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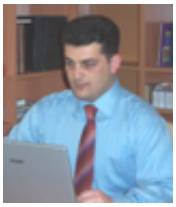
Address-Based Geospatial Applications: A Case Study of Trabzon, Turkey



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Abstract

Today, spatial information systems are used in many fields for various purposes in light of the technological improvements. Main purpose of these systems is to manage data in an effective way in order to reach an optimum decision. In this respect, Address-based Information Systems (AIS) is a vital for local governments to provide some valuable services to individuals. Because these systems can set up a very good relationship among the basic geospatial data layers for a city-work and link these geospatial data with corresponded objects directly. Thus, AIS minimize the time and financial losses for local governments and institutions using a fixed address data. Linkages among digital maps and related address inventories databases are the main components of AIS. Identification of all addresses and preliminary works such as developing a numerating system should be introduced first. Using some map layers such as buildings, roads, and land parcels and supply of linked address data to these layers is the most precisely task within AIS. Address-based information systems are important for spatial query and analyze. Because these systems are map-based, and they can be used effectively in many field such as urgent emergency analyze, address query, collection of the real estate tax, risk analyze etc. In this paper, to design and implementation of an AIS will be examined.

1. Introduction

In the real world, addresses are the most commonly used and smallest unique identifier. They have often used as the primary link between individuals and locations. Address has a much more user-friendly quality than other identifiers such as property identification numbers (PIN's). For example, a citizen who may wish to extract data from a Geographical Information Systems (GIS) would find it much more intuitive to be able to query a database using an address than by most other means [Metrogis, 1997]. Address serve two major functions: first is to emergency services. However, since the emergence of GIS, and the growing importance of Geographical Information (GI) in mainstream data processing, the address has also gained importance as a universal property identifier. Most recently, the use of address for the geographic location of properties or buildings has been recognized as a vital part of national and international information infrastructures. GIS has driven this demand because users need an explicit link between entities represented on a map and an identifier that allows the attributes of those entities to be drawn from other sources [Barr, 2002].

When considered technologic innovations, it seems that building an address inventory system with classical methods, updating, querying, and realizing required analysis are not possible. In this respect, there is a systematic approach. This is a good addressing system which has always been important for systematically recording personal or individual company information and effectively delivering products. In a society

demanding for rapid information exchange, address serves also as a key to associate various governmental records to link data of varying summarized levels and to assist in strategic planning [Lilian et al, 2000].

2. Importance of Address Data

It is wisely accepted that the address issue is of great importance in the world of GI. Experience shows that the availability of full cover address data of a reasonable quality is often the key element that can "open up the world of GI". A well-formed, public address system contributes to the physical infrastructure of a modern society, enabling ordinary people, postal services, rescue teams and utility companies etc. to navigate without coordinates. Proper address data can - likewise - contribute to the information infrastructure, pinpointing and labeling, in human language, all locations where people live, work, shop, entertain and educate themselves. Public address data is in many countries seen as a natural part of society's core data, on which a more sophisticated spatial infrastructure can be built.

In the geographical world, to make a distinction between reference systems based on coordinates and reference systems based on identifiers. Addresses belong in the last category, which means that for instance the address "34 Long Street, Trabzon" identifies a particular (more or less well-defined) location without use of geographical coordinates [Lind, 2000]. On the other hand direct and relating economical loses that derive from address data is very important in view of budged especially in developing countries like Turkey. For example; in 2001, address problems such as numerating system issues, incorrect addresses, address duplications and updating problems that appeared in Turkey cost approximately 60 Million US dollars. Over there, United States Postal Service (USPS) incurred 1.5 billion US dollars in expenses due to undeliverable mail because of incorrect mailing addresses. About 5.4 billion pieces of mail have been identified as undeliverable or 3% of mail volume in a given year.

Despite the billions of dollars spent on automation, development of national addressing standards and mailer compliance initiatives, mailers continue to mail to bad and poor quality addresses. Mailer efforts should be concentrating on improving those non-automatable addresses by using such methods as Address Element Correction and mailing First-Class postcards to verify addresses. Mailers should consider not mailing to those addresses that cannot be improved since they are literally throwing away their investment in marketing. Moreover, the result of poor address hygiene directly contributes to postage rate hikes [Perryjudds, 2001].

Researches conducted in some European Countries, budgets according to formed by postal mails or messages in years are stated following. It is very important that used address information is accurate in order to have these messages delivered and to minimize economic loses in this process. The Federation of European Direct Marketing (FEDMA) has been publishing an annual statistical report for the European direct marketing industry for several years. This report presents a few important index numbers that illustrate in particular the scope and (possible) growth of the phenomenon "addressed direct mail".

The first table shows the number of addressed postal items (direct mail) for some European countries in the period from 1996 up to and including 1999. In the second table the costs of direct mail (in million euros) for the same countries and period can be found [Humaninference, 2000].

Addressed direct mail (in million items)

Year	Austria	Denmark	Finland	France	Germany	Netherlands	Portugal	Spain	Sweden	UK
1996	567	241	456	3703	6605	1225	138	1186	593	3173
1997	593	270	495	3842	6834	1272	164	790	601	3588
1998	633	284	503	4000	6048	1379	176	855	598	4014
1999	674	263	511	4127	6398	1449	189	854	606	4345

Total costs of direct mail (in million euro)

Year	Austria	Denmark	Finland	France	Germany	Netherlands	Portugal	Spain	Sweden	UK
1996	906	568	407	5136	6335	1767	31	1836	622	2050
1997	988	441	428	5160	6567	1802	36	1886	663	2872
1998	1044	475	444	5673	8078	1978	37	2028	671	2464
1999	1101	380	460	5844	8385	2147	42	2180	706	3203

3. Address Issues In Turkey

When examining of the address formats used in Turkey, it seems that there is not a standard system. Because majority of address components, lack of needed sensitivity of numerating studies, different addresses formats used by different societies and lacking of awareness of societies about changes in address components, address confusion is faced in Turkey [Yildirim et al, 2002], [Yildirim et al, 2004].

Because many datasets are geographically referenced by an address, defining and using a standard address format will increase the ease with which these datasets can be incorporated into the GIS for mapping an analysis. And because address are so often used as a means of communication between and within organizations, standardizing address will increase an organizations ability to share these datasets with other organizations. Standard address can also increase the efficiency of automated applications. For example, they may make locating address on an emergency service system more efficient and accurate or usable over a wider area covering several communities [Metrogis, 1997].

4. An Address Based Geospatial Application: Case Study of Trabzon City Address Information Systems (TAIS)

Information systems are used respect to necessities in different areas. One of these areas is Address Information System (AIS) in which following, querying and displaying of numerating processes are realized in urban information system applications. Meeting of demands to these systems optimally is depending on eliminating of possible problems via pilot projects applications. So, firstly, in this application an AIS design and application realized for Trabzon City, selected as pilot area and then it is aimed that this design and application will be consider a general model for the others. After determining of how a workflow is followed in AIS applications, constructing an infrastructure for distributing of urban data to people by web, developing an automation system for updating were aimed.

Study Area

The study area is Trabzon City where located in the North Eastern part of Turkey and having coast to the Black Sea (Figure 1). The province has 39 districts with 28,3 square km. Its population in 2000 is recorded as 478000.

Figure 1: The location of Trabzon Province in Turkey

In this study, firstly, AIS requirements were examined. Secondly, AIS design was realized and this design was applied in Trabzon City (Figure 1). Data acquired from different resources, land studies and public or private institutions of city is manipulated in ArcGIS 9.0 environment. As a result, an AIS design and application was realized for as a model (Figure 2) [Yildirim, 2003].

The spatial data layers which are in address based information systems were specified and then graphic and non-graphic information of these layers were acquired. Respect to this information, databases were designed and related with each other. After needed controls had been done, queries and analysis were done in the software system. By this system, addresses of important societies and organizations can be queried and displayed in the graphic screen, and also these societies and organizations can be coded on the map via their addresses [Yildirim et al, 2002].

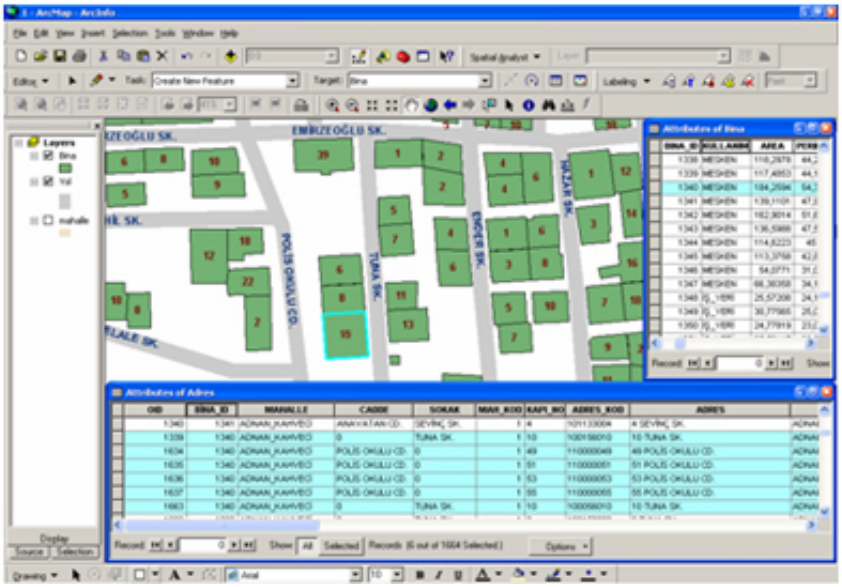

Figure 2: An Interface view of "Trabzon City Address Information System"

5. Addressing Applications In TAIS

a) Address Matching

Address matching is the process of adding location information to a database containing business, survey or administrative records. It is a very powerful GIS technology, because it can transform any existing database with street addresses into a GIS database that can be mapped or used as input into more sophisticated spatial analyses. Address matching is inexpensive, as well, since it can be performed on microcomputers with low-cost GIS software and the address referenced fields. Although address matching has a number of important limitations, it is nevertheless one of the most cost-effective means for applying GIS mapping and spatial analysis tools to the country's pressing urban problems [William, 1995].

b) Address Geocoding

Geocoding is the process by which a point added locations defined by street address or other address information, to a map. It is the computer equivalent of pushing pins into a street map on wall. When a geocode tabular data containing addresses, software reads the address, finds where they are located on a map, and creates a new theme containing a point for each address it was able to find. Address is probably the most commonly used form of geographic data. By geocoding address data a wide range of applications can be performed, from showing where students live in relation to their schools, to mapping customers to help users to decide where to locate new branch offices, to analyzing a city's crime patterns etc [Ncjrs, 2000]. In Figure 3 address references fields is showed.

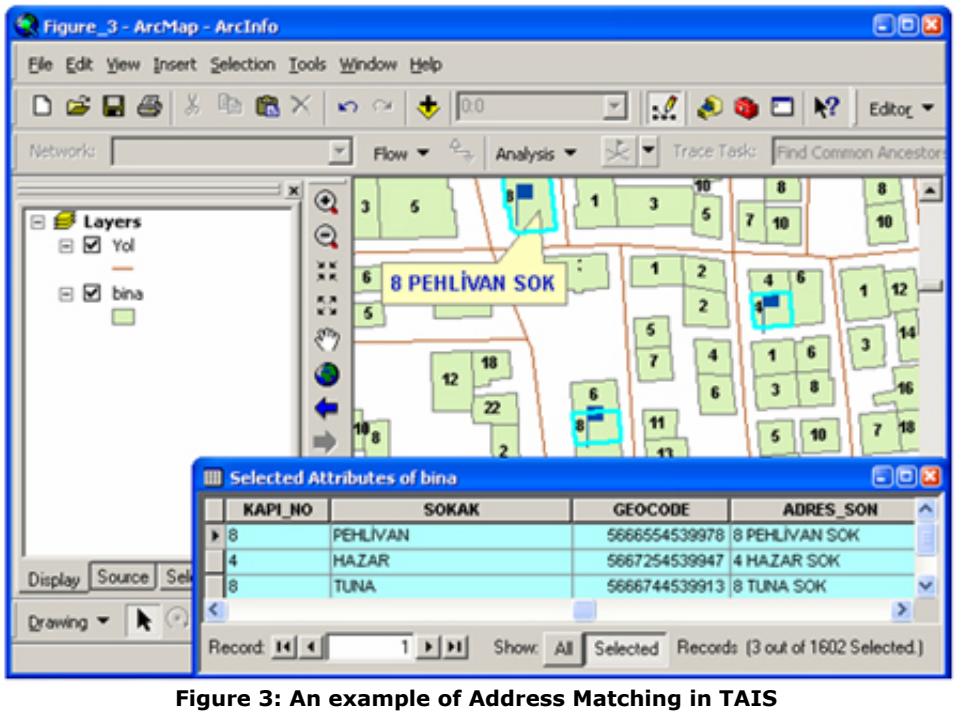

Figure 3: An example of Address Matching in TAIS

c) Real Estate Tax Collection

Local governments (and some cities) are responsible for identifying land parcels and buildings for the purposes of property taxation or recording of interests on land. In application which is performed in Trabzon City real estate taxes computed automatically and using address data they were communicated tax payers (Figure 4). In this way, tax collection processing was implemented in an optimum way.

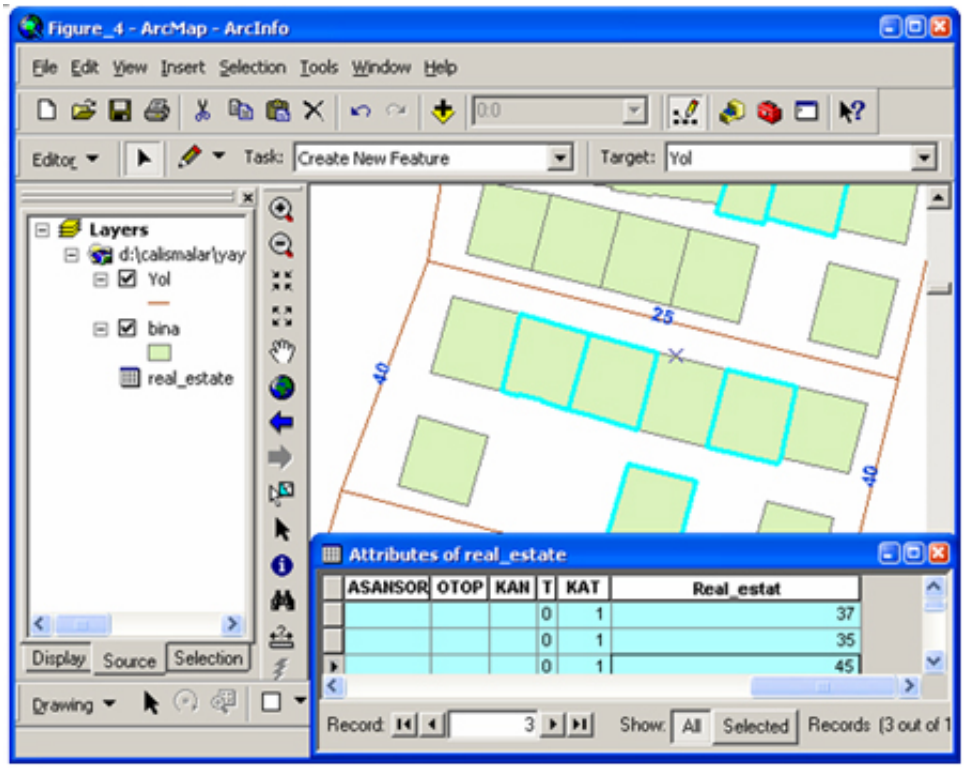

Figure 4: Trabzon City Real Estate Tax Collection

d) Emergency Analysis

In urgent cases, like arriving to target area in minimum time of ambulance, fire brigade and police vehicles, deciding fire brigades center's location, deciding which house's electrical are cut off in breakdown cases, network analysis are used [Yomralioglu, T., 2000]. Using address data, these queries and analysis are the most effective methods for optimum deciding. Because address data is a position identifier and it is often used in these cases (Figure 5).

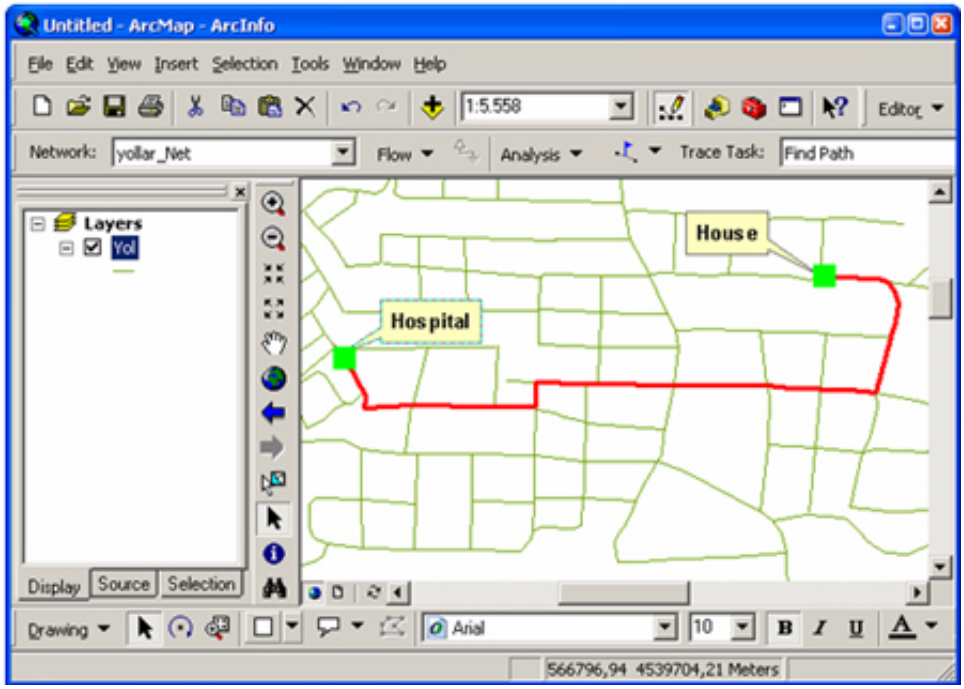

Figure 5: Using address data to find the most route for hospital

e) Distribution Applications
Determining the best location for warehouses and distribution facilities is an intimidating task. Hundreds of candidate locations and thousands of customers crate millions of freight rate combinations that need to be considered in just one facility location problem. Despite these challenges, progressive companies routinely study their distribution costs or improve customer service. Consequently, using GIS functions and address data sets to perform distribution network design is very simple [Clayton and Bates, 2001].

f) School Enrolment - Bus Route Service
Using address data and address matching procedure to place X and Y coordinate on each matched address and then use the coordinate location to geocode the school attendance area. Once the coordinate is placed on the matched maps are generated showing each student location in relationship to the attendance area. Sometimes these maps take the form of “desire line” maps, or “spider maps” which draw a line from each student address to the school of attendance over a street base simple.

Address data is used for design services route too. For example, a company have provided employee address data to run through the address matching procedure. Then, with an X and Y coordinate value assigned to each matched employee, a “spatial look” at the results can be made. In these scenarios, it is produced a set of maps and visually evaluates the results; comparing the employee locations, density of employees and proximity to existing routes to make a determination on any route changes simple [Clayton and Bates, 2001].

g) Real Estate Valuation (Land Valuation)
In order to estimate the effect of an individual variable upon property prices, the structural, neighborhood, accessibility as well as the environmental attributes of a property need to be calculated. For example, accessibility variables define the ease with which local amenities can be reached from the property and for study school, railway stations, shops, parks and the Town Hall were all considered. Having located these facilities using various local directories, they were referenced using address data and address matching procedures [Lake et al, 1998].

6. Conclusion
In spite of the many differences that the address system in various countries and regions show, they still fulfill the same basic needs: To identify certain locations, where we live, work and educate ourselves, in a language which mirrors the way we get around: our common road network [Lind, 2000]. Address data provide many advantages over street segments files, and in the community safety arena may actually become a necessary component for building future applications. In order to meets these demands, GIS professionals need to understand how to create and maintain the site address data, and make each address as positional correct as possible [Bates, 2002]. Seconds or minutes are very important for life. In emergency cases, delay with determining positing using address data directly effects man health. In this respect, it seems that address data is a rescuer in usually. So, it is important that integrating these data and information systems. It should no be forgotten, “nobody can help you, if they cannot find you”.

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