# DESIGN AND DEVELOPMENT OF A 3D LIS FOR URBAN APPLICATIONS

**MAHMOUD R. DELAVAR[1] AND MAHDI G. MAJDABADI[2]**

[1] The University of Tehran
[2] National Cartographic Centre
Iran

**ABSTRACT**

One of the most important factors in urban planning is spatial structuring of physical plan of residential areas with respect to the day to day increasing population that leads to urban expansion horizontally and vertically. Land Information Systems (LIS) is a combination of technical and managerial aspects to optimize geospatial data collection and management to be used as a spatial decision support systems especially for urban managers and decision makers.

Keywords: Land Information Systems (LIS), 3D LIS, Urban Management

As the variation of the nature, quality and quantity of land ownership, management and legal statues pertaining to cadastre/LIS not only take place in horizontal plane but also in vertical direction, the need to collect, store, update, use, retrieve and exchange of 3D geospatial information has been become compulsory.

Nowadays living in apartments is extending its dominance in urban areas and bringing out the new concept of ownership and land use. Besides apartments, other infrastructures such as water and wastewater, gas, electricity and teleTelephone network systems need 3D information for georeferencing to the land parcels over and below the land surface.

Complex spatial analysis has increased the need to 3D topographic and thematic data. Urban town planning is heavily dependent on the ability to have a meaningful visualization of 3D information over urban areas. Such a 3D information will help to dissolve a number of legal disputes in land ownership and usage especially in urban areas. Based on the concept of georeferencing, there are a number of surveying, photogrammetry and remote sensing methods to collect 3D data over urban areas. This research is focused on the design and development of a 3D LIS for urban applications.

There are a number of methods for 3D spatial data acquisition such as digitizing cartographic and as built maps, photogrammetry, remote sensing and laser scanning. The possibility of using the above-mentioned methods in this research has been investigated and finally the following approaches have been selected and implemented:

A. Use of photogrammetrically produced digital terrain model (DTM) and digital surface model (DSM).
B. Use of architectural maps and as built plans.

The study area is Vavan District located 22 Kilometer distance in the South West of Tehran, Iran, covering an area of 166 hectares. A PC IBM at least 486 and 8 MB RAM has been used for implementation and a set of software's such as Microstation and SCOP for spatial data handling and Oracle as a database has been used. A number of spatial and aspatial data from various sources have been collected.
For spatial part, the following data has been collected:

1. Digital topographic maps at a scale of 1:500,
2. Architectural maps including site plan, floor plans,
3. As built maps,
4. Documentation of cadastral boundaries, streets.

The following attribute data has been collected:

1. Information regarding housing construction cooperatives in the area,
2. Land owners, tenure, land values, usage.

The practical works done in this research are as follows:

1. Edge matching and spatial indexing of digital topographic maps.
2. Graphical processing and control of photogrammetric input files.
3. Flagging photogrammetric data.
4. Data cleaning
5. Feature forming
6. Polygon formation.

Based on the feasibility studies done to assess the needs, available hardware and software as well as data, a conceptual model based on a feature-based approach has been designed and spatial database has been established. In addition, DTM has been produced using available topographic maps. Then, land parcels were registered to the DTM. Using architectural maps and parcels, boundaries have been separated and finally 3D buildings have been formed.

In the first approach to use architectural maps, 3D shape of buildings including framework of building floors, parking, etc. have been formed based on available information on architectural maps in Microstation environment.

In the second approach, digital photogrammetry has been employed to create a DSM of the area. Primitive 3D spatial data from buildings and streets has been extracted from the digital images and integrated into Microstation software. In addition to 3D files in DGN and DXF formats, the buildings were reconstructed and using faced views information extracted from land tenure documents, a textural mapping has been done and finally resulted in a virtual reality modeling of the area.

The fly through MDL program of Microstation has been used and finally a user interface has been developed to ease proper querying from the system. Some of the capabilities of the developed system are as follows:

1. Access to 3D information such as building floors.
2. Data retrievals and overlay of data layers,
3. Possibility of virtual monitoring of 3D urban features,
4. Use of an efficient and easily query language,
5. The possibility to respond the following questions:
   - Calculating the area of a street in the region,
   - Retrieval of architectural maps of buildings,
   - Looking side profiles of buildings,
   - Spatial searching of land parcels and buildings within a specific area threshold,
   - Searching of land parcels concerned with a specific building using water, electricity and teleTelephone codes/numbers.

The results have shown the prospects and limitations of using architectural and as built maps as well as photogrammetric approach for 3D information extraction and also the advantages of a 3D LIS for a number of spatial query visualizations for urban planning and management.

### CONTACT ADDRESS


| | |
|---|---|
| Name: | Dr. Mahmoud R. Delavar, assistant professor<br>Assistant Professor of Geospatial/<br>Land Information Systems |
| Institution: | The University of Tehran<br>Department of Surveying and Geomatic Engineering<br>Engineering Faculty<br>Tehran<br>Iran |
| Telephone: | + 98-21-8013093 |
| Fax: | + 98-21-8008837, |
| E-mail: | mdelavar@yahoo.com |

| | |
|---|---|
| Name: | Mahdi G. Majdabadi<br>Senior Expert |
| Instiution: | National Cartographic Centre<br>GIS Department |
| Office address | P.O Box 13185-1684<br>Tehran<br>Iran |
| Telephone: | +98 21 600 1391 |
| Fax: | +98 21 600 0031-7 internal 238 |
| Fax: | +98 21 600 1972 |
| E-mail: | majdabad@ncc.neda.net.ir |