

AN EMBEDDED GOOGLE EARTH/MAPS APPLICATION ON REAL ESTATE DATABASE INQUIRY AND DISPLAY

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ABSTRACT:

Most of the real estate brokerage sites are aware of utilizes Internet as form of media for publicity however; the contents are limited to specific property itself and the functions of query are mostly just provided searching by condition. This paper proposes a query interface on website which gives function of query by condition and query by zone. The zones were generated by performing an overlay analysis over many of raster layers, for instance, the price, proximity to the park, and to the market, etc. The approach of overlay analysis is developing an user-friendly interface with ESRI ArcObject in Visual Basic, especially for non-GIS users. The inquiry results can be shown on the web page which Google Earth COM API and Google Maps API embedded in it. Therefore, the website shows the query results in a webpage with two-dimensional of Google Maps and three-dimensional of Google Earth styles. In addition, the display of inquiry results will give the multimedia present way which includes the Virtual Reality scene of house, panorama of interior of building and so on.

1. INTRODUCTION

Since real estate is an asset, as depicted in the adage "The land represents the property," the inherent traditional concept, as well as the government, has been under the land-tax system for quite some time. This is because real estate has long been a popular prime-assets investment. But, since "the information is asymmetrical" in the real estate market--namely because realtors have very specialized knowledge--the purchasers don't have enough information to make informed decisions.

There are essentially three aspects in the concept of real estate (Henry Assael, 1984; Burnkrant, R. E. & Alain, C., 1975). First is the house's natural quality, such as the number of floors, house price, general location and so on. Next is the location, a detailed location such as the address. Last is the property information of house, for example, owner, creditor and so on. In addition it may also include transportation, geographic situation, local school districts and other vital information. According to the housing search, decision-making of the purchasing procedure generally is decided based on the type, (town house, apartment or rookery) including the facade, the indoor space (for example, number of rooms), the location (for example urban district or suburb) as well as the quality (for example, building age, bathroom, kitchen equipment, air conditioning and other factors) along with various other qualifications deemed fit by any of the parties involved.

Although actually going to the property in question and seeing it first-hand is the only true way of examining it, occasionally when speaking of the not-so-brand-new house, the following questions may arise. First, the potential buyer may be unable to go to and inspect each house in which they are interested. Next, if there are current inhabitants, the two parties must be in contact to arrive at a mutually agreeable time for inspection. Therefore, before looking at the property, it is important to get

all pertinent information possible. Not only this beneficial for the real estate agent as they can provide the sellers with the most information, thereby solidifying the interest of the buyer, but may also save time and the cost of manpower if something is out of place.

The brokers in the intermediary housing market have provided well-designed videos or service on their website which is aimed at the demand of their potential consumers. Regarding the indoor arrangement, the brokers provide vivid views that combined 360 degree panoramic photographs from continual pictures by way of specialized software on their website (SinYi Realty, 2008; YungChin Realty, 2008). But occasionally the information of the location, environment or surrounding services (for example, the proximity local hospitals, schools and transportation stations) on the website is restricted to short bits of text, two-dimensional maps, and façade pictures. They also sometimes lack satellite images. Overall the brokers have greatly improved the space and content available on websites.

The method of using GIS has already been transformed from early data graphical displays into the module analysis. Therefore, the ability to choose the zone of the real estate by spatial analysis has already become a tendency of the application. For non-GIS specialized customers, they can also apply the function of GIS when they choose the real estate zone. The method of Component Object Model (COM) was adopted in this article. Although users can choose either ArcObject or MapObject, the latter has a more limited function. For example, it cannot be used with MS Access databases. If we are working with geodatabases, we obviously are using ArcGIS. Because ArcGIS is developed based on the ArcObject system, the ArcGIS users still prefer to use ArcObject as their first choice. Moreover, ArcObject cannot function well once it is separated from ArcGIS. ArcObject only functions on a computer on which the ArcGIS system is installed (ESRI, 2005). Therefore,

the inquiry function of spatial analysis was also relatively restricted in this article.

This article takes the real estate information as data processed from National Taipei University. The interface is established on inquiry of traditional conditions and inquiry with GIS application of spatial analysis by ASP. This function of GIS applications of spatial analysis was based on Visual Basic 6.0 and ArcObject. There are many users who are not GIS professionals. To provide spatial solutions by developing a user-friendly platform with spatial analysis to non-GIS users is worthwhile. The inquiry results could be shown on a website that was designed with embedded Google Maps API on it. The result of inquiry may be indicated on maps, and one may further inquire about each related bit of information, as well as view additional images; for example, panorama of interior of the house, virtual realty, pictures of the façade and so on. In addition, the demonstration of inquiry result may hyperlink to Google earth and see three-dimensional representations of the all around environment, and verify that each vital service (for example the MRT station, parks, markets, schools and financial organizations and so on). The research methodology was shown in Figure 1

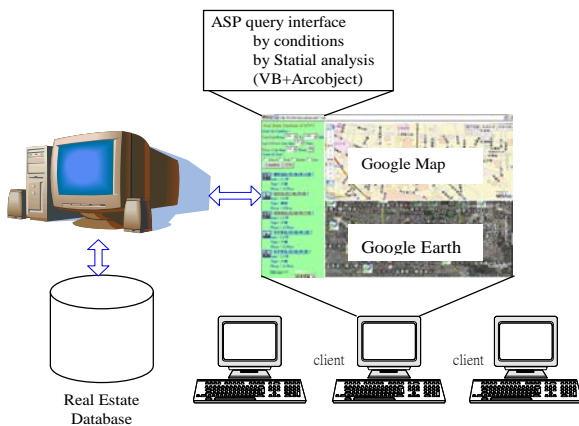


Figure 1. The research methodology

2. PAPER REVIEW

Google Corporation promotes many free tools it has on the Internet. One is Google Maps, a free interactive mapping and visualization service providing direct access to zoom-able maps or satellite views of the entire planet. Google Maps and Google Earth have a widespread application potential. This allows the user to use global maps and to develop an application system integrated with self-made data. Because the application demand increases, there is more map service providers that become involved and release their API for free. They are Yahoo!Maps (Yahoo! Map, 2007) and MSN Windows Live Local (MSN, 2008). Google Maps is the most often used among them in Taiwan. Google Maps is probably the best-known Ajax application. Functionally, it offers some great advances over conventional map websites. The user can pan and zoom and change location without the page being reloaded. After the API

is released, it is possible that GIS is integrated with website for local service use (Garrett, J. J., 2005).

Because map data and development platform of websites are available, electronic maps may be carried on integrated applications with other domains industries. For instance, Google Maps has joined with Craigslist's real estate listings to create a tool that lets people find housing simply by looking at a map in America (Housingmaps, 2008). A Colorado search engine gives the ability to search property listings in Metro Denver, Boulder and Northern Colorado (Coloradofuture, 2007). The search engine provides a description of each house for sale, including photos, virtual tours, and satellite images. HousingRadar aims to provide house hunters with a convenient tool to search for available houses in desired areas (Housingradar, 2008). Trulia search engine provides real estate information at the local level to help users make better decisions in the process (Trulia, 2008). With all of them, the searches just focus on the USA and only provide conditional queries. In Taiwan, the computer center GIS team at Academia Sinica also aimed at Google Maps and Google Earth and has completed some tests (Sinica, 2008). They also show some applications and provide tools to use. Eemap (Eemap, 2007) in China shows many main buildings or spots with Google Maps for browsing. But, it just has with satellite imagery without the electric map of street while the Ditu (Ditu, 2007), has the opposite.

3. THEORY

3.1 ArjObject

ArcGIS is constructed by a COM that is based on ArcObject module. Using this module we can develop corresponding professional GIS functions. According to ESRI ArcView 8 documentation, developers can also create extensions for ArcView 8 using ArcObjects in standard development environments such as Visual Basic, C++, or Delphi. ArcObjects is the development platform for the ArcGIS family of applications, such as ArcMap, ArcCatalog, and ArcScene (ESRI, 2005).

ArcGIS above the 8.x version has discarded the procedure of need moreover to study avenue script in 3.x version and just developing with ArcObject in VBA or VB instead. Compared to the avenue's dozens of objects to say, ArcObjects has provided over 1,000 useful functions. The user can easily develop an application with VBA or VB for custom specific domain purposes.

To effectively use ArcObjects, the developer has to be familiar with the COM and with knowledge of reading Object Model Diagrams (OMDs) for programming with interfaces and COM classes. For example, utilizing Union between two layers in ArcObject is included in the function of IBasicGeoprocessor which provides access to the methods and properties of the BasicGeoprocessor object (ESRI, 2005; Huang, 2003). The usage was shown as below:

```
Dim pBasicGeoprocessor As IbasicGeoprocessor
Set pBasicGeoprocessor=New BasicGeoprocessor
Dim pUnionFeatureClass As IFeatureClass
Set UnionFeatureClass=pBasicGeoprocessor.Union (pTable1, False, pTable2, False, 1 ,pFeatureClassName)
```

In addition, when utilizing the `IBasicGeoprocessor.Union` method, there are some parameters that need to be followed. These values of parameter, for example, `pTable1`, `pTable2` and `FeatureClassName`, are also obtained through the Interface. The usage was shown as below:

```
Dim pTable1 As Itable
Dim pTable2 As Itable
Dim pFeatureClassName As IFeatureClassName
Set pTable1=pFeatureClass1
Set pTable2=pFeatureClass2
Set pFeatureClassName=pDataset.FullNam
```

Most developers use Visual Basic to create a COM component that works with ArcMap. In Visual Basic we can develop functions of spatial analysis and then build a COM component that will work with ArcMap by creating an ActiveX DLL and then call those same functions from ASP Scripts. To access "ArcObjects" we must have ArcGIS installed on our computer. Although, we are developing an application, to run that application the computer must have ArcGIS installed on the hard drive and a valid license for ArcGIS. In the case of application on real estate, to provide spatial solutions by developing a user-friendly platform with spatial analysis to non-GIS users is worthwhile.

3.2 Active Server Page, ASP

The ASP provides an environment for server to execute the script. The ASP may combine with the HTML, the ASP instruction, Script, CGI and the Active X part to produce dynamic, interactive, and high efficiency website server applications. The application development by ASP may be easily developed and then revised. For the purpose of running Windows and playing around with ASP on our own system we will need to install Microsoft's Internet Information Services (IIS). ASP pages have the extension .asp instead of .htm, when a web page with the extension .asp is requested by a browser the web server knows to interpret any ASP contained within the web page before sending the HTML produced to the browser. This way, all the ASP is run on the web server and no ASP will ever be passed to the web browser.

There are limitations on using ASP. According to network safety consideration, the ASP does not allow to call the out-process objects or program, and therefore many of ActiveX objects built in VB were unable to be used on the ASP web pages. So, many of basic functions have to be newly developed. ASP cannot call out-process program, meaning that it is unable to use the executable files which had already developed. In order to overcome the limitation of ASP and to integrate the query function with the ASP web pages, the program based on VB with ArcObject will be compiled into DLL file format in this article.

3.3 Google Maps

In Google Maps, the user can pan, zoom, and drag without the page being reloaded. After the API is released, it is possible that integrated maps with websites for specific service and developed utilize interface with it (Google Maps, 2008). To use Google Maps API you only need a document editor and web server, for instance IIS. Because the operation process must alternately communicate with the Google Maps server, the website server must be a public permanent address server. The Google Maps API allows us to embed Google Maps in our own

web pages. A single Maps API key is valid for a single "directory" on our web server, so if we sign up for the URL `http://www.mygooglemaps.com/mysite`, the key we get will be good for all URLs in the `http://www.mygooglemaps.com/mysite/directory`.

Using Google Maps for map display is extremely simple, you only need several lines of code including the key you got when you signed up for the API, then save as HTML web pages or ASP file format. After that, the web pages have to be uploaded to our own web server. The URL of "http://maps.google.com/maps?file=api&v=2" is the location of a JavaScript file that includes all of the symbols we need to place Google Maps on our pages. Our pages must contain a script tag pointing to that URL, using the key we got when we signed up for the API. The coastline of north part of Taiwan would be shown on the browser if the coordinates of Taipei were assigned to the Google Maps API. The map control of zoom, pan, and tilt is easy to operate. We just need to click and drag by mouse on the map.

All the imagery shown in Google's satellite maps are at least a year old and in some places date back to 2001. The GIS data used in Google Maps is provided by Tele Atlas and NAVTEQ, while the small patches of high-resolution, from 1 to 0.6 meters, satellite imagery are largely provided by DigitalGlobe and its QuickBird satellite, with some imagery also from government sources. The main global imagery base called NaturalVue was derived from Landsat 7, with 15 meters ground resolution, imagery by MDA Federal.

3.4 Google Earth

Google Earth is a virtual globe program that was originally called Earth Viewer and was created by Keyhole Inc. It maps the earth by the superimposition of images obtained from satellite imagery, aerial photography and GIS over a 3D globe. The free edition namely has provided satellite of image the world and each place has a different rank. The degree of resolution available is based somewhat on the points of interest, but most land is covered in at least 15 meters of resolution. Las Vegas, Nevada and Cambridge, Massachusetts include examples of the highest resolution, at 15 cm. The Layers feature in Google Earth provides a variety of data points of geographic interest that you can select to display over your viewing area. We can use KML (Keyhole Markup Language) to add custom layers and share places and information with other users of Google Earth and Google Maps (Google Earth, 2008). KML is an XML grammar and file format for modeling and storing geographic features such as points, lines, images, polygons, and models for display in Google Earth.

4. EXPERIMENT DATA

The dataset in this article is the real estate database processed from National Taipei University in 2003. There are seven sub-databases, and the title and content of sub-databases are shown as Table 1. Because the Court Auction House in Taipei kept more detailed information and has a high successive percentage of geocoding by address, the sub-database of Court Auction House is used in this article.

The real estate location in the database needs geocoding, the process of converting addresses into geographic coordinates of

lat/long, for Google Maps display. We investigated and collected related images of houses in addition to enriching the real estate information content. In this article, these collected data included facade of house, interior room arrangement, public facility, and function for daily life, etc. All of these data have to be further processed. The full path and file name of house photos needs to be built in real estate database for display after query. These photos of interior arrangement of room were processed in panorama style by Photo Vista and Virtual Realty files by Photomodeler Pro 5 (Eos, 2004). Public facility and function for daily living was transferred into KML file format and loaded into Google Earth as one of layers.

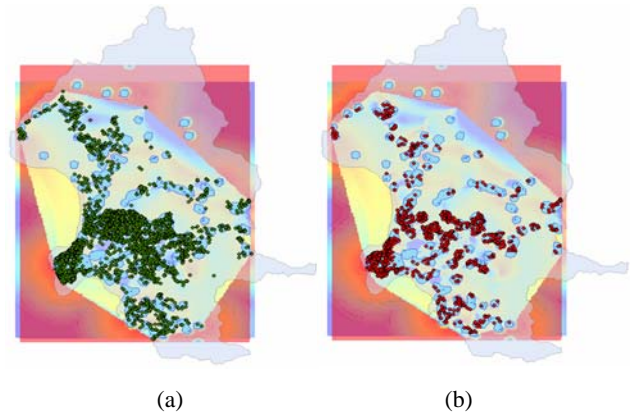


Figure 2. (a) Shows the results before overlay processing between zone and house for sale; (b) shows the results after overlay processing.

Sub-Database	Quantity	Region of Collection	Collection Period
Public land	About 5200	Taipei, Taichung and Kaohsiung City	Since 1993
Readily available house	About 32000	Taipei City and Taipei County	Since 1993
Presale house	About 2500	Taipei City and Taipei County	Since 1993
House for rent	About 3500	Taipei and Kaohsiung City	Since 1993
Court Auction House	About 22000	Taiwan	Since 2000
Office for rent	About 6500	Taipei City	Since 1993
Valuation of Real Estate	About 23000	Taiwan	Since 1998

Table 1. Contents of real estate database

5. RESULTS AND ANALYSIS

5.1 The query interface

There are three sections of web pages developed by ASP on this site. On the top of the web page with query function are two types of query, one is query by conditions, for instance, the price, floors, etc., and the other is query by zone, for instance, near to the park, the zone with far more schools, etc. The bottom-left page shows the results of query by listing five items per page. The demonstration inquiry results contain a smaller sized picture of the house, which got the file name from database, address, area, the highest number of floors, etc. Clicking on the smaller picture, a panorama of the inside of the house would be shown in a new window. Clicking on the address item, many of parameters would be passed to the bottom-right page, which was embedded with Google Maps API and then placed a mark on the map. Clicking on the mark will get more information about the house, including extra photos of the house, the price, etc. The polygon in figure 2 shows zone of spatial analysis of school, park, market, and price layers. The point features show the data of real estate for sale in Taipei. Figure 2(a) shows the results before overlay processing between zone and house for sale while Figure 2(b) shows the results after overlay processing. The query of result display on Google Maps was shown as Figure 3 was shown the query of result display on Google Maps.

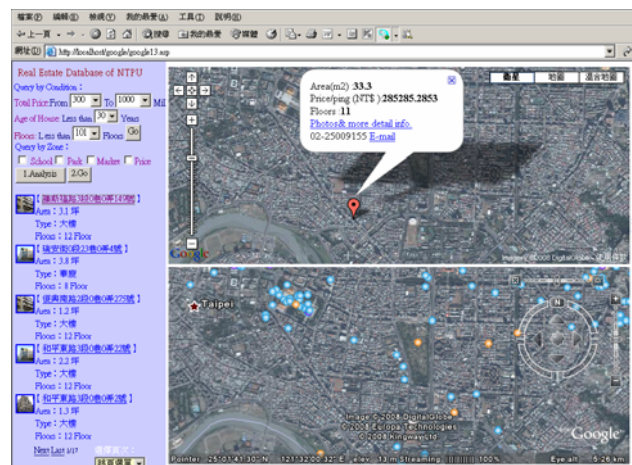


Figure 3. The query of result display on Google Maps

5.2 Query by spatial analysis

On top of the web page, the query function was designed besides traditional conditional query, moreover the demand zone query function was proposed in this paper. For instance, the demand zone means that the user may query by the demand of finding the zone where the amount of time driving a car to the park is less than 30 minutes and to the market is 10 minutes. The optional demand items include school, market, park, and reasonable house price in this article. Although spatial analysis can be processed with GIS software, many users are not GIS professionals. In order to provide spatial solutions to non-GIS users, developing a user-friendly interface with ArcObject in VB6 is needed. One problem is that an EXE type of file cannot be processed in ASP. Compiling the file with function of spatial analysis to DLL in VB6 is the one of solutions. The procedures of the process are shown below:

1. Compile the file with function of spatial analysis into DLL (myDLL) in VB6
2. Save the DLL to C:\Windows\system32\
3. Manually register it with the regsvr32 application
4. To access the function that is contained within it with ASP

```
<%
Dim myObject
myObject=ServerCreateObject("myDLL, myClass")
```



```
myObject.myMethod("something")
myObject=nothing
%>
```

5.3 Connection with database in ASP

In an ASP web page, the connection between web page and database is based on the connection object of ADO (ActiveX Database Objects). There already is a standard rule for connection between database and web page called ODBC (Open Database Connectivity). This is an Application Programming Interface (API) that allows for data extraction from a database through a unified source.

The main task of Connection object is passing the "Connect String" to ODBC for processing. After receiving the "Connect String", ODBC analyses the string and then communicates with the database by a specific protocol of TCP/UDP 1433. Therefore, the content of "Connect String" needs to include all of the connection information. This information may include type of database, name of the server, name of database, and login name, etc. Once there is a successful connection, the Connection object will keep all of the connection information in its memory to avoid breaking the connection.

After filling out the query form on the top of web page, the parameters in the query form will be passed to the other ASP web page. Then, the ASP web page on the bottom-left part receives values of parameter and checks out with corresponding fields in real estate database, respectively, and then the results, which are matched with query conditions will be listed on the web page in five items per page. In order to show the location of the house and check further detailed information on Google Maps, the items of query results have to include the house information such as coordinates, address, and house price, etc.

5.4 Google Maps/Earth Embedded and Synchronization

In this paper, Google Maps and Google Earth were embedded in one webpage. We've used the GoogleEarthAirlines plugin, in combination with a little extra javascript, to try and make navigating the various layers more intuitive and make two of systems synchronization(GoogleearthAirlines, 2007). The procedures of plugin IE Browser are shown below:

1. include geapi.js which is supported by GoogleEarthAirlines in your web page
2. `<script type="text/javascript" src="./js/geapi.js"></script>`
3. use ApplicationGE.Plugin("content ") to instanciate plug by javascript
`<div id="content" class="contentarea" >`
`<script> ApplicationGE.Plugin("content"); </script>`
`</div>`
4. refer to `http://earth.google.com/comapi/` to get a reference to the classes and methods implemented in geapi.js

In addition, in order to shows the query results in a webpage with two-dimensional of Google Maps and three-dimensional of Google Earth, the function of synchronization between Google Maps and Earth is needed. The addListener() is one of APIs of Google Maps which is the function of detecting the event of map "moveend". The Google Maps center's coordinates and zooming factor were stored and then passed to the function of

SetCameraParams() which is one of COM APIs of Google Earth.

```
GEvent.addListener(map,'moveend', function() {
    var center=map.getCenter();
    var zoomLevel = map.getZoom();
    synchronization (center.y, center.x,zoomLevel); });
```

Results of query will place a mark on the Google Maps and then clicking the mark will create an information window showing the detailed information of the real estate. Pan and zooming on Google Maps can lead to synchronize with Google Earth. There is much of pre-collected and pre-located information shown around the "Target". The query result was placed on the Google Map and Earth with function for daily life information as shown in Figure 4.

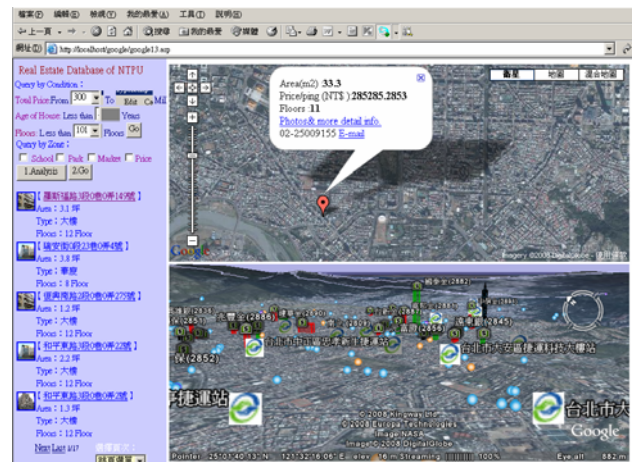


Figure 4. The display of query result with function for daily life in Google Earth

6. CONCLUSION

This article proposes two types of query to find out the zone that satisfies customer's demand and then checks the location of real estate for sale. These two types of query include the traditional condition query, and query by zone which resulted from spatial analysis that developed in VB with ArcObject. Results of query were demonstrated on the web pages that had embedded Google Maps and Google Earth API. In this paper, the platform has the function of two-dimensions of Google Maps and three-dimensions of Google Earth. There are many of conclusions shown below:

1. The problem of coordinate system transformation always exists within the different types of maps in Taiwan. Most of dataset of geographical position used on government maps here is the TM-2 system (Datum of GRS67) while Latitude and Longitude (Datum of WGS84) is used on Google Maps and Earth. There are a little bits of displacement after the transformation between each other. Fortunately, the shift of position is still acceptable for the application of real estate query and display.
2. The display of query results include facade photos of house, indoor panorama, two dimensional Google Maps and three dimensional Google Earth with function for daily life, etc. From the information expression of view, these kinds of

expressions can certainly let the content of real estate database become an active form.

3. The resources of dataset of images and electric map, and development platform for developer were already supported by Google Maps at no cost. Developer can easily integrate database with map display by developing web pages and Script functions. Because of easy to combine with web page, it is more convenient to use than GIS. But, the API of Google Maps do still not support the function of spatial analysis. The limitation of using API of Google for application already exists.

4. Google Earth is designed for site-based, in this paper, we proposal an web-based approach of embed Google Maps and Earth in one webpage. We can check the query results of real estate in two-dimensional and three-dimensional view from client site.

5. The method of COM was adopted in this article. Although users can choose either ArcObject or MapObject, the latter has a more limited function. For example, it cannot be used with MS Access databases. If we are working with geodatabases, we obviously are using ArcGIS. Because ArcGIS is developed based on the ArcObject system, the ArcGIS users still prefer to use ArcObject as their first choice. Moreover, ArcObject cannot function well once it is separated from ArcGIS.

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