Development of a Crime Mapping System Using .NET and ArcIMS

Chris Gao, GIS and Mapping Branch
Dave Cook, Police Department
Fairfax County Government, Fairfax, VA 22035

Introduction

The Fairfax Crime Mapping Web site is a joint venture between GIS division and police department at Fairfax County, Virginia. It focuses on several primary goals:

- Providing general information about police service for an area based upon the user entering a specific address
- Providing crime information about a specific area based upon criteria defined by the user
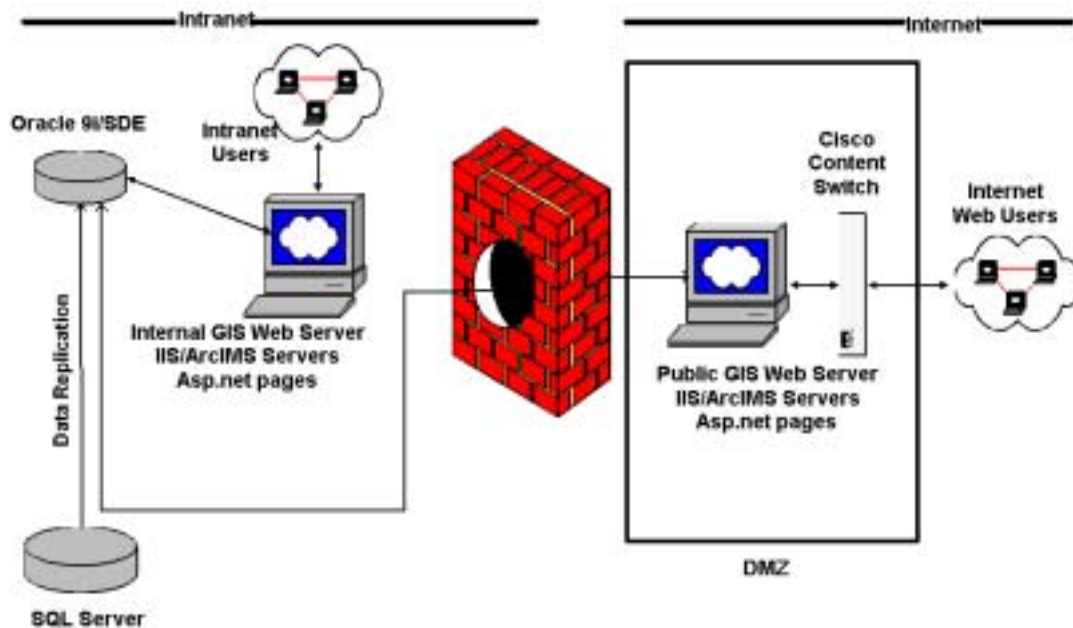- Providing general County-wide crime statistics and information

The purpose of the site is to:

- Increase awareness- an interactive, user-driven site would allow for the public to be more informed about crime in a particular area. It would also allow the public to be more aware about what is being done to address crime and traffic issues.
- Increase participation- an interactive, user-driven site could spark public support and activity to resolve issues or problems.
- Increase efficiency- a majority of the information listed in the goals is currently being provided by the Crime Analysis Unit. While important, this hampers the Unit's overall analytic function. An internet site is an ideal means to reduce this burden for the Crime Analysis Unit.

This web site is developed with Microsoft asp.net and ArcIMS 4.0.1 and coded in VB.net.

Application Architecture

This mapping system has a three-tiered architecture. Inside the county enterprise firewall, a Microsoft SQL Server database stores the crime incident data tables. An Oracle 9i/SDE server stores the geographically enabled crime incident data replicated from SQL Server db and other base map and reference data layers. For the intranet version of this system, a windows 2000 server machine which is also located inside the firewall hosts both an IIS web server and an ArcIMS server. For the internet version, a windows 2000 server machine outside firewall in the DMZ hosts the IIS web server and the ArcIMS server. This server machine is also connected to a Cisco Content Switch.

Back End – The Data Preparation

The SQL server database server is the main database that stores the crime incidents data. However, in order to be used by an ArcIMS application, the data must be spatially enabled and stored in a database server with the SDE extension. GIS division's SDE database server is an Oracle 9i server so the data must be transferred from Police Department's SQL server to GIS's Oracle server. In addition, this data must be geographically enabled. Currently there are around one million rows for the crime incidents data. Five separate tables are created to store different types of crime incidents so the satisfactory query performance can be maintained.

• The first geocoding batch processing

Initially, the crime data was downloaded to a PC's hard drive and geocoded using ArcMap's geocoding engine. Then the geocoded data with x and y coordinates data is manually uploaded to Oracle database. An ArcObject program is used to create points for the x, y coordinates in the correct projection system – NAD 1983 State Plane Virginia North FIPS 4501 (Feet) and insert these points into a feature class. This feature class also has all the attribute columns required for the reporting tool of the system.

• Daily data replication

Everyday, new incidents data will be inserted into tables in SQL server database. A trigger and a SQL server table will be created on SQL server database. The newly inserted data will be also copied to this table by this trigger. Every night, data from this table will be replicated to Oracle using SQL Server's linked server tool. Then an Arcobject program will create points for this new data and inserts these points to the feature class. A much simplified scenario is assumed here: There are very rare occasions that updating and deleting of incident records will happen so these situations can be ignored. So only new data is replicated and inserted into feature class.
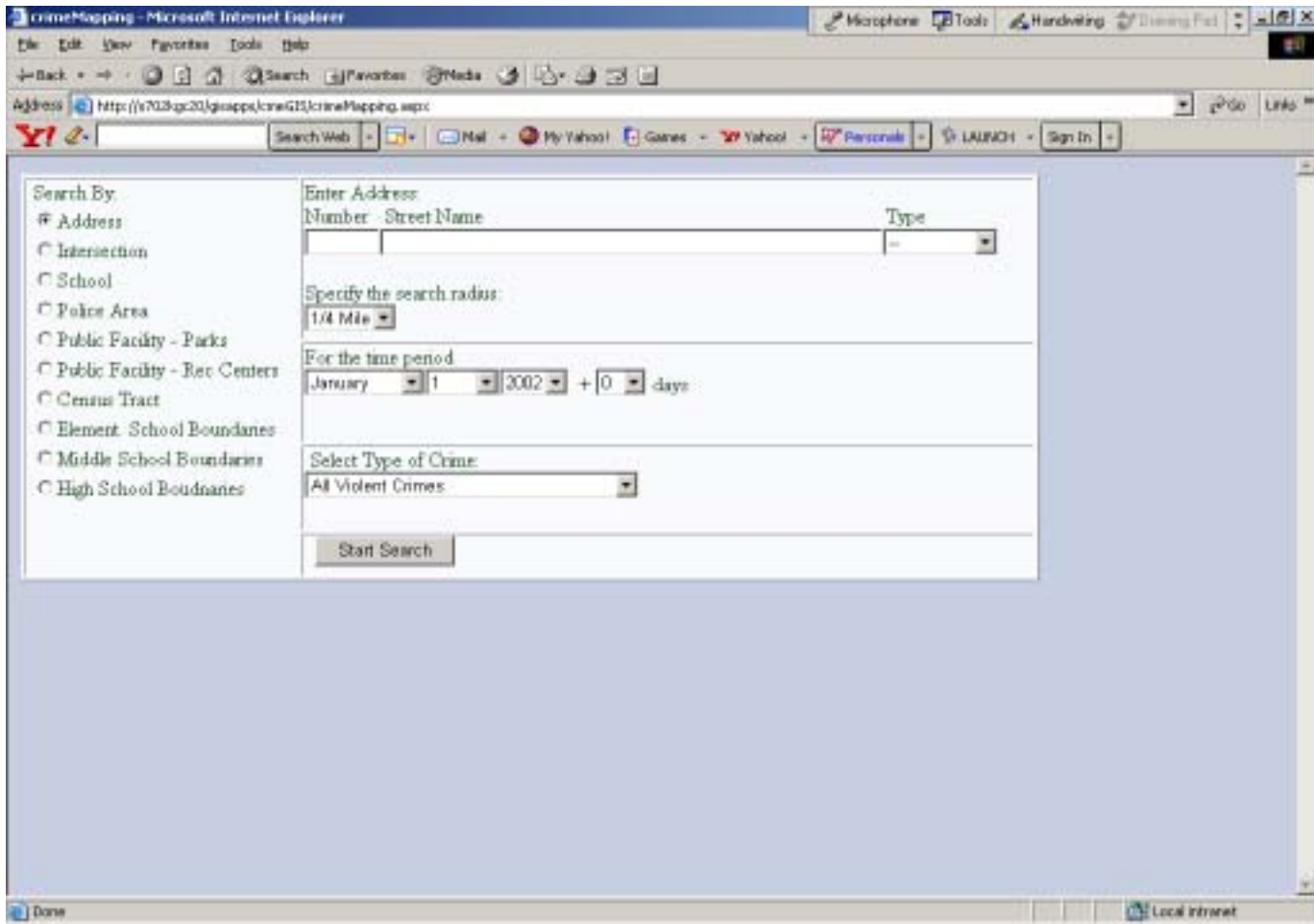
• Other geographical reference data layers

The Oracle SDE database also stores all the necessary reference map layers such as regional jurisdiction boundary layer, supervisor district layer, major road layer, street centerline layer, etc.

Front end – The User Interface

The Main Fairfax Crime Mapping Page incorporates a query interface and interactive mapping. The query interface and the criteria specified by the user determine the mapping results.

• The Query Interface

The query interface is broken down into several parts

- Search by (radio button):

    - Address
    - Street Intersection
    - School
    - Police Area (District Station)
    - Public Facility – Parks
    - Public Facility – Recreation Centers
    - Census Tract
    - Elementary School Attendance Boundaries
    - Middle School Attendance Boundaries
    - High School Attendance Boundaries

    All the choices are implemented using one radio button list control. The "AutoPostBack" property of this control is enabled so when users click one choice, this query interface page is reloaded with a drop down list containing

data related to that choice, which is retrieved from the database. In the case of address and intersection search choices, no drop down list is provided. A free text box is provided instead.
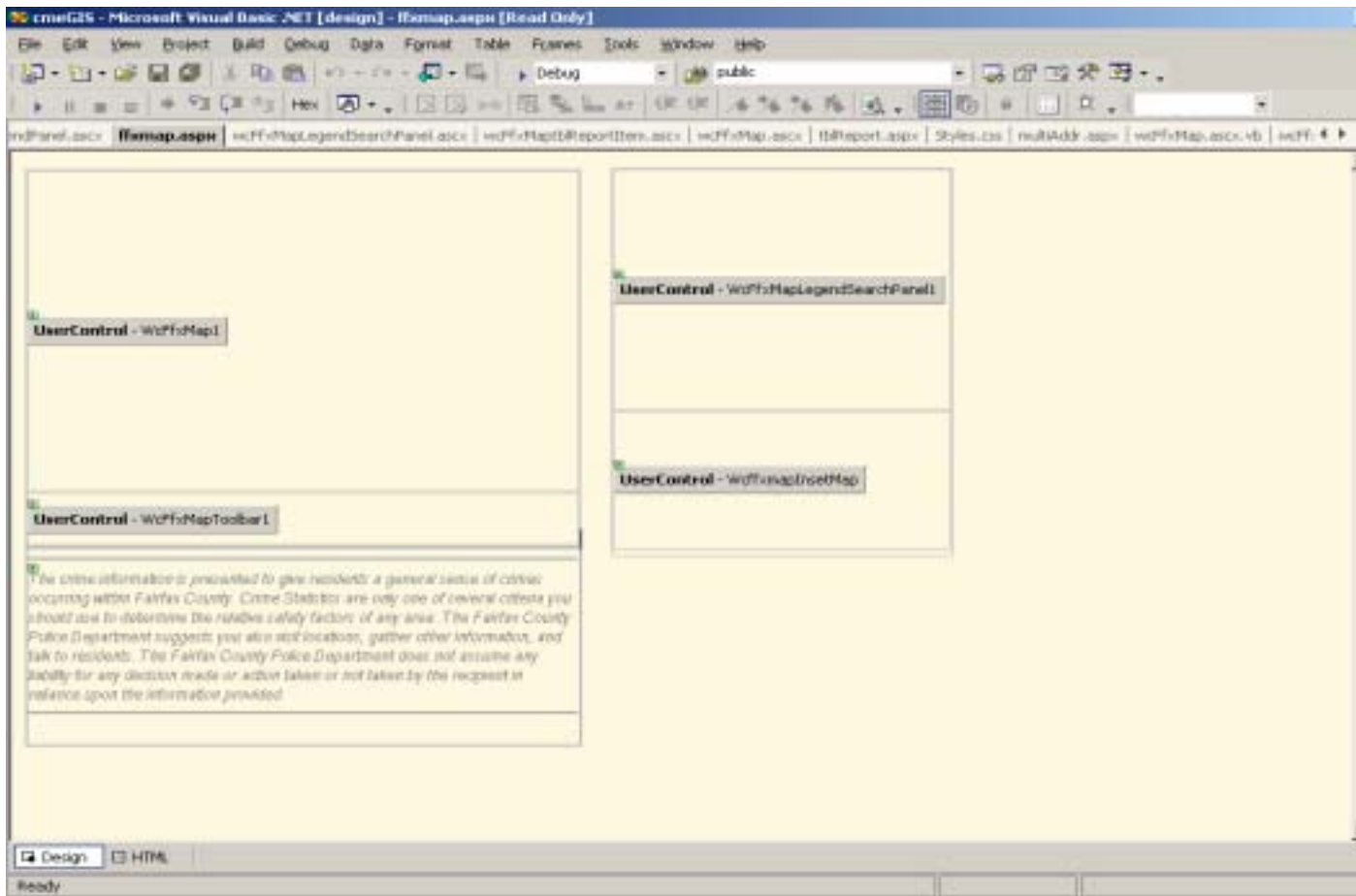
The user will specify the search radius- ¼ mile, ½ mile or 1 mile. The search radius will select all the incidents that have occurred within that area.

- For the time frame
    - Date Range
    - Month
    - Year

- Crime Type
    - All Crimes
    - Violent Crimes (with separate categories for Murder, Rape, Robbery and Aggravated Assault)
    - Property Crimes (with separate categories for Burglary, Larceny and Auto Theft)
    - Quality of Life Issues (including Tamperings, Vandalisms and Destructions, Disorderly Conduct and Peepings/Indecent Exposures)
    - Traffic Violations
    - Police Services
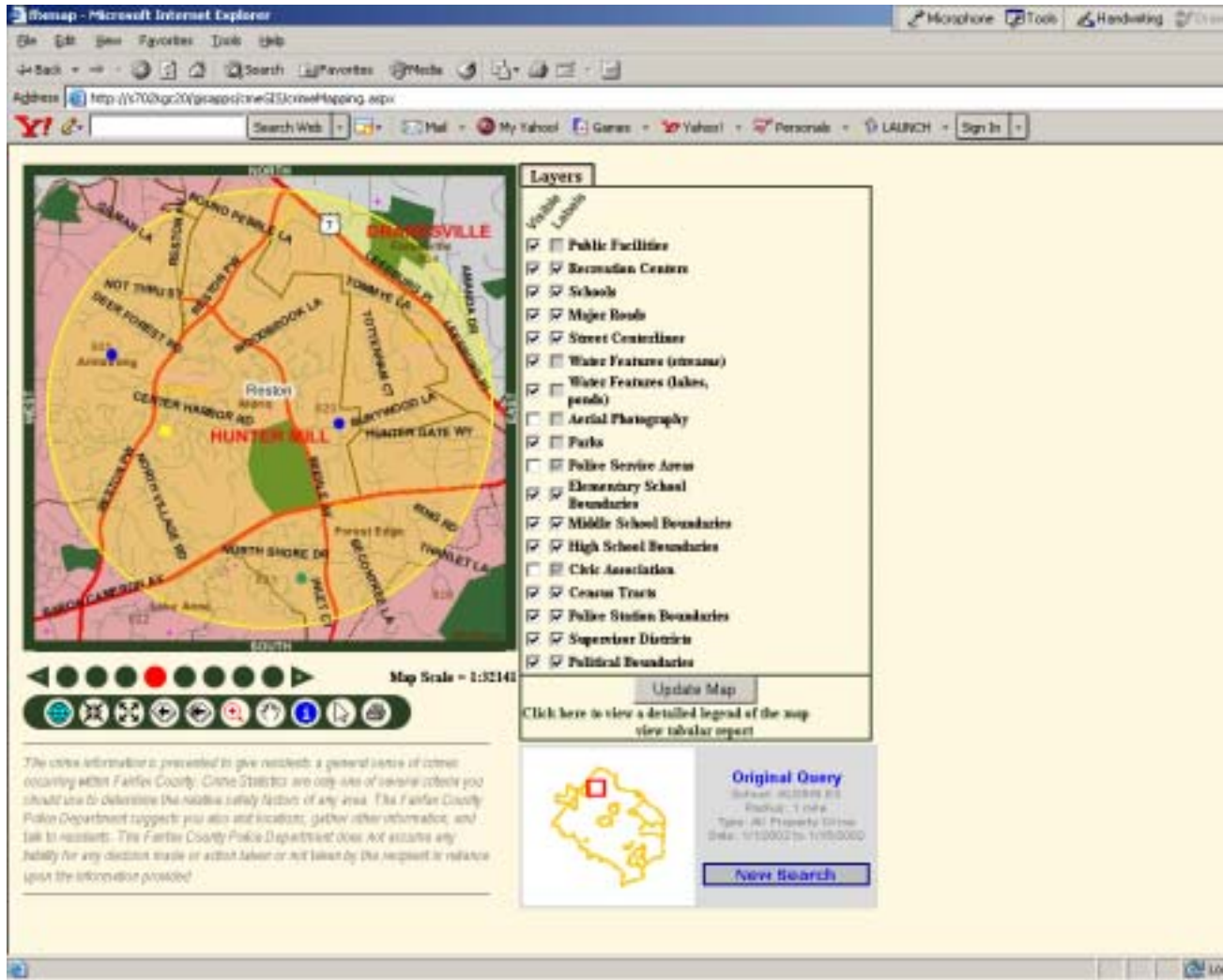   - Other Crime/Incident Types

• Interactive Mapping

One major feature of this mapping system is to utilize .net web user controls to effectively code many map presenting and spatial analysis functions. ffxmap.aspx page is a standard aspx page and it is the core hosting page. It contains several user control pages (.ascx pages). Some user control pages have place holders and child web user control pages are dynamically loaded at runtime. WcFfxMap1 user control is the major control. It has all the core mapping and spatial analysis functions. This control determines which type of spatial/mapping action the program will perform, gets the mapping window extent, creates the ArcXML request, submits the request to the ArcIMS server, gets the response from ArcIMS server, and retrieves the final map image from the response.

No ArcIMS .net connector existed when this application was initially developed. This mapping system is using a thirty-party developed function, which creates a socket connection to the ArcIMS server, submits and retrieves requests and responses in xml format to and from the ArcIMS server.

Mapping tools:

- Map Quest style zoom bar
- Pan
- Zoom In and Zoom Out
- Identify
- Last View
- Original View
- Select Area (click and drag to select a subset of data)
- Inset Map Window (identifying where one is looking in relation to the entire County)
- Map Scale
- Print
- Identify with Report
  If a user clicks on a specific incident, a new browser window is brought up with a report generated off that incident indicating both what the original query was and what the new query (the specific incident) is.

- Layer Control. A user is given the ability to add in specific layers, turn on/off labels.

Also a disclaimer is displaced on every mapping page.

The Fairfax county crime mapping system is still being developed and tested. Some new features such as the hot link for the crime incidents are planned to be added in the next deployment. Many efforts are being made to tune the performance of the backend database and to improve the front end .net coding.