

WEB-BASED DATABASE APPLICATION WITH ARCIMS

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Abstract

The Pebble Beach Community Services District's (District) new Web-based information systems allow users with different needs and backgrounds to access property and infrastructure data and GIS maps simultaneously on the same page through an intuitive and unique front-end. The new technology replaced the previous Access database and ArcGIS combination which was more costly and challenging to maintain and less flexible. After an intensive analysis of cutting-edge technologies, it was decided to move to Microsoft SQL server environment with MS Internet Information Server 6.0 by using .NET framework; and ArcIMS for the Web platform. The new system combined the data on the District's various functions in one intranet site giving the ability to find information with a fast, efficient and user-friendly interface. In addition, the new system does not require client-end maintenance, and staff can access the latest updated information and changes on the server by simply using any Internet browser.

Introduction

The Pebble Beach Community Services District is a local governmental agency which provides the following services to citizens, property owners and residents in Pebble Beach, California:

- Fire Protection and Emergency Medical
- Supplemental Law Enforcement
- Wastewater Collection and Treatment
- Solid Waste Collection and Disposal
- Reclaimed Water Storage and Distribution

The District covers an eight square mile area with an estimated population of 4,600. The population fluctuates throughout the week and usually the number of people increases considerably over weekends and holidays, due to visitors and returning part-time residents. Population further increases significantly during large special events such as the AT&T National Pro-Am golf tournament and the Concours d'Elegance, thus increasing the need for services provided by the District. The District owns and operates significant amount of infrastructure.

Over the years, the District has developed a database application to support its management and operations. The database includes information records on properties and property owners, including mailing addresses and other contact information, assessor's parcel information, fees collected for services, sewer permit records, sewer inspection records, information on house laterals, maintenance information on main sewer lines (the District owns 75 miles of wastewater lines which includes approximately 1700 segments), sewer manholes, property fire inspection records, maintenance and flow information on fire hydrants (there are approximately 350 fire hydrants within the District), property owners' special needs in case of a disaster and feedbacks received from residents regarding District services.

The database development originally started with Dbase IV format and then switched to Microsoft Access database in mid-1990s. In 1999, GIS feature was added to the database by using ESRI's ArcView 3.0. MS Access has successfully been integrated with Arcview, and provided seamless interaction between these two applications. Users could see the map of a property, locate a sewer line or a fire hydrant, and they were able to click on any feature on the map and the data would be changed automatically in the database page. Users then had to switch back to the Access application to review the data on a customized screen.

The application was working satisfactorily, but switching between two programs back and forth, and selecting menu items with a right mouse click were cumbersome. Most importantly, each time, when the new versions of Windows operating system, MS Access or Arcview was released, the application had to be revised, and new versions of the programs and application needed to be installed on each workstation (Fig. 1).

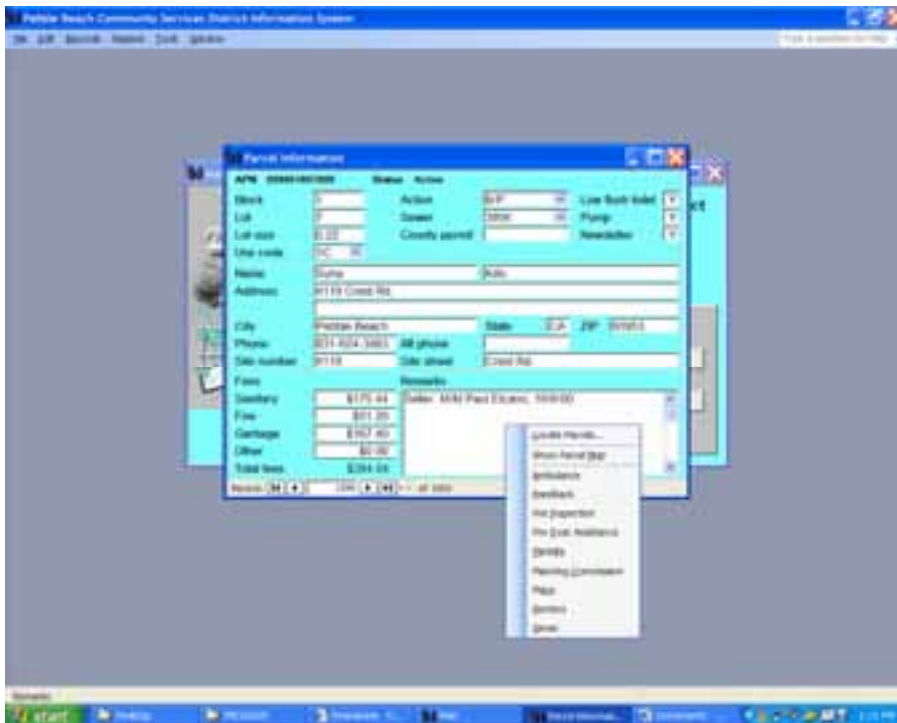


Figure 1: Property Information in MS Access format and right-click menu options

In late 2005, the District started considering a web-based alternative and using ArcIMS technology to eliminate the need for the updates and customization on the client workstations, and to develop a more intuitive interface as well as to improve programming flexibility for future expansion.

Methodology & Implementation

The new web-based database development gave the District an opportunity to re-think and review the database operations to improve the information systems and to access the data in a more user-friendly way by using the features of the new technologies. The development team and the staff had several meetings to analyze each feature of the original application and to develop efficiency improvements. The next step was creating screen mock-ups of the new system and having the staff review them and provide feedback on the design. After finalizing the design, the implementation phase started with the development team and the key staff members holding monthly meetings to refine the system. Finally, a three-month beta testing stage was implemented before the system was placed into use.

The District's Web-based Database System was implemented as a web application running on the Microsoft .NET framework. It uses a SQL Server database as a repository of information and builds web pages dynamically using Microsoft ASP.NET and AJAX framework. In addition to tabular information, the system also presents maps showing property locations, fire hydrants, sewer lines, manholes, topography and other infrastructure provided by an ESRI's ArcIMS server.

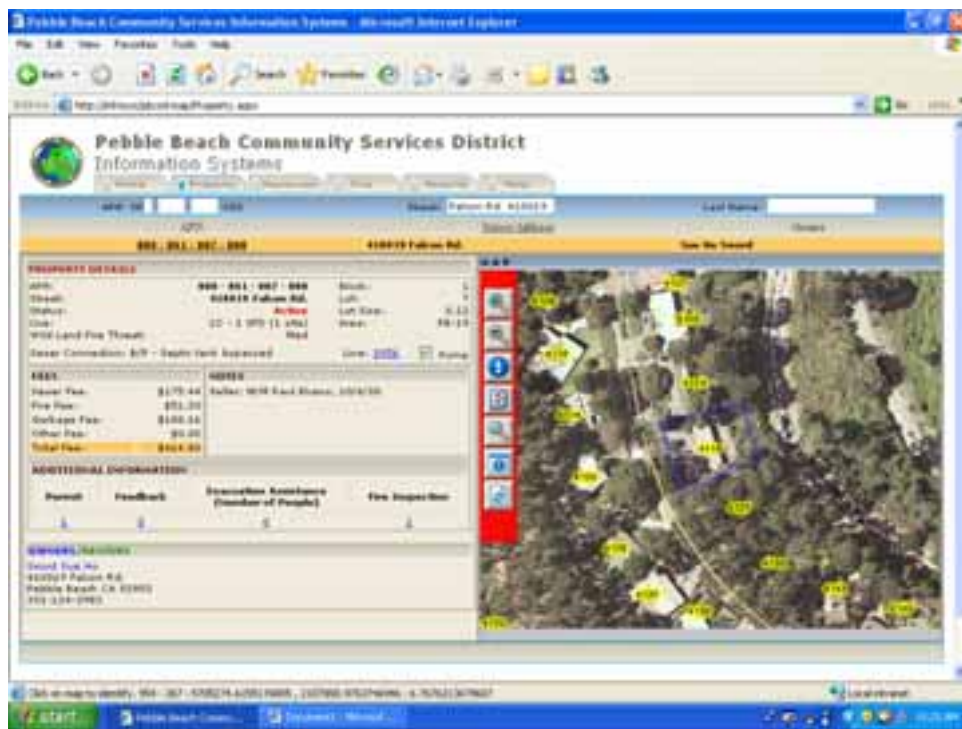


Figure 2: Property information page with aerial map and some extra layers turned ON

The District purchased a dedicated Windows 2003 server to host the new database (which is also used as the District's Intranet server) and ArcIMS software. Since IIS 6.0 comes with the Windows 2003 server, and ASP.NET AJAX and SQL Server 2005 Express Edition is available for free download (for the databases smaller than 4 Gb), the District did not have to purchase additional Microsoft products.

The system integrates with ArcIMS using web service on the server side and through a Javascript and HTML (AJAX map control) on the client side developed by Nobel Systems Inc. of San Bernardino, California. Nobel Systems Map Control is an AJAX Control. This control communicates to a Web Service which in turn communicates with ArcIMS Server using ArcXML commands. This approach was selected to avoid the whole page refresh and have only the Map to be refreshed as required. The web page passes the map control a key field to be used in queries run on the ArcIMS server. After the map is drawn, users have the ability to pan and zoom with no interference in other areas of the page. Users also have the ability to select other properties on the map. The web page then issues another query to the database and reloads the page. In order to accomplish this, the map control was extended to trap the response from ArcIMS. The system extracts the new key from the response and builds a new database query (Fig. 2, Fig. 3).

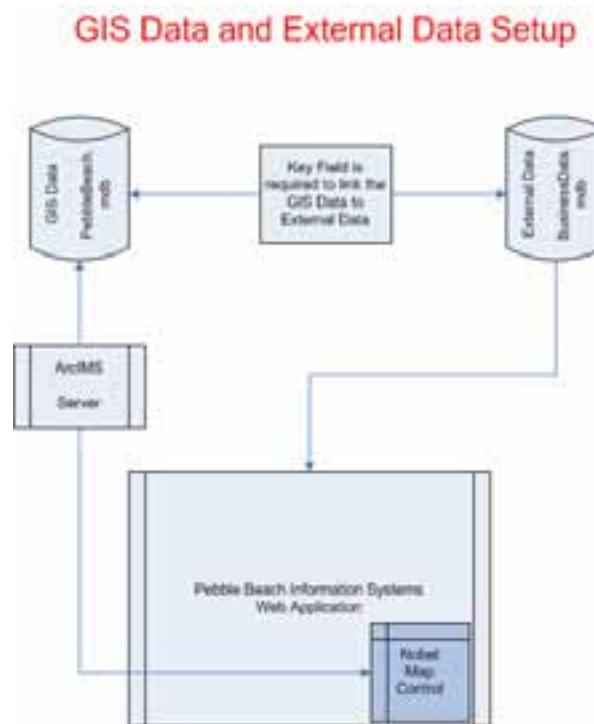


Figure 3: GIS Data and External Data Setup

The challenge was to transmit the client side parameter to the server and then to get it back and parse at client end and display to the user. The XML transactions have been used which made the parsing easier. The data can be a Personal Geodatabase or ESRI Shapefiles. The ArcIMS Service can be a Regular Image Service or ArcMAP Image Service. The Web Service will generate different ArcXML commands based on the type of Image Service used.

The current system has the following basic Map Functions:

1. Zoom In.
2. Zoom Out.
3. Identify.
4. Layers Turn On/Off.
5. Zoom to Full Extent.
6. Show Layers Legend.

Also the user can press the “Alt” key and draw a box using the mouse to Zoom In. This control can be used as a Plug-in to any Website. The District uses this control in the Management Web site. This control can be extended to add more functionalities and even link with external database. This control can also perform a query and zoom to that specific GIS Feature. The system uses these features so the map can be zoomed to the right location. JavaScript and DHTML are extensively used at the client end, and .NET Web Service and ArcXML are used on the server side.

Database user security is provided by Windows authentication so only users with the proper credentials have access to the system. Users with “administrator” rights can perform maintenance and updates right on the page being viewed, without having to leave the application.

Web-Based System Made Life Easy

The newly developed web-based database system substantially improved the efficiency of the staff, with its intuitive user interface, and easy-to use features. It doesn’t require extensive training. In addition, users can use their favorite internet browsers to access the database without going through another user authentication, since the database uses Windows authentication.

The system allows users to locate a property record by the owner’s last name, site address or the assessor’s parcel number (APN). Once a record is located, general information on the property as well as the sewer line number which the property is connected to, number of sewer permits issued to the property, calls/comments received from residents of the property, fire inspections, and, the property map are displayed simultaneously. The authorized staff can view and print the information easily. Other information related to the property can be accessed or modified by point and click or intuitive drop down menus. As the users type a request, the drop-down lists provide the possible choices eliminating potential typing errors. The dynamic exchange between .NET and ArcIMS allows a map of the property to appear on the screen simultaneously which allows the user to turn various layers, including building footprints, topography or aerial photos, as needed. Reciprocally, selection of any attribute on the maps simultaneously reloads the data from the database and updates the information on the page. This feature allows the users to access the information either through the maps or .NET search engines of their choice (Fig. 4).

The database system also includes information about sewer lines and manholes (which are also on separate layers on the map), and allows the maintenance personnel enter maintenance and Television inspection records. The users have the ability to generate status and maintenance

reports during time periods of their choice. This helps the District management and engineering staff to prioritize wastewater line or manhole replacement projects. (Fig. 5)



Figure 4: Property page

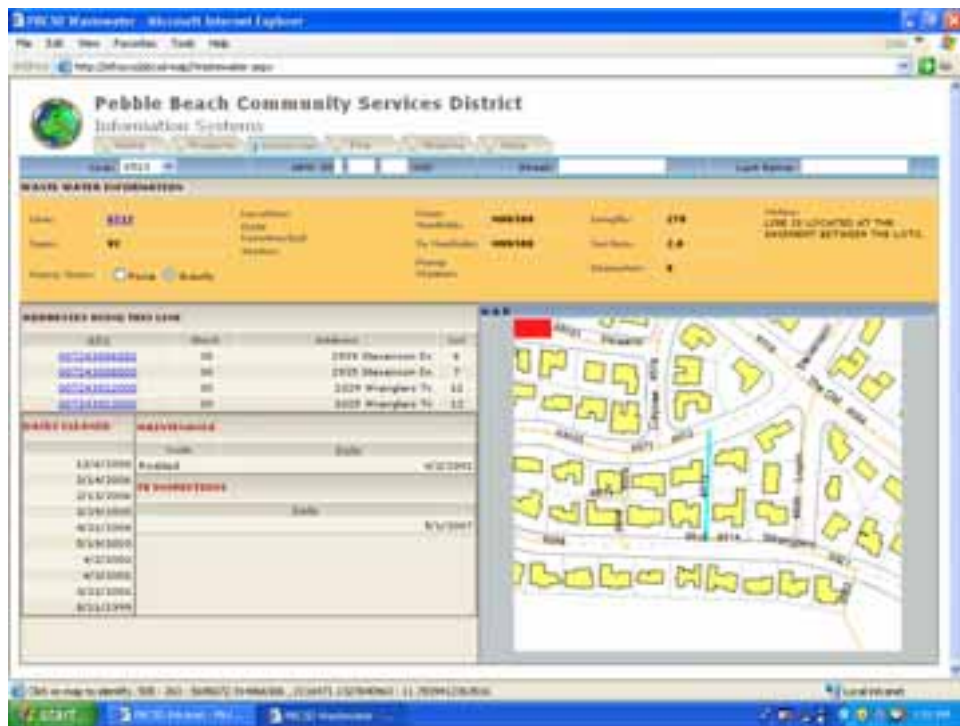


Figure 5: Wastewater maintenance and monitoring page, showing a selected sewer line

The District Fire department staff currently uses the database to record fire inspections, evacuation assistance requests and fire hydrant maintenance. The system allows generation of various customized reports (Fig. 6)

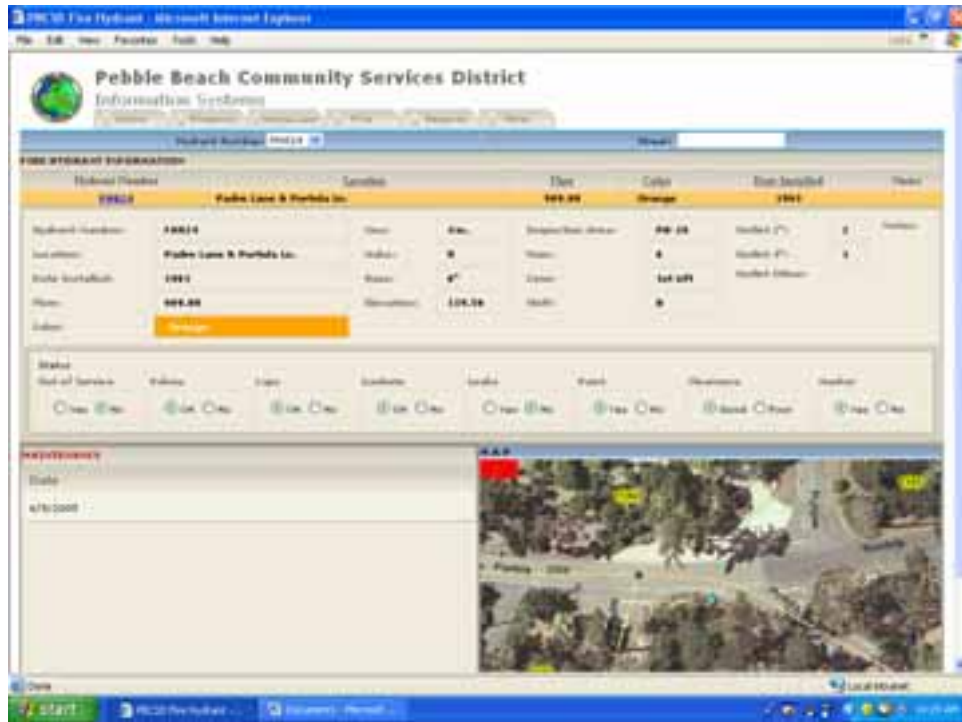


Figure 6: Fire Hydrant maintenance and inspection page

Conclusion

The new web-based database application helps the District staff to more efficiently perform their daily operational and maintenance tasks, and allows the management to easily access to the information used in planning and decision making. The system is fast and user-friendly thus well-accepted by the users. The integrated web technology and ArcIMS has the potential to better automate other tasks and make them part of the current information systems. In the near future, the District has plans to allow the database to be remotely accessed over the Internet widening the potential uses of the new system.

Acknowledgments

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