ArcGIS 9: Deploying Server-Based GIS Functionality for Indianapolis/Marion County, Indiana

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This presentation focuses on ArcGIS Server and its usefulness in providing GIS data and functionality in the form of web services. Address matching web service that utilizes standard geocoding services, exposed through ArcGIS Server, as a means to validate a user or machine entered address will be explored. Discussion will cover functionality of the service as well as design and implementation practices in an ArcGIS Server environment.

Background

Recognizing that more than 80 percent of local government data has a spatial or location component, Indianapolis/Marion County has been involved with AM/FM/GIS for about 18 years, investing millions of dollars in data, software and salaries. Most commonly, the spatial component is an address, so the City/County has been working to implement a Master Address Database. The Master Address Database or MAD was conceived as a central repository of address information for all City/County systems, most of which are non-GIS applications.

Desires

Development of the MAD has required considerable effort, both in the design of the database and in the collection and verification of the data going into it. The effort was justified in part by its ability to leverage the City/County investment in GIS technologies and the MAD into other systems in the enterprise. From the beginning of the project, a major goal for the MAD system was development of a tool to validate addresses used in other systems. Not all systems would use the MAD to store their addresses, so the tool needed to validate an address against the MAD before storing it in another system. Since a wide variety of systems are used within City/County government — Mainframe, UNIX, Windows and a variety of vendor-customized systems — the MAD's validation tool would need to use widely recognized standards and be platform neutral. With those considerations in mind the City/County started working with Woolpert to define a Standard Object Access Protocol (SOAP)-compliant web service for validating addresses.

Geocoding — Why ArcGIS Server?

After an exhaustive search for products that provided the fuzzy matching logic similar to that of ESRI's geocoding engine, the team determined that ArcGIS Server was the best product to support the solution. Existing City/County data is in an SDE database, so the choice of ArcGIS Server took best advantage of staff members' skills, out-of-the-box functionality provided by the development platform, and the ability to leverage the existing software and hardware infrastructure of the City of Indianapolis.

Development Environment — Why Visual Studio .NET?

Microsoft Visual Studio .Net was chosen for many of the same reasons as the Geocoding solution. First and foremost, the City/County has a great deal of expertise with Visual Basic 6.0, and the next generation of that product, Visual Basic .Net, is incorporated into the Microsoft Visual Studio .Net development package. In evaluating potential solutions, the team decided that the optimal choice would build on the staff members' skill set, thereby providing the most benefit with the shortest learning curve. Furthermore, it allows the City to maintain its applications in the future with a minimum of effort.

The Solution: The Address Validation Web Service

To meet the address compliance needs of Indianapolis/Marion County, the team developed the Address Validation Web Service (AVWS), a SOAP-compliant web service that leverages the functionality of ArcGIS server and the ease of development in Visual Studio .Net.

The AVWS provides three methods of accessing the underlying geocoding services, all of which are restricted by user name and password.

- Simple Validation

  The first method, Simple Validation, validates an address when a user inputs address and zone. If a match is found, it returns the match in its standardized form and corrects any potential misspellings of the input address.

- Candidate Validation

  The second method, Candidate Validation, builds upon Simple Validation. However, if the AVWS receives an unmatched address, it returns a list of potential addresses or

candidates. Since the system assigns point values for the level of match, the user can set a minimum threshold and candidates with a lower match value will not be returned.

- Fallback Validation

  The third method, Fallback Validation, again builds upon the previous methods. However, it ranks the geocoding services in order of most precise to least precise. This gives the user the ability to select where to begin in the matching process — whether at the unit, building, parcel or street level. If the system does not find a match at the current level, the AVWS falls back to the next most precise geocoding service, continuing until it reaches the streets level geocoding service, the least precise. At the streets level, the system provides a listing of candidates, if any are available that exceed the match score.

When the AVWS is unable to match requests, generates errors or experiences performance problems, the system logs the information in a separate web service which system administrators can access to facilitate troubleshooting.

Perceived Benefits

So what benefits does this application provide? The single biggest benefit is that this web service makes it easier to integrate the MAD into other applications. This, in turn, ensures that applications using this service will be storing good, clean Marion County addresses, helping the City/County avoid data cleanup costs in the future. This clean address data will provide the basis for better maps and better decisions. And that means better, more efficient government operations.

Initial Use

The first use of the AVWS was for integration with the City's new Siebel Citizen Relationship Management (CRM) system, a front end for tracking citizen requests for service to any of several City of Indianapolis departments and Marion County agencies. The new CRM system is currently integrated with three systems used by four City Departments to manage their operations: the Animal Care and Control Division of the Department of Public Safety (DPS) uses one system to manage animal control; the Department of Metropolitan Development (DMD) uses a different system to manage permits and permit compliance; and the Department of Parks and Recreation (DPR) and the Department of Public Works (DPW) use a third system to manage their operations. The CRM feeds citizen requests to all three of these systems. Two of the systems (permitting and DPR/DPW operations) also make use of the MAD for addressing needs.

It's vital to have a valid address in order to deliver services to citizens who encounter problems.

In the old CRM system, with no address validation component, some 60 percent of the addresses that were input failed to conform to the standards of the MAD. These errors were due to misspelling of street names or missing and/or incorrect address components such as direction or street type. A great deal of work went into cleaning up the addresses found in the DPR/DPW database prior to integrating it with the MAD. The DPW and DPR decided that they would no longer accept and input invalid addresses for citizen requests. The solution was to integrate the CRM with the City/County MAD system. Since information received from citizens is sometimes inaccurate or incomplete and the Customer Service Representatives cannot be expected to memorize nearly 11,000 street names, the two departments hoped that the AVWS would solve their addressing problems. In fact, the address validation needs of the CRM system helped to define the functionality of the AVWS.

The CRM application went on-line June 21, 2004. In the first two days of use of the new system the percentage of addressing errors was reduced by 90%.

Additional Web Services Deployed

Point-In-Polygon Analysis

In addition to the AVWS the City/County has deployed another SOAP-compliant web service based on ArcGIS Server technology. This Point-In-Polygon analysis service is also consumed by the Seibel CRM system. A first phase of the service is currently in production and a second phase is under construction.

In the first phase, a static request is made to intersect a given address point — derived by geocoding the address — against a static listing of layers. The address submitted must have been validated by the AVWS. The service can intersect one or more polygons for a given layer and return data for both when polygons overlap.

The second phase for the service is an extension that will make the list of layers to be intersected dynamic. The user will pass the normal address information but supplement it with an XML string listing all the layers to be included in the results set. Users can learn of usable layers by querying the City's metadata server. In addition, calling applications will be able to specify a query that can be used to limit the results returned for a layer. For instance, the user may only be looking for the attendance boundaries for elementary schools for a given address, not all schools. By creating the where clause of a query, the user can be certain that undesired records are not returned. The second phase of the project will also allow input of xy coordinates so that the geocoding step may be skipped if an address has already been geocoded or a user has picked a location graphically off of a map.

Find Nearest Analysis

At the time that this paper was written, an additional SOAP-compliant web service was being developed to do "Find Nearest" analysis. Similar to the second phase of the Point-In-Polygon analysis, this service is designed to accept an address or xy coordinates and an XML string listing layers and fields to be returned. The service will return the requested attributes of the nearest feature within each of the specified layers. Rollout of this service is planned for late August, 2004.

Future Possibilities

The City/County is also discussing the possibility of using the AVWS with the new Case Management System being instituted statewide by the Indiana State Supreme Court. Currently this is limited by the fact that the City/County only has good address data for Marion County. We have also been discussing use of the MAD and the AVWS with the Marion County Health & Hospital Corporation, as they implement new information systems. As the City/County deploys new information systems, the intent is to make use of the AVWS wherever it makes sense. Because the CRM system is a very high profile project within the City/County, interest has already been generated to do this. Development of additional SOAP-compliant web services are also under consideration. These may include generation of mailing lists, geocoding, finding items within a radius of a given location, and generation of embedded maps for other applications.

Problems Encountered/Lessons Learned

Most of the development for this effort was undertaken using the beta and pre-release version of ArcGIS Server. While the risks inherent in this approach were recognized and accepted, they did end up causing problems. Development was complete prior to the production release of ArcGIS Server. When the production release was received, the application would not run without throwing errors. This was a design feature of the .NET environment intended to prevent hacking of code, based on Microsoft's assumption that if an application is compiled with a DLL that uses strong naming and the DLL is replaced by another DLL with the same name but different manifest information, then someone has replaced the original DLL with malicious code. To overcome this anti-hacking element, the team had to rebuild the application with the production version of the server software. Our first attempts to rebuild were unsuccessful, because references to the pre-release version of ArcGIS Server were retained within the application. We finally had to completely uninstall both the application and ArcGIS Server, then rebuild the application before it would compile cleanly. This is an issue that will need to be dealt with again when subsequent versions of ArcGIS Server are released.

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