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THE GENERATION OF A WIRELESS STUDENT AUTOMATION SYSTEM

Zeynep ALTAN[1] **M. Nusret SARISAKAL**[2]

[1,2] Istanbul University, Faculty of Engineering, Computer Engineering Department
34850, Avcilar, Istanbul, TURKEY

[1] e-mail: zaltan@istanbul.edu.tr [2] e-mail: nsarisakal@istanbul.edu.tr

ABSTRACT

Today most web clients are PCs, but according to Meta group "By 2003 over 50% of internet access will be non-PCs". XML offers a widely adopted standard way of representing text and data in a format that can be processed without much human or machine intelligence. Information formatted in XML can be exchanged across platforms, languages, and applications, and can be used with a wide range of development tools and utilities. In this study we developed a Turkish tool supplying various student information on the WAP platform for the undergraduates of Istanbul University. First of all, the data obtained from different student offices has been converted to the XML documents, and then they are performed as a WML document for the integration to the WAP technology.

Keywords: *Mobile computation, XML, WML and ASP technology.*

I. WHY XML TECHNOLOGY?

Many new Internet based solutions use XML technology to exchange data between mainframes and the Web. For example; information technology planners are implementing their e-government strategies to control the certificates of the vehicle owners and landowners, or to follow the hunters and anglers, and for many other public works. In this manner, the task of the authorities should fairly be simplified by using the Internet based solutions. XML is a standard that is simple, self-describing way of encoding both text and data. Data coded in XML is easy to read and understand, plus computers can process it easily. Thus, any content can be processed with relatively little human effort, and can be changed among different hardware, operating systems, and applications. Both XML and HTML are closely related to the SGML. Although XML is similar enough to HTML in its actual format, there are two fundamental differences between them. Firstly, dissimilarity is watched out at the separation of the form and content. HTML mainly consists of tags that define the appearance of text; but the tags in XML generally define the structure and content of the data, and the actual appearance is specified by another application. Secondly; XML is extensible, there is no fixed set of tags. Individuals or organizations can create new tags for some specific application, whereas W3C defines the HTML standard tag set. On the other side, XML is also a W3C standard supported by software industry market leaders.

In traditional databases, data records require schemas, which were set up by the database administrator. Since meta data for XML documents are constituted in the form of tags and

attributes, it is not required any definition as in other databases. This is the self-description property of XML. XML provides a basis for author identification and versioning at the element level. Any XML tag can possess unlimited number of attributes such as author or version. Tags, attributes and element structure supply content information that can be used to interpret the meaning of content. For the applications which content information is difficult or impossible to evaluate, XML over HTML or plain text is a major advantage with its machine-readable context information. XML tags separate content from presentation symbolizing what the tag means, and how it looks. Therefore the appearance of a document or a Web site can be changed without reorganizing the content of the document. Thus it is possible to obtain multiple presentations of the same content. Whereas HTML describes the presentation as how it looks. Supporting property to multilingual documents and Unicode is also an important characteristic for the internationalization of the applications.

The tree structure of XML documents as a facilitation property allows documents to be aggregated and compared efficiently one by one, and these documents can contain any possible data type from multimedia data to active components. Since XML documents can consist of nested elements that are distributed over multiple remote servers, they are currently the most sophisticated format for the distributed data.

II. THE EFFECT OF XML TO THE DATABASE SYSTEMS

Some of the database systems consist of both transaction processing system and RDBMS-based information system. Therefore, a huge increase has being observed to access to these databases over the Internet. Such systems are also used to support electronic business operations. They include various business transactions, for instance transactions between systems related with an enterprise, between businesses in a supply chain, or directly related to the customers. At the beginning, most companies desired to integrate these diverse operations by the software, which was generated or bought as application servers, and to employ different protocols such as DCOM or CORBA to perform the integration of XML. But extracting process of data from one database, and put it into another, as a middleware application may rather be complex. For example, the SQL standard extracts data from an RDBMS being independent from the vendors, in spite of that it requires to pay careful attention to the database schemas on each side in order to work them properly. But XML has changed this situation with its precise schema definitions, and with its standardized *meta-format* that can represent any kind of data. These data exchange applications can be written without reference to the detailed format descriptions or schemas. Many products from many vendors are available that implement something close to the WWW Consortium Recommendation on XML. The convenience of this technology made XML to use widely to integrate the Web applications, supply chains and enterprises.

III. THE STRUCTURE OF THE PROJECT

The aim of this project representing the wireless student automation system was to present the student information in different faculty databases at the Istanbul University, on the WAP platform. First of all, Engineering Faculty students were utilized from this application as a prototype, and then this prototype has been expanded in a way that the program would work at the other faculties of the University. We used WML language while developing this project, and the information in different databases was converted to the XML document. The hierarchical configuration of database can be seen in *Figure 1*. If the structure of the database is known, it is easy to convert it to the XML document. In this project, Visual Basic 6.0 programming language has been used to convert the data into XML document. Because of the greatness of the database, more than one XML documents have been constituted. Thus, the performance and complexity problem have been eliminated while compressing the database into XML document. This transformation process can be seen in *Figure2*.

During the design of the model, it was considered to perform the following processes:

- The hierarchical structure of the XML document;
- Choosing the name of the related XML file as the root element of each XML document;

- The convenient usage of the data in the tables with the hierarchical structure of the database; in other words a component which has been constituted by using a field in the lower level of the table was not located over a component which has been constituted by using any field from the higher level of the table.
- The information in a component was composed of different components that have been formed after the inference of various loops.
- The information at any field of the database was used to constitute the attribute in the label. For example; *"<ogrenci no="1306010001"> Ahmet BAL </ogrenci>"*.

The XML documents (bolumler.xml, duyurular.xml, sinavtarihleri.xml etc.) in *Figure 2*, which would then be modified for the WAP technology, were obtained asfollows:

- The field name in the database was read, and after the completion of required operations it was written between "< >" characters.
- Secondly, the field value was written, and the final label between "</ >" characters was rewritten as the field name.

The definition of any label related to the field has been completed after the processes above. Moreover;

- Some of the field values in the XML document can be replaced into the label as an attribute. This procedure consists of the names that have been defined according to the field name instead of the label names.
- If there are other low level components requiring to be added to the basic component, the labels of these low level components have to be written before closing the procedure with the "</ >" label.

All of these procedures constitute an appropriate hierarchical structure of the XML framework.

III.1. The Integration of XML Documents with WAP Technology

As we can see from the simple WML example in *Figure 3*, it is possible to display different interfaces with the transition between cards using card IDs. The links implementing this process have been placed to the XML document. The WML line *<card id= "Card_1 "title="Giris">* puts a text box to the screen for the user to enter his/her student number, and a "OK" button to send the input data to the right bottom side of the screen. By pressing the "OK" button, the student number in the text box is sent to the document, which its path is defined by a *"x"* variable. This process is similar to the *method="post"* approach of the ASP technique. Student number has been sent to an ASP document called "notlar.asp" as the basic procedure of the WML-WAP integration. The codes and screen display can be seen in *Figure 3*.

This project, originally, relates the transferring process of the student information to the WAP platform. Exam dates and results, AGNOs (Weighted Averages of the Success Grade) or department announcements are some of them, and the project supplies to access all of this information with a WAP adapted mobile telephone. By using the WAP technology, the integration of XML technology depends on to the use of XML documents as a *data source* that the data has been stored. In Figure 4, a XML document including student information as a hierarchical structure can be seen. While some of the data like student name and number are directly written to the document, some of them like the department number and course names, which each holds relational data quality, are written with their associated numbers like 1,2,3.

Since XML documents have been used as data source, relational database model has principally to be used. Therefore the basic document has been divided into two groups as the department and student records. bölümler.xml document is loaded to the memory in case of the requirement of department information, then data called relational data helps to obtain the department information from the bölümler.xml document. *Figure 5* displays a sample for this kind of document. When the first screen of the student automation program that has been configured in order to enter the student numbers is active, the OK button sends this number to the document between <go> and </go> tags. As it can be seen from the *Figure 3*, this number information is sent to an ASP document. The first lines of the ASP document specifies the format of the document as:

```
<%
Response.ContentType ="text/vnd.wap.wml"
%>.
```

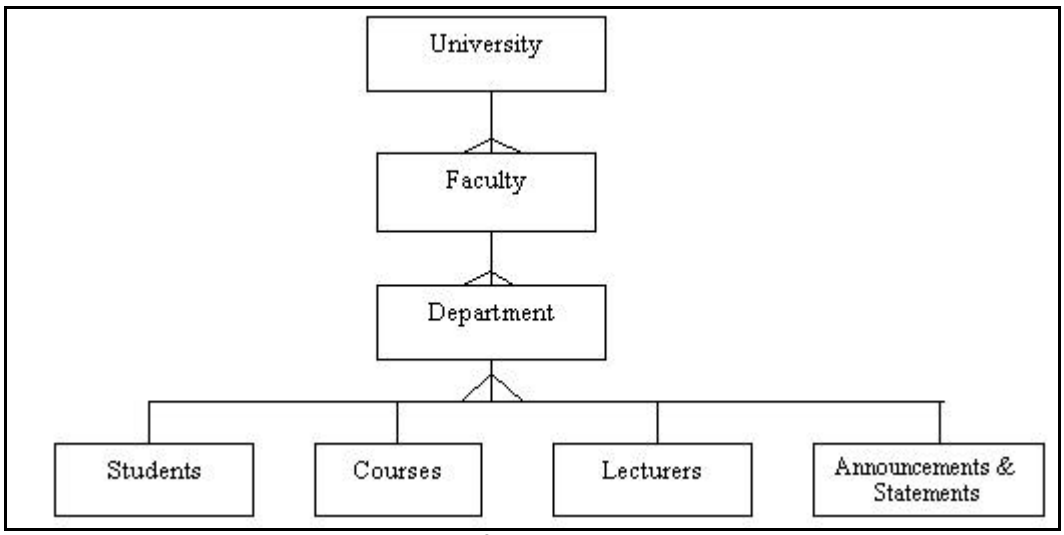

Figure 1: *Overview of the tree hierarchy in the study*
∧ operator indicates that the subclasses can be extended into more classes.

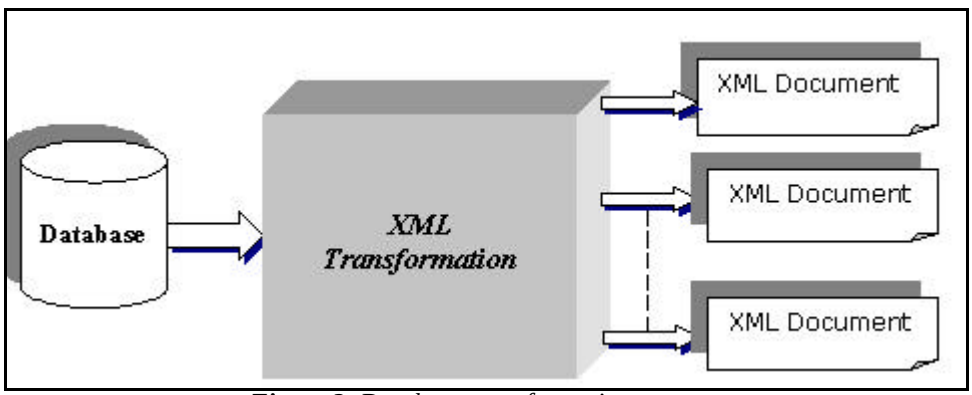

Figure 2: *Database transformation process*

```
<?xml version="1.0"?>
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.1//EN" "http://www.wapforum.org/DTD/wml_1.1.xml">
<wml>
<card id="Card_1" title="Giris">
<p> Lütfen numaranizi giriniz:
<input name="number"/>
</p>
<do type="prev" label="OK" name="number" optional="false">
<go href="http://nusret/Wap1/notlar.asp" method="post">
<postfield name="x" value="$(number)"/>
</go>
</do>
</card>
</wml>
```

Figure 3: *A simple WML example and its screen output.*

```
<?xml version="1.0" ?>
- <ogrenci_kayit>
  - <ogrenci no="1306970039">
      <ad>Tagmac Unal</ad>
      <bolum no="1" />
    - <notlar>
      - <donem no="1">
        - <ders no="1">
            <sistem1>45</sistem1>
            <sistem2>2</sistem2>
          </ders>
        - <ders no="2">
            <sistem1>55</sistem1>
            <sistem2>2</sistem2>
          </ders>
        </donem>
      </notlar>
    </ogrenci>
  - <ogrenci no="1306970013">
  - <ogrenci no="1306970045">
```

Figure 4: A XML document including student information

```
<?xml version="1.0" ?>
- <bolumler>
  - <bolum no="1">
      <ad>Bilgisayar Bilimleri Muhendisligi</ad>
    - <donem no="1">
        <ders no="1" d="3" u="2" l="0">Bilgisayar
          Aglari</ders>
        <ders no="2" d="3" u="0" l="0">Yazilim
          Muh.</ders>
      </donem>
    </bolum>
  - <bolum no="2">
      <ad>Cevre Muhendisligi</ad>
    - <donem no="1">
      </donem>
    </bolum>
</bolumler>
```

Figure 5: *A WML document for department information*

The server doesn't operate the document fragments that are exclusive of <%> … <%> tags, and they are directly written to the document as follows:

```
<?xml version="1.0"?>
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD
WML 1.1//EN"
"http://www.wapforum.org/DTD/wml_1.1.xml">
<wml>
<card id="card1" title="Secenekler">
<p>
```

After the first part of the WML document has been completed, the student number is controlled. Therefore ogrenci.xml document must be loaded to the memory and parsed, then the existence of the record related with the student must be determined. All of these processes are carried out by the Document Object Model (DOM) technology. DOM technology can parse the XML documents in a way that the required branch can be accessed to obtain the data. The ASP code between <%…%> lines is written as follows to implement these processes on the server:

```
<%
numara = Trim(request.form("x"))
Set XMLDoc =
Server.CreateObject("Microsoft.XMLDOM")
XMLDoc.Async = false
XMLDoc.load(Server.MapPath("ogrenci.xml"))
Set root = XMLDoc.documentElement
Set nodeList = root.selectNodes("//ogrenci" &
"[@no = '" &
  numara & "']")
   if nodeList.length<>0 then
    %>
```

In the first line above, the number information, which has been sent by the "x" variable, is taken. Then by generating a new DOM object, ogrenci.xml document is loaded to that variable. Finally, DOM functions examine the record of student number. If the student number is true, the list of operations are seen on the screen as follows:

```
Lütfen listeden birini seciniz:
<select name="secenek">
<option value="SinavSonuclari">Sinav
Sonuclari</option>
<option value="AGNO">AGNO</option>
<option value="SinavTarihleri">  Sinav
Tarihleri</option>
<option value="Duyurular">Duyurular</option>
</select>
```

Otherwise, " Bu numaraya ait ögrenci kaydi bulunamadi!.." message will be seen on the screen. Then, the WML tag is closed and ASP document is finalized.

```
<%Response.ContentType = "text/vnd.wap.wml"%>
<?xml version="1.0"?>
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.1//EN"
"http://www.wapforum.org/DTD/wml_1.1.xml">
<wml> <card id="card1" title="Sinav Tarihleri"> <p>
<%   donem = Trim(request.QueryString("donem"))
   bolum= Trim(request.QueryString("bolum"))
   Set XMLDocDersler = Server.CreateObject("Microsoft.XMLDOM")   XMLDocDersler.Async = false
XMLDocDersler.load(Server.MapPath("bolumler.xml"))
Set rootDersler = XMLDocDersler.documentElement
Set nodeListDersler = rootDersler.selectNodes("//bolum" & "[@no ='" & bolum & "']" & "/donem" & "[@no ='"
& donem & "']")
Set XMLDocTarihler = Server.CreateObject("Microsoft.XMLDOM")
XMLDocTarihler.Async = false
XMLDocTarihler.load(Server.MapPath("SinavTarihleri.xml"))
Set rootTarihler = XMLDocTarihler.documentElement
Set nodeListTarihler = rootTarihler.selectNodes("//bolum" & "[@no = '" & bolum & "']" & "/donem" & "[@no =
'" & donem & "']")
if nodeListTarihler.length<>0 then %>
<table columns="2" align="CC">
<tr><td><strong>Ders</strong></td><td><strong>Tarih</strong></td></tr>
<%for t=0 to (nodeListDersler.item(0).childNodes.length-1)%>
<tr><td><%=nodeListDersler.item(0).childNodes.item(t).text%></td><td><%=nodeListTarihler.item(0).childNo
des.item(t).firstChild.text%></td></tr>
<%next%>   </table>  <%else%>
Bu doneme ait sýnav tarihi bilgisi bulunamadi!..
<%end if%> </p>
 <do type="prev" label="Back" name="number" optional="false">  <prev/>
 </do>  </card> </wml>
```

Figure 6: *The codes completely related to the Sýnav Tarihleri.wml document*

When the third option of the list "SinavTarihleri" is selected, the user accesses to the screen, which the semester number related to the final dates, would be entered. The link "Goster" changes the screen indicating the exam dates. We can follow the ASP document "SinavTarihleri.wml" in detail from *Figure 6*, and various screen output of the study can be seen from *Figure 7*.

As a result, ASP technology supplies the document to form as a WML document, XML documents are used as a data source and DOM technology makes possible to search the required data in the XML documents. In other words, it is possible to branch out to the other pages of the automation by using these four technologies ASP, XML, DOM and WML to implement the searches and to present all kind of information to the user.

IV. CONCLUSION

One of the most important properties between the wireless applications and Internet is the advancement at the usability. There are several usability issues emerging with respect to delivering content to wireless devices. They also may require supplying the content for the wireless market according to the standards and the presentation of comprehensible applications. Generally website output has being produced in WML format. For example e-commerce applications as B2C (business to consumer), B2B (business to business), B2B2C (business to business to consumer) communications and m-commerce (mobile-commerce) are gaining a lot interest at many developing companies. The flexibility property of the XML in transforming content format made that language very popular for the most web-based applications, and many famous companies also announced their support for XML. Simultaneously, the variety of the wireless compatible devices have been arisen many versions of the WML.

The project developed in this study supplies the undergraduates to be able to check their course information or to access different faculty announcements using a WAP adapted mobile telephone. For example confirming the timing of an exam is an extra facility for the students who were abroad of the University. First of all, this project has designed for the Computer Engineering Department, and then it expanded to all faculties of the University. We made use of the Microsoft Active Server Pages technology and the Microsoft Document Object Model to perform the transformation on the server-side., i.e. the web server transformed the XML document into WML. Then, the WML content was sent to the WAP emulator.

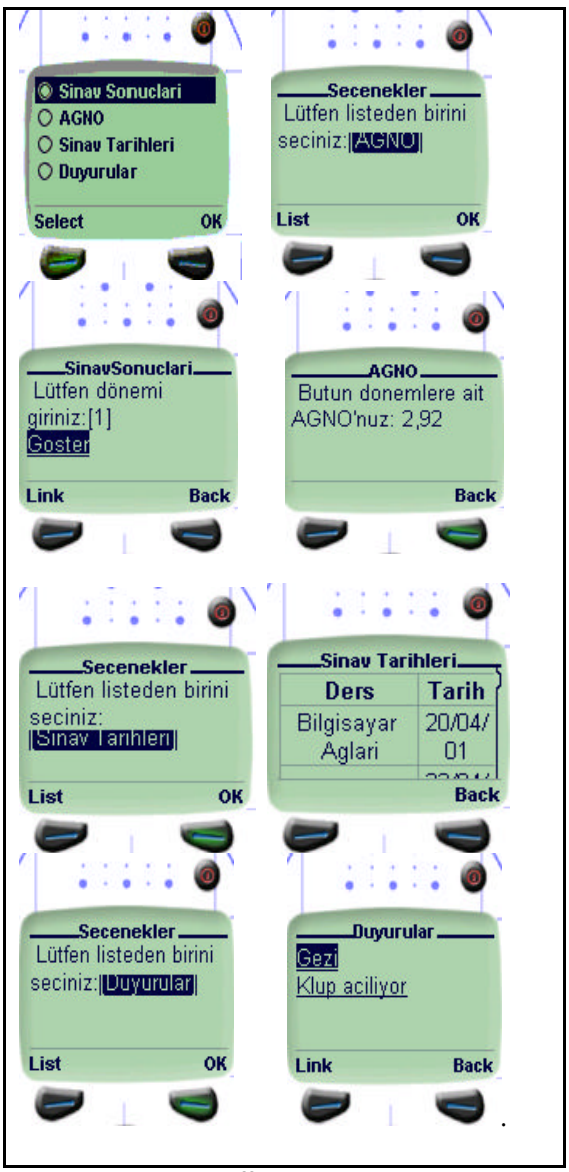

Figure 7: *Different screen outputs*

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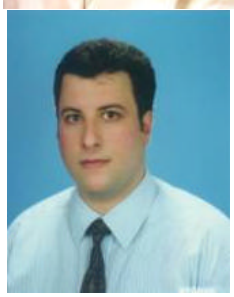

Zeynep ALTAN attended Istanbul Technical University both as an undergraduate and as a graduate student, receiving a B.A. as Mathematical Engineer in 1980 and a Master of Science Degree in System Analysist Section of The Institute of Natural and Applied Sciences in 1983. She completed her Ph.D. Degree at the Istanbul University in Numerical Methods Section of Social Science Institute in 1990. Until 1993, she was a research assistant at the Istanbul Technical Univesity, Mathematical Engineering Department. Since then she is an assistant professor of Computer Engineering Department at Istanbul University, Faculty of Engineering. She teaches computer science courses, and her interest areas are computational linguistics and software development techniques. She is mother of a daughter and a son.

M. Nusret SARISAKAL was born on the 7th of June 1971, in Istanbul, Turkey. He received both his B.Sc. and M.Sc degrees in Computer Science Engineering from the Faculty of Engineering at Istanbul University in 1997 and 2000 respectively. Between May 1995 and December 1998 he worked as an application programmer, technical coordinator and project administrator for an important software company. He worked as a research assistant from December 1998 to October 2001 in the Computer Science Engineering Department of Istanbul University. Since October 2001, he has been teaching computer science courses for the same department. His research interests include; Computer Networks, Communication, Web Programming, XML, EDI, VRML, Database Systems, Security and Cryptography. He is married and has one son.