

Development of an Approach for Municipal GIS

P.K. Garg

Abstract---Infrastructure planning, development, management and analysis for the future infrastructure is the major advantage of having a Municipal GIS system. The generation of thematic maps in GIS which create a high visual impact, are used for the assessment of several sectors such as for water supply, network planning, property mapping, maintenance of cities and civic amenities services, etc. Strategic planning is a key concept for effective and successful development of infrastructure and their management which have to be considered by the governments and decision makers.

GIS technology has found its way into many municipalities across the globe. Municipalities, particularly in developing countries, have out-dated tools to handle such information - there will almost always be computerized municipal systems handling municipal information in place and these are often the tools that handle municipal data prior to a GIS. GIS is capable of linking textual or numeric data (attributes) to the digital (spatial) maps. For a municipality, the combination of spatial analysis and attribute data makes a GIS extremely useful. The municipal users require a broad spectrum of information from large-scale regional demographic analysis to precise locations of a property. To accommodate these needs, the GIS must be designed to supports a number of applications. In this study, Dehradun in Uttarakhand, India has been taken as a model city. The primary objective of the study was the proper mapping of all properties using GIS as a tool, and subsequently computes the property tax.

Keywords---GIS, Infrastructure, Municipality, Planning, Property mapping

I INTRODUCTION

STRATEGIC planning is a key concept for effective and successful development of infrastructure and their management which have to be considered by the governments and decision makers. GIS technology provides municipalities with extraordinary quantitative and qualitative benefits [1].

The IT and GIS technology can provide the basis for revolutionizing the working of government processes. Some of these benefits and changes can be achieved quickly through GIS development process, while others may take much longer to be realized.

In order to develop a Municipal GIS, Dehradun in Uttarakhand, India has been taken as a model city. The growing needs of the city due to its vast expansion, particularly in last 8 years, has necessitated the requirement of revising the property records as well as to store the information in digital format. The primary objective of the study was the proper mapping of all properties using GIS as a tool, and subsequently computes the property tax.

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II MUNICIPAL GIS DATABASE

GIS technology has found its way into many municipalities across the globe [2]. Many local governments now rely on GIS technology as a support tool to design development plans and to make important decisions [1]. Municipalities often have a number of out-dated tools to handle such information - there will almost always be computerized municipal systems handling municipal information in place and these are often the tools that handle municipal data prior to a GIS. Various database requirements in GIS are shown in Fig 1 [3].

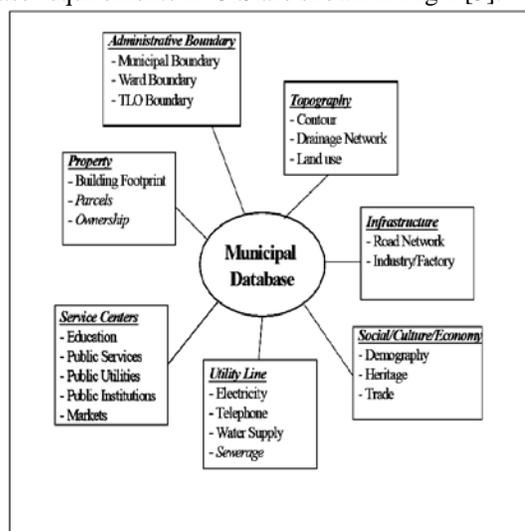


Fig. 1 Data required for creation of a Municipal GIS

A GIS is also capable of linking textual or numeric data (attributes) to the digital (spatial) maps. It is also possible to use this information to generate both spatial maps and reports about a property [4]. For example, a property parcel can display its ownership and assessment information, or highlight all property parcels according to land use classification, or generate a report with property owner names and addresses for all properties within a one kilometer radius of a property.

For a municipality, the combination of spatial analysis and attribute data makes a GIS extremely useful. Developing a GIS for municipal government is the most diverse and challenging type of work [2]. The municipal users require a broad spectrum of information from large-scale regional demographic analysis to precise locations of a property. To accommodate these needs, the GIS must be designed to supports a number of applications. To derive full benefits, a municipal GIS must meet diverse users' requirements, such as accurate modeling of water, sewer, and storm water systems [3].

III. CASE STUDY – DEHRADUN, NORTH INDIA

In order to develop a model for Municipal GIS, Dehradun in Uttarakhand State has been taken as a model city. It proved to be first successful GIS database at large scale developed in the State so far. The growing needs of the city due to its vast expansion, particularly in last 8 years, has necessitated the requirement of revising the property records as well as to store the information in digital format. The primary objective of the study was the proper mapping of all properties using GIS as a tool. The Municipal Corporation so far is maintaining the property information on papers, and revise the information every five years. According to this, all assessed properties lying within the purview of the Corporation were given a record number on the computer-coded.

IV. GIS BASED PROPERTY MAPPING

A GIS can be very helpful to map the exact dimensions of the property and prepare a updated map using high resolution satellite images. At the same time, attributes collected from the field about the properties can be added in a database. Thus the fact that a Municipal GIS helps in collection of revenues, a successful application package has been developed that included immediate property identification based on several types of queries and reassessment of property [4].

The Dehradun Municipal Corporation is presently facing the challenges due to increased urbanization. It has paper maps of the ward boundaries, revenue maps lying within the Municipal Corporation limits, Master Plan for Dehradun, records maintained in the register. There is no digital database which could be used for monitoring and planning of land in the region. As a result, Revenue maps had to be searched every time a problem occurred in the field or during a property dispute. In absence of any digital database, the judgment of the Tax Inspectors and the clerical staff had to be relied upon the information available on papers.

In addition, another major problem was the allocation of property numbers, which many times were done by the clerical staff, making it extremely difficult for the Tax inspectors to actually locate the properties in the field. Property numbers were not given in sequence, and sometimes there was a wrong entry of property number. Thus, there was a poor link between the property and its corresponding data. Many of the new properties were not accounted for and this makes the assessment of properties as an essential need for the study.

After a rapid inventory of all available information, the first step is to prepare a base map of the study area from the available map at the 1:20,000 scale. Google images were extensively used to map the property locations and property numbers allotted. New numbers were allotted to unassessed properties and then the cross checking of data was done in the field. This involved carrying out an extensive property survey on the basis of a questionnaire, and the data thus collected was checked, corrected and fed into GIS database. The information pertaining to a property, for example, location,

number of floors in the building, year of construction, year of stay of the resident, status of resident (owner/renter), rent paid (if the property is rented), type of construction, area of rooms, total area and covered area of the property, was collected and a GIS database was prepared.

The database of Ward no. 4, named Hathibarkala, comprises of approx. 183 hectares of land was prepared as a pilot project. Total number of properties to be mapped as per the municipal record was 865, and the total number of household/buildings captured in the ward were approx 1350. The database contained the following information:

- Administrative boundaries
- Residential Buildings
- Commercial Buildings
- Mixed Built-up Area
- Public and Semi-Public Structures
- Public Utilities Buildings
- Recreational spots
- Religious Structures
- Slums

In addition, the following information were also collected and digitized:

- Properties,
- Vacant land,
- Roads,
- Schools,
- Hotels,
- Fire station,
- Police station
- Parks,
- Pump house
- Electric sub-station
- Canal, river,
- Important landmarks

The team in the field attempted to map the plan of each property, which was not clearly visible from Google images. DGPS observations were taken so that the exact boundary of the property/land could be drawn and overlaid to the spatial maps prepared from Google images. Properties were further divided on the basis of land use, type of construction, year of construction, year of stay, location of property, availability of basic amenities, covered area and carpet area.

The spatial database, thus prepared, is shown in Fig 2. The GIS database was used to extract the information in several ways. As an example, the cost assessment of revenue collected at present and cost recovered as per GIS work is given in Table 1, which clearly indicates the benefits of GIS in revenue collection.

TABLE I
COST ASSESSMENT

Type of Structure	Assessment (INR) Current Scenario	Assessment (INR) Proposed by study	% Increase
Residential	1,64,702	9,83,101	497
Commercial	96,938	2,08,444	115
Mixed Builtup Area	5,738	24,437	326
Public and Semi-Public	12,675	4,48,388	3438
Others	1,907	7,811	310
Grand Total	2,81,960	16,72,181	493

V. CONCLUSION

Municipal GIS is by far one of the most critical uses. Almost all the cities will have to carry out a similar exercise due to the severe municipal financial crisis, even though it is generally mandated every five years. The magnitude of financial benefit from this kind of GIS database is enormous. Since this exercise was only a one-time operation, it is necessary to train the staff in order that the database is updated regularly.

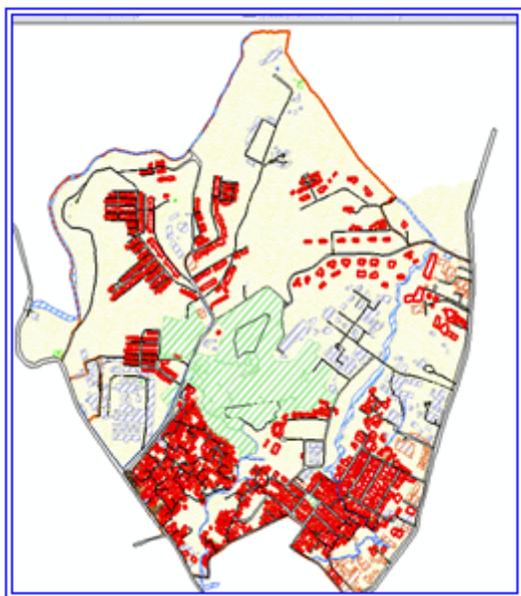


Fig. 2 GIS Municipal database containing several layers

One of the major challenges in municipal level planning is balancing the spatial equity of facility or service provision with that of economic viability. Naturally, most residents would prefer high level of access to service facilities, such as schools, health services, banks and other services. Planners need to consider whether or not it is feasible to provide such facilities, given the available resources. Hence important decisions have to be made on what are the best locations for facilities given variations of local need or demand. Similarly, providing adequate transport facility, developing a new residential land use and other physical infrastructure must be

balanced against the environmental impacts. GIS plays an important role to support such decisions which can be of a great value in municipal planning process.

There is an increasing demand for better information within the municipality and in the relevant organizations to guide more rational planning process. GIS technology is seen as integrating tool for divergent sources of data and information and the obvious way to achieve these objectives is through the use of GIS technology. To do so, municipal authorities have to improve the data handling capabilities, set-up appropriate technical infrastructure and interface with a wide variety of other agencies, such as government departments, local authorities, NGO's and many others. The proliferation of GIS have offered new era for spatial modeling in municipal level planning and encourages interactions and cooperation among related agencies.

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