GEOGRAPHY MARKUP LANGUAGE - GEO-METADATA AND WEB GIS

A.Kalantari Oskouei & Aliasghar Alesheikh

KNT university - Tehran- Iran
oskhom@yahoo.com

ABSTRACT:

Nowadays developing geo-metadata with the capacity for data quality management and dissemination plays an important role in GIS/Geomatics world. Data quality information embedded in geo-metadata helps the users to decide whether the available dataset does fit the intended use. Standardized metadata for geo-spatial data is a key in data sharing and finding information on the web and crucial in building Geospatial Data Infrastructure (GDI). The main aim in this paper was to develop a web-based geo-metadata dissemination system for in-situ sensors based on, most importantly, interoperable, standard and open technologies introduced by Open GIS Consortium (OGC) namely Geography Markup Language (GML). To do this research at first a use case diagram was developed to demonstrate the user's requirement. Then an application XML schema based on user's requirement was created. To build this schema some GML schema documents (developed by OGC) were imported into the application schema. System architecture was designed based on client/server model so a UML class diagram is developed to present all classes and their attributes, operations and associations within the system. Implementation was conducted using GML, XML, XMLHTTP, DOM, ASP, and VBScript that brought out a web-network-based in-situ sensors metadata application. This application provided a user friendly interface to do search and find sensor related information. Based on this research it was found that although GML and XML are powerful tools to build geo-metadata and also embedded quality information but it is important to note that GML document size may be a problem when dealing with huge amount of data.
KEY WORDS: Data Quality**,** In-situ sensor, Interoperability, GML, Metadata

1. INTRODUCTION

Data quality is an important element to decide whether the available dataset does fit the intended use. However, in many cases, users have difficulty extracting quality information about geo spatial datasets (Devillers , 2006). The only way actually used to communicate data quality parameters is using metadata (Devillers , 2002). Metadata is defined as "data about data". It is the background information, which describes the content, quality (defined as fitness for use), condition, and other appropriate characteristics of the data. The term is generally applied to electronic resources. Metadata can be organized into several levels ranging from a simple listing of basic information about available data to detailed documentation about an individual data set [ITC, 2001]. In order to build a strong geospatial data infrastructure (GDI), metadata is crucial. Metadata and metadata servers enable users to integrate data from multiple sources, organizations, and formats. Metadata for geographical data may include the data source, its creation date, format, projection, scale, resolution, and accuracy. Metadata can be used internally by the data provider to monitor the status of data sets, and externally to advertise to potential users through a national clearinghouse [Groot,1999].

The main aim in this research is to develop a web-based sensor geo-metadata dissemination system prototype based on interoperable technologies namely Geography Markup Language (GML). The OpenGIS® Geography Markup Language (GML) Encoding Specification is an XML encoding for the modelling, transport and storage of geographic information including the spatial and non-spatial properties of geographic features. The specification defines the XML Schema syntax, mechanisms, and conventions that:

- Provide an open, vendor-neutral framework for the definition of geospatial application schemas and objects
- Allow profiles that support proper subsets of GML framework descriptive capabilities
- Support the description of geospatial application schemas for specialized domains and information communities
- Enable the creation and maintenance of linked geographic application schemas and datasets
- Support the storage and transport of application schemas and data sets
- Increase the ability of organizations to share geographic application schemas and the information they describe

Implementers may decide to store geographic application schemas and information in GML, or they may decide to convert from some other storage format on demand and use GML only for schema and data transport [OpenGIS, 2007].

The motivation for attention and developing metadata rises from produced difficulty in finding information on the web. Day-by-day the web is getting bigger and rapid growth in the amount of web-based resources demands for a powerful mechanism providing facilities to discover the available web resources in an easy and standard way. Although there are several search engines available on the web, but searching through sensor metadata dissemination prototype will provide benefits to user than via search engine site (such as Yahoo, Google, and so on) in which user must open one by one suggested page and examine weather desired information there is or not. It is obvious that this practice is tedious and time-consuming.

Generally, two types of metadata attributes can be identified: human readable metadata intended for display to the user, and metadata for automation (machine-understandable) [Groot, 1999]. Here the focus is on the first aspect of metadata namely human readable metadata that provides capabilities for the users to find different data sensors based on their metadata.

Based on literature review it was found that there is no study or done work regarding sensor metadata creation using interoperable technologies and existing systems are based on proprietary technologies so it can be said that this research is the first study in this regard.

2. MATERIAL AND METHODS

In general the research methodology is classified into the following steps:

- Analysis and design of the sensor metadata dissemination system
- Implementation

Each of these is described in the following.

2.1 System design criteria

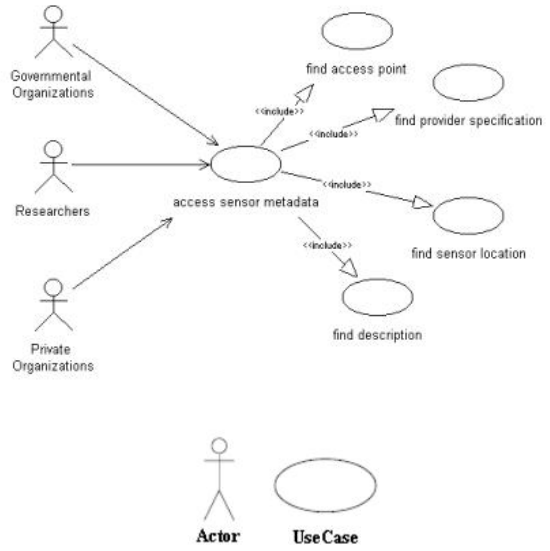
The sensor metadata dissemination system was designed with maximum reliance on existing technologies and standards. To develop this system the attention was drawn to build a system based on the following criteria:

- Interoperable data format
- Open data format
- Platform independent data format
- Loosely coupled data format
- Vendor neutral data format
- Flexible and extensible data format
- Use of standardized and interoperable protocol to communicate between client and server applications
- Use of client-server Architecture
- Use of XML programming using the Microsoft XML parser.

2.2 Analysis and design

UML use case diagram design

To develop sensor metadata prototype knowledge about the users and user requirements play an important role for constructing a powerful system. The following UML use case diagram is developed to show the users and describes what users intend to use the system for.



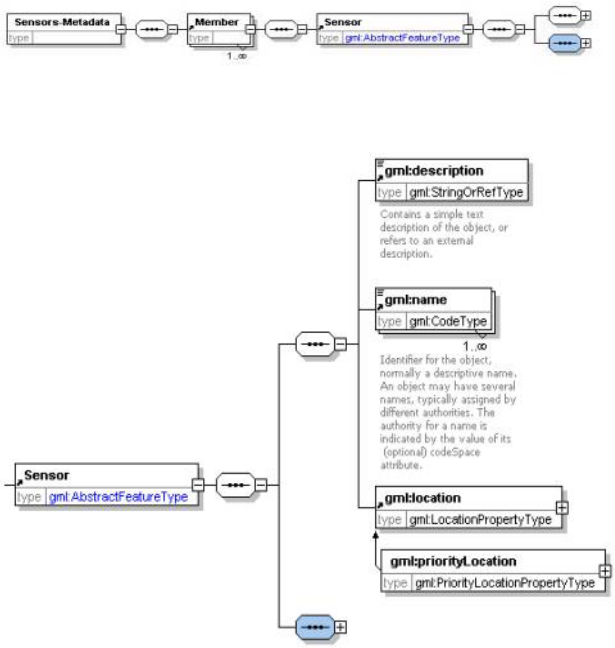
Legend

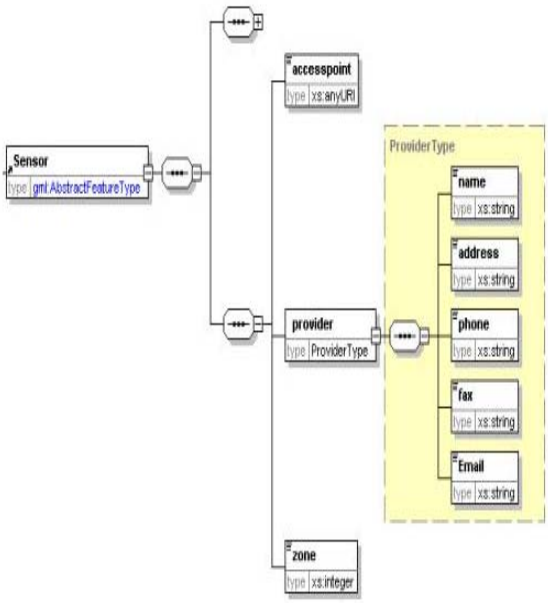
Figure 1- UML Use Case diagram of sensor metadata prototype

As the use case diagram shows Researchers, governmental and private organizations constitute the sensor metadata system users. Governmental organizations are the major users of sensor metadata system. In all countries over the world, governmental organizations play an important role in managing and control of for instance, natural resources, air quality, traffic, security, and son on that can be based on data measured by different kind of sensors deployed in environments like rivers, cars, boats, forest, streets and roads. On the other hand, companies can take benefit of sensor metadata system in order to locate the sensor datasets of interest for using in their projects. In general, researchers and research and educational institutes, Location Based Services (LBSs), Protection environment agencies, Meteorology organizations, Municipalities, Police centers, Agricultural organizations, and many other sections can be users of the sensor metadata system.

2.3 Design of Application XML Schema

Design stage for XML-based systems development begins by developing the application XML schema, which defines elements of XML document that is used by the application. Schemas serve as design tools, establishing a framework on which implementation can be built [Vlist ,2002]. As mentioned earlier, the sensor metadata prototype is to be based on XML technology to encode and transferring data on the web. To this end, design phase includes developing an XML schema based on user requirements, which defines XML document elements. Next, this schema is used to edit and validate XML document of prototype. XML schema is an XML document that defines content model of an XML document. Content model describes which elements and attributes can appear in XML document, in what order, and how many times [Vlist ,2002]. In fact, an XML schema can be thought of metadata (essentially, data that describes data) for XML document. To build application XML schema for sensor metadata several GML schema documents are imported into metadata application schema. Here Altova XMLSPY software is used to schema creation and editing. Based on the system requirements analysis, the following XML schema is developed to support the sensor metadata dissemination system.





2.4 UML class diagram design

A UML class diagram is used to represent all the classes and their attributes, operations, associations within sensor metadata system. It models the static aspects of this system [Schmuller,1999]. To develop a class diagram, the first step is

to identify classes in the sensor metadata system. Since the sensor metadata prototype corresponds with server/client model, here classes for this system include two classes as the following UML class diagram presents:

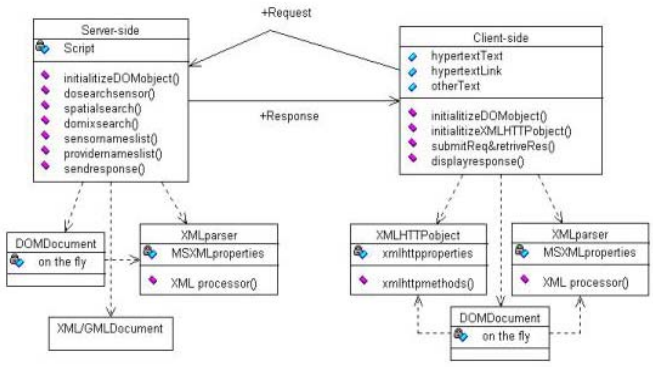


Figure 3- UML class diagram of Sensor Metadata prototype

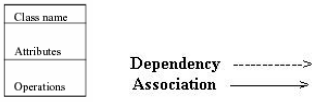


Figure 4- Legend of class diagram

Client-side class defines attributes and operations that will be used in the client-side browser. Diagram also shows existing dependency between this class and DOM, XMLHTTP objects and XML parser classes. Based on this model client-side class makes request and submits it to server-side to further process. This relation is shown through association line between two classes in the diagram. The main operation in the client side includes operation in order to initiate DOM and XMLHTTP objects, submit request, retrieve and display responses sent by server-side.

Server-side class defines functions required to support of client-side requests. As the class diagram shows, server-side class is responsible to provide the response of request for client-side. Server-side is in dependency with DOM object, XML parser and XML document. The main functions in the server-side are:

- Initializes DOM object, which is used to initializes DOM object that enables system applications access and manipulate XML/GML document.
- Do search sensor, which is used to do search against XML/GML document in order to find sensors metadata based on the sensor name user input.
- Spatial search, which is used to do search against XML/GML document in order to find sensors metadata located in an area.
- Do mix search, which is used to do search against XML/GML document in order to find sensors metadata based on combination of parameters
- Sensor name list, which is used to provide a list of registered sensor names available in the system repository.
- Provider name list, which is used to provide a list of registered data provider names available in the system repository.
- Send response, which is responsible to send the query results toward client-side as XML packets.

UML class diagram was developed using Rational Rose software.

2.5 System architecture design

Figure 5 shows developed architecture for sensor metadata dissemination system. This architecture is based on client-server model. According to client-server model, client by using a web browser interacts with the server-side application, makes a request and submits the request to server-side to further process. Then server-side application retrieves and processes the request and finally sends relevant response to client [Groot, 1999]. An important point regarding this architecture is that it makes use of XML/GML technologies.

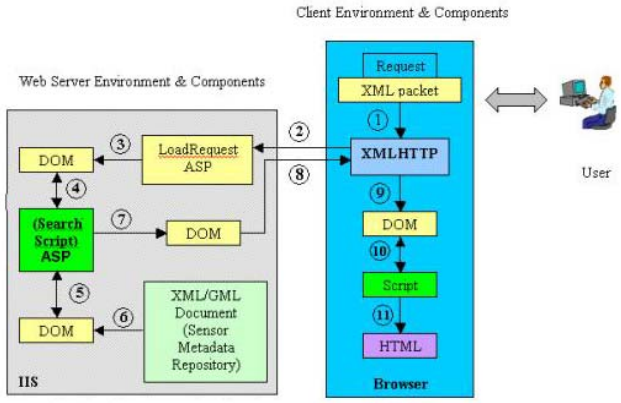


Figure 5- System architecture

2.6 Design of data provider entry interface

Sensor metadata dissemination system is a mediator, which links the sensor data providers and sensor data users (consumers). Here the intent is to develop a special interface allowing data providers to register their datasets metadata. In fact, the main intent of the development of this interface is to support sensor metadata dissemination system repository via the Internet. The following figure shows architecture and mechanism required to this end.

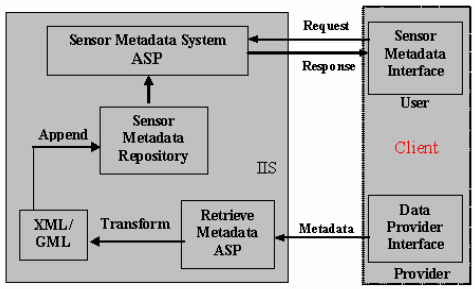


Figure 6- Relationship between Sensor Metadata Prototype, user, and Data Provider

Based on this architecture, data provider starts the scenario and by using provider interface registers information regarding datasets metadata into server side XML/GML-based repository. The data provider's interface can be reached using an URL. Next server side script retrieves the received information and using relevant function converts the received information into XML/GML format. This process is done since sensor metadata repository has been built based on XML and GML data structure. After completing transformation step, received metadata is added into sensor metadata prototype repository.

This repository is used by the sensor metadata prototype to do search based on received request from the users.

2.7 User's interface design

Similar to other dissemination systems, there is a need for a user interface providing interaction facilities for the users of the system. The principles of user interfaces design are that user interfaces should be clear, concise, easy to operate, and easy to navigate [Christoph,2002]. Here the interfaces of the system are designed in away that every part of the interfaces have a title and a small text describing which main functionality it will supply to fulfil tasks, and each user interface has a return button so that the user can easily go back to the main interface.
This interface provides three clickable options for the users to do search. Available options include: search By Sensor Name, Spatial Search (by window) and search By Name of Sensor, Data Provider and a free Keyword (Advanced Search).

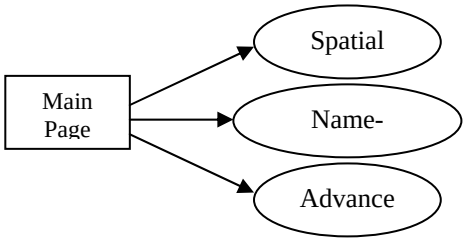


Figure 7- User's interface structure

2.8 Implementation

2.8.1 XML/GML Document Creation

One of the steps in the implementation is to create, edit, and validate XML document .As mentioned previously, XML schema, built in the design section, is used to develop the sensor metadata system XML/GML document. This document is responsible for storing members of sensors metadata. Validation means the process by which an XML instance document is systematically checked and verified to be in conformance with all the rules and restrictions defined within a content model [Larry,2003]. The following figure shows partially of the built XML document for sensor metadata prototype. This document contains root element, three Member elements (the first one is expanded) and Sensor subelement children shown in the grid view of XMLSPY.

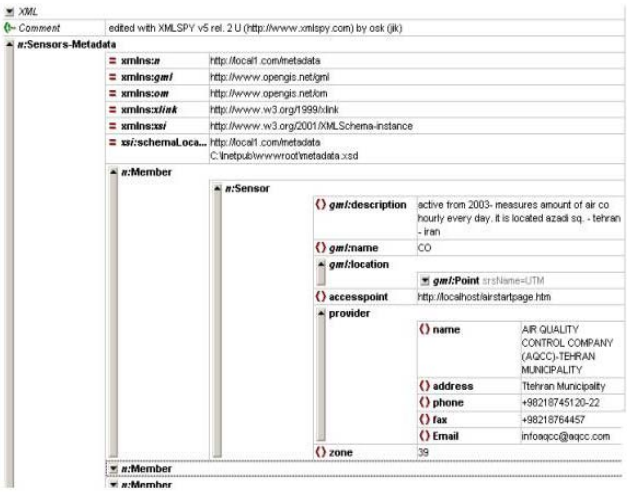


Figure 8- Part of developed XML document for sensor metadata prototype in XMLSPY grid view

2.8.2 System architecture implementation

Implementation in this phase is classified into two parts: Client side Implementation and server side Implementation. Each of these is described in the following:

Client side implementation:

Based on system architecture, sensor metadata system makes use of XML for sending and receiving messages. In order to pass the user input to server side, the user input should be packet as an XML packet [Christoph, 2002]. The following code is an example used in developing the system to this purpose.

```
xml="<sizeofwindow>"
 xml = xml& "<x1value>"&
document.rsqfrm.x1.value&"</x1value>"
 xml = xml& "<y1value>"&
document.rsqfrm.y1.value&"</y1value>"
 xml = xml& "<x2value>"&
document.rsqfrm.x2.value&"</x2value>"
 xml = xml& "<y2value>"&
document.rsqfrm.y2.value&"</y2value>"
xml = xml& "<zonevalue>"&
document.rsqfrm.zn.value&"</zonevalue>"
xml = xml& "</sizeofwindow>"
```

Next step is to create an XMLHTTP object to communicate with the backend HTTP server where the server script for processing the request can be reached. This will enable client-side to pass an XML packet to server using the HTTP connection between the client and the server [Moefoo,2002]. The XMLHTTP object can request to open a connection with an HTTP server, specifying the HTTP request method, such as GET or POST, the resource it is looking for, such as an ASP script (spatialsearch.asp) for processing the request, the asysnchronization flag, and finally send the XML packet out to the server using the XMLHTTP send method. Step two of the diagram points to this process. An instance of the corresponding function that is used for initialising and doing the tasks can be seen in the following:

```
set xmlhttp=createobject("Microsoft.xmlhttp")
xmlhttp.open "post" , "http://localhost/spatialsearch.asp" , false
xmlhttp.send xml
```

Server side implementation:

In the server-side a function is responsible to retrieve the sent client-side XML packet. To do this, there is a need to create a DOM instance and load it with the incoming XML content. The following function is programmed for this process:

```
set xmlRsq= server.CreateObject("Microsoft.xmldom")
xmlRsq.async=false
xmlRsq.load Request
```

After the loading is completed, a DOM tree of the request at the server-side is created. Now it is possible using DOM programming techniques to extract content of request to further process. Created DOM tree in this phase is used by server-side search function in order to locate requested information. This research makes use of an XML/GML document called metadata.xml, containing registered sensors metadata. This document is used by search function to locate the requested sensor metadata. The following illustrates mechanism followed

to access and use of XML document to do search and generate the response for the client-side within search function.
1.Loading Metadata.xml as a DOM tree (step 6 of the diagram). To access the information enclosed in the XML/GML document, metadata.xml, the first task is to create a DOM object and then load it with data from the document. The following shows the relevant function to accomplish this task:

```
Function initialitizedomobject()
dim metadoc
set metadoc=server.CreateObject("microsoft.xmldom")
metadoc.async=false
metadoc.load(server.mapPath("metadata.xml"))
If metadoc.parseError then
 response.write "Error"
Else
 set initialitizedomobject=metadoc.documentElement
End if
End Function
```

2. Creation a DOM tree for the response document (step 7). As discussed earlier, the response of request is sent as a XML packet. To this end, there is a need to a DOM tree to store the response. This can be accomplished by the following function:

```
set spatialsearchRes=server.createobject("Microsoft.xmldom")
spatialsearchRes.async=false
set newnode=spatialsearchRes.createElement("Results")
spatialsearchRes.appendchild(newnode)
```

As the codes above shows, created DOM tree contains a root element named <Results>. This is done by using createElement and appenchild methods.

3. Query for matching the request to the possible information in the XML/GML document (step 5 of the diagram). Here the search method based on numeric node index that finds all children of a node and then looking for the interested information within the node. The following is an example to find sensors metadata located in a certain area. The request form for this information, as discussed already, consist coordinates of the area. Here a 'For' loop is used to access the elements of XML document. Then using a conditional statement, 'If', whole the nodes of XML document are verified to find the requested information.

```
For i=0 to n_member-1
If cdbl(xha) <= cdbl(x2) and cdbl(yha) <= cdbl(y2) and cdbl(xha) >= cdbl(x1) and cdbl(yha) >= cdbl(y1) and zone=zonefile then

NameofSensor=root.childnodes(i).childnodes(0).getElementsBy
TagName("gml:name").item(0).text
xURL=root.childnodes(i).childnodes(0).getElementsByTagNa
me("accesspoint").item(0).text
xlocation=root.childnodes(i).childnodes(0).childnodes(2).getEle
mentsByTagName("gml:coordinates").item(0).text
.
.
.
End if
Next
```

Provided that the search function finds nodes matching the request, it will set variables for the content of the elements. For instance, in the code above the NameofSensor variable is used to store the content of sensor name element. The created variables in this process will be used in the response creation stage.

4. Generating a Response to the client. As mentioned already, a DOM tree is dedicated to store the response. For this purpose, it is needed to create elements required to encode the response within DOM tree. The following shows part of function to generate subelements that are components of response.

```
Set NameSensor=
spatialsearchRes.createElement("NameofSensor")
spatialsearchRes.lastchild.lastchild.appendChild(NameSensor)
spatialsearchRes.lastchild.lastchild.lastchild.text =
NameofSensor

Set desc = spatialsearchRes.createElement("description")
spatialsearchRes.lastchild.lastchild.appendChild(desc)
spatialsearchRes.lastChild.lastchild.lastchild.text = description

Set zoneasp = spatialsearchRes.createElement("Zone")
spatialsearchRes.lastchild.lastchild.appendChild(zoneasp)
spatialsearchRes.lastChild.lastchild.lastchild.text = zonef

Set location =
spatialsearchRes.createElement("SensorLocation")
spatialsearchRes.lastchild.lastchild.appendChild(location)
spatialsearchRes.lastChild.lastchild.lastchild.text = xlocation
Set unit = spatialsearchRes.createElement("CoordinateSystem")
spatialsearchRes.lastchild.lastchild.appendChild(unit)
spatialsearchRes.lastChild.lastchild.lastchild.text = unitofcoord
```

Previous code shows five new elements built within spatialsearchRes DOM object and determined values for them. As the list above shows, these new elements are used to carry Name of Sensor, Description about Sensor, Zone number, Location of Sensor, and name of used map projection (unit).

5. After search function performed its responsibility, the last step in the server-side is to send the response of request toward client-side script (step 8). This task is accomplished using Save method of XML DOM that save and send the response to the client-side. The following shows corresponding function to do so:

```
spatialsearchRes.save(response)
```

As mentioned previously, XMLHTTP object on the client-side is responsible for retrieving the response sent by HTTP server.

Till now it was described that how the server-side script manipulates the request and sends the response to the client - side. Next section will discuss on details in the client-side and explain the mechanisms in order to retrieve and display the sent response by server-side to the user.

As the figure 5 shows the client-side XMLHTTP (through send method) is in charge of retrieving the response sent by server-side script. To this end, XMLHTTP object supports a property called responseXML that carries the response sent by the HTTP server. The following function is used to create a DOM tree and loading the response from responseXML of XMLHTTP object by the client-side script (step 9 of the diagram).

```
set receivedDoc=createobject("Microsoft.xmldom")
receivedDoc.async=false
```

```
set receivedDoc =xmlhttp.responseXML
```

As the code above shows the response is loaded into an object called receivedDoc that can be used by the client-side script to further process (step 10). The rest of scenario in the client-side includes dealing with receivedDoc object in order to present the response to the information requester.

To this end, client-side script makes use of a loop structure and node indexes to present the results of request to the user (step 11). The following is an instance function used for this purpose.

```
Function displayresponse (byRef receivedDoc)
If receivedDoc.documentElement.haschildnodes() then
document.write "<h1 align=center>Sensor Metadata
Prototype<br>Result of Spatial Query (by Window)<br>"
x1=receivedDoc.documentElement.childnodes(0).childnodes(0)
.text
y1=receivedDoc.documentElement.childnodes(0).childnodes(1)
.text
x2=receivedDoc.documentElement.childnodes(0).childnodes(2)
.text
y2=receivedDoc.documentElement.childnodes(0).childnodes(3)
.text
document.write "Window Size: "&x1&","&y1&" -
"&x2&","&y2&"</h1><hr color=green><h2>"
cn=0
For i=0 to receivedDoc.documentElement.childnodes.length-1
cn=cn+1
For j=4 to
receivedDoc.documentElement.childnodes(i).childnodes.length
-1
if
receivedDoc.documentElement.childnodes(i).childnodes(j).nod
ename="AccessPoint" then
url=receivedDoc.documentElement.childnodes(i).childnodes(j).
text
document.write "Access Point: "&"<font color=red><a
href='url'>"&url&"</a><font color=black><p>"
Else
document.write
receivedDoc.documentElement.childnodes(i).childnodes(j).nod
ename &": "&
receivedDoc.documentElement.childnodes(i).childnodes(j).text
&"<br>"
End if
Next
document.write "<hr color=red>"
Next
document.write "Found Sensor/s: "&cn
Else
msgbox "Sorry, There is no information for entered size of
window"
exit function
End if
End function).
```

3. RESULTS AND DISCUSSION

The final result of design and implementation steps is a web-based application that provides facility to do search and access to sensor related metadata. The following figure shows the begging interface of the application when relevant URL of the application is typed in the address bar of a browser.

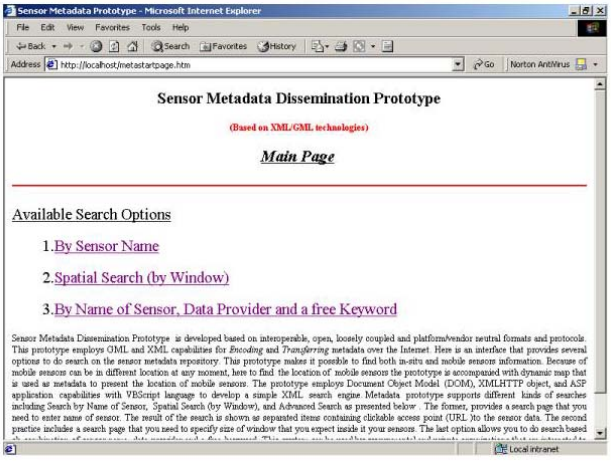


Figure 9- Main page of sensor metadata dissemination system

This interface provides three options and some guidance for users. The following is devoted to explain functionalities of the available options and relevant interfaces in detail.

By Sensor Name option

This option allows to user do search based on name of sensor of interest. Clicking on this option loads By Sensor Name search interface as shown in figure 10.

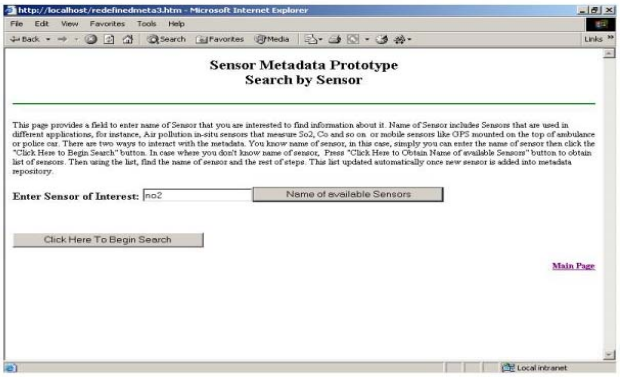


Figure 10- Search by sensor name page of sensor metadata dissemination prototype

As the figure 10 shows, Search by Sensor page contains a text field that accepts user input. User input should be a sensor name and in cases where user is interested to get information about available sensor in repository, they can click on 'Name of available Sensors' button. In this case system provides a list of registered sensor names for the user. This interface is sensitive to empty field input. In cases where user submits empty field, the system will show an error message.

As an example, entering a sensor name in the 'Enter Sensor of Interest' field, for instance No2, and clicking 'Click Here to Begin Search 'button will generate output as shown in figure 11.

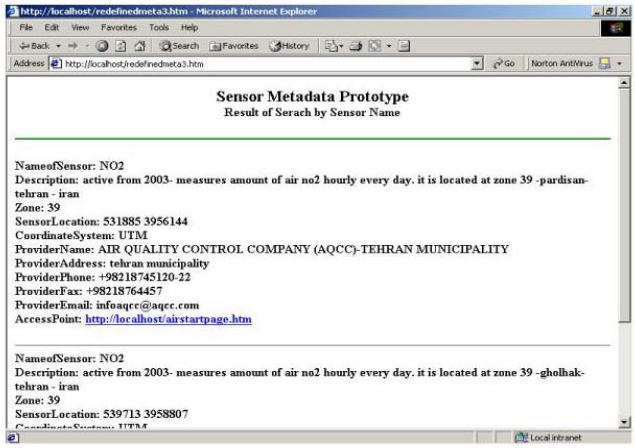


Figure 11- Output of sensor metadata dissemination prototype according to the figure 10 data entry

Figure 11 shows the result of system containing page title and found No2 air sensors metadata separated by horizontal lines. The following is sensor metadata elements reported by the system:

1.Name of Sensor, which points to sensor name.
2.Description, which gives more information about sensor dataset.
3. Zone, Which refers to sensor location UTM zone number.
4.Sensor Location, which points to geographic position of sensor.
5.Coordinate System, which points to the name of used map projection (UTM).
6.Provider Name, which points to name of sensor data provider. It can be name of companies or people.
7. Provider Address
8. Provider Phone
9. Provider Fax
10. Provider Email
11. Access Point (URL), which provides a link to access to sensor data set.

Spatial Search option

Spatial Search option makes it possible to find information regarding deployed sensors within a specified area. This area is specified using its coordinates. Clicking on this option loads the relevant interface shown in figure 12. This interface contains five fields to specify coordinates (window) and UTM zone number of the area.

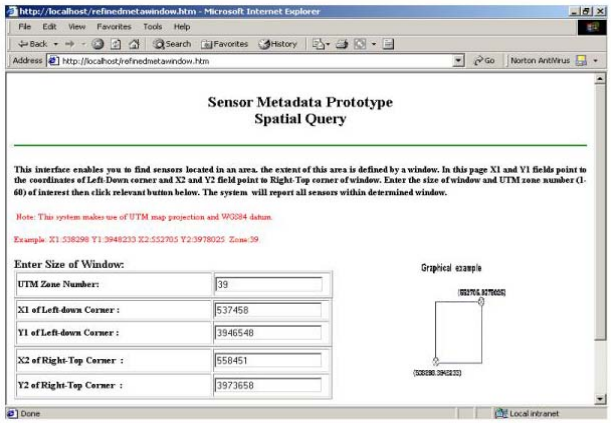


Figure 12- Spatial query page of sensor metadata dissemination prototype

This page also provides guidance for user regarding how to determine size of window (by text and picture). This interface checks user inputs values before sending them toward server-side script. The following includes system restrictions when data entering:

- "UTM zone number" field value must be positive, at most 2 digits, and numeric.
- "X1 and X2 of Left down/top corner" fields value must be positive, 6 digits and numeric.
- "Y1 and Y2 of Left down/top corner" fields value must be positive, 7 digits and numeric.

In cases where the user pays no attention to the mentioned restrictions, system will produce an error message and not allow continuing the work. Figure 12 shows user input in which zone number is 39 and specifications of area are defined as (537458, 3946548) - (558451, 3973658). In this example, first point refers to coordinates of left-down corner of window and latter to right-top. The following figure shows output for mentioned user input.

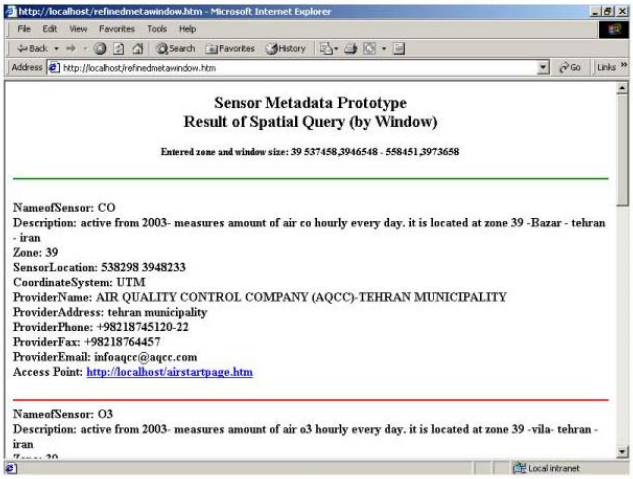


Figure 13- A part of output of sensor metadata dissemination prototype according to figure 12 data entry

As the figure 13 shows, this output includes found sensors along with their relevant metadata within determined area that are separated by horizontal lines. Due to space limitation, the figure 13 only shows Co sensor and relevant metadata completely.

By Name of Sensor, Data Provider and a free Keyword (Advanced Search)) option

This option allows the users to do search, based on the combination of three parameters namely sensor name, provider name, and a free keyword of interest. Clicking on this option loads the interface shown in figure 14. The free keyword in this interface can be anything that helps the user to reach the information of interest. For instance, it can be “air” or “water” that point to environments that sensors can be deployed. This interface also provides facilities to users to reach the list of registered sensors and data provider names. Two button ‘Name of available sensors’ and ‘Name of available providers’ can be used for these purposes. Figure 14 also shows an example that makes use of combination of So_2 as sensor name, Tehran municipality as data provider name and air as keyword in order to find sensors metadata based on these information.

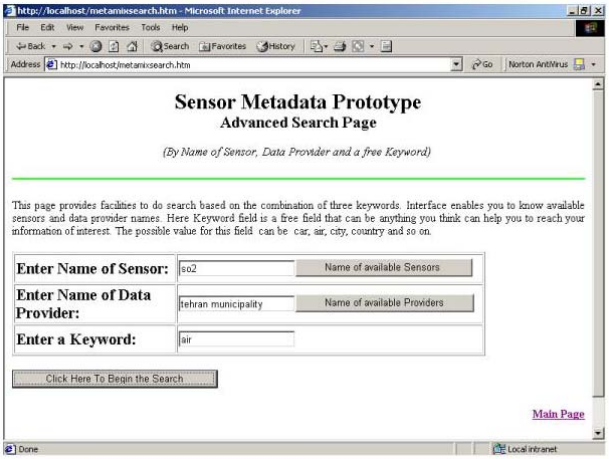


Figure 14- The advanced Search page of sensor metadata dissemination prototype

Submitting user input corresponding with the figure 14 will generate output shown in the following figure:

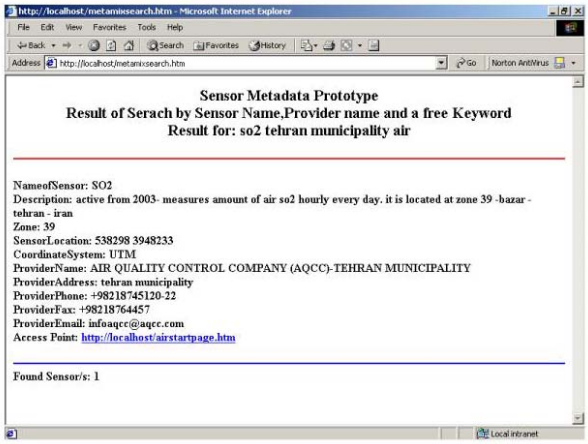


Figure 15- Output of sensor metadata dissemination prototype according to the figure 14 data entry

As the figure above shows, there is only one sensor in the repository at the search time, which matches the request. Based on this output, So_2 is the found sensor that is located in UTM zone number 39, at location 538298, 3948233 and relevant dataset for this sensor is available in the URL specified in the Access Point field. In addition, specifications of Tehran municipality as data provider can be seen in the output.

4. CONCLUSIONS

This research demonstrated an application of XML and its derivative GML in building a sensor metadata repository with the capacity to provide information on quality, content and etc. The main feature of this research is that it is a real application of OGC standards for developing a geo-metadata applicable for management and dissemination of quality information on the web. During this study it was found that XML and GML are very powerful tools to model metadata file for sensors. The use of XML enforces XML features like interoperability; openness, flexibility and loose coupling on metadata file in this system and on the other hand, validation rules improve the reliance of the information stored in the sensor metadata repository. But it realized that the use of XML/GML based documents may result in huge documents reducing data processing speed on the web and network environments. Moreover the use of Scalable Vector Graphic (SVG) technology along with GML will improve functionality of developed application in this research. Therefore this issue is recommended as future work for those who are interested in Web GIS related studies.

5. REFERENCES

Christoph,W. and C,Koller, 2002. Active Server Pages in 24 hours, Sams publishing, pp. 176-187.

Devillers,R and R,Jeansoulin, 2006. Fundamentals of spatial data quality. ISTE, London, pp. 251-252.

Devillers,R and M,Gervais and Y,Bedard and R,Jeansoulin, 2002. Spatial data quality: from metadata to quality indicators and contextual end-user manual. OEEPE/ISPRS joint workshop on spatial data quality management, 21-22 March 2002, Istanbul.

Groot,R.and J,Mclaughlim, 1999. Geospatial data infrastructure, Oxford university press, pp. 65-70.

ITC, 2001. Principles of Geographic Information Systems, ITC publishing, pp. 34-48.

Larry,k., 2003. The official XMLSPY handbook, Wiley publishing, pp. 89-117.

Open GIS Consortium (OGC) Inc, 2007. "OpenGIS® Geography Markup Language (GML) Encoding Specification", http://www.opengeospatial.org/standards/gml (accessed 16 May. 2007)

Schmuller, J., 1999. SAMS Teach Yourself UML in 24 hours, Sams publishing, pp. 213-223.

Vlist,E.,2002. XML Schema. Oreilly, pp. 112-127.