powerful. While it would surely be possible to represent a constraint set in XML for the purposes of communicating it, XML has no inherent mechanism for enforcing constraints of this sort (DTDs and schemas are constraints of a different, more limited sort). Without constraints, you just have data, not a data model.

Overall, we have been quite satisfied with the results of our approach and we will use this technology in future projects too.