An Introduction to 3D GIS

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GIS 산업의 패러다임 변화

- Smaller G & Larger IS
- Oracle 8-i의 등장
- GIS goes to “thin”(WebGIS, Mobile GIS)
- Remote Sensing 기술의 본격적인 적용(IKONOS, OrbView, QuickBird, Alternative 등)
- Mobile Mapping의 등장 및 상용화
- 지도 패러다임의 변화 – MultiMedia Map의 등장(http://www.skylinesoft.com 등)
- 3D GIS의 활용 및 그래픽 기술과의 결합

3D GIS의 등장 배경

- 풍부한 고해상도 위성 영상의 공급 및 활용
  - IKONOS, OrbView, Quick Bird, Alternatives, KOMSAT2 등
- 자동화된 3차원 지형 정보의 획득 및 활용
  - SAR, LIDAR, Digital Photogrammetry, Mobile Mapping 등
- 컴퓨터 그래픽스 기술의 비약적인 발달
  - 저가의 고성능 그래픽스 카드 대량 출시
  - PC상에서 OpenGL, DirectX의 구동 등
- 지도의 패러다임 변화
  - 전통적인 2D 기반의 지도에서 3D 기반의 멀티미디어 지도로의 이동

3D 지리정보의 영향

- Historical GIS
  - Automation of people's doing with maps
  - Perform analysis that would be difficult to do by hand
- So, Why people work with maps?
  - Attempting to process information about their surroundings
  - Until recently, 2D maps have been the only method avilable
- 3D Data
  - Modern sensors & Photogrammetric techniques provide 3D data
  - Now GIS users want to use GIS as a mechanism to manage data about their surroundings without being constrained to the inherent limitations of 2D maps
  - Increased needs of visualization

Challenges of 3D GIS

- Functional Challenges
  - One should be able to access, display, manipulate, and query the geodata in meaningful way.
- Magnitude of 3D Geodata
  - Magnitude of 3D geodata is usually very large.
  - Another kinds of solutions should be considered about 3D geodata(Hierarchical data model, wavelet based data model, progressive mesh data model etc.)
- Visualization problem
  - Applications of 3D GIS is quite varied and requires flexible display options.

Bring 3D to the Geodatabase

- GIS = Geographic Information Systems
  - GIS도 결국은 정보시스템
  - 따라서 3차원 지리정보를 수용할 수 있는 3D 포맷 혹은 3D Geodatabase가 1차적으로 필요

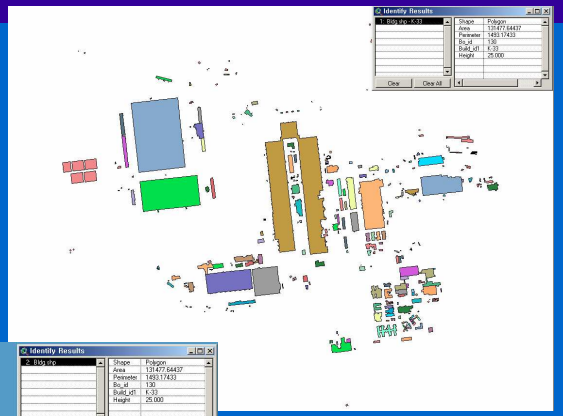
- 2D & 3D GIS의 기본 사상
  - Point, Line, Polygon
  - Point, Line, Polygon with Z coordinates
  - Triangular strips, Triangular fans, Planar polygon rings which can represent the boundary of virtually any 3D object.(ESRI's multipatch format)

Database Driven Symbology

- Database driven symbology
  - Direct link to the geodatabase gives us smart data.
  - Attributes associated with features tell users how they should be drawn
- 2D GIS
  - Users can control the size, color, patterns of features
- 3D GIS
  - True 3D symbols will be used.
  - Points may be stored in the database to represent the type and position of different trees in a park
  - Lines may represent the road, river and so on with its textures.
  - Polygons can be resymbolized to a building.

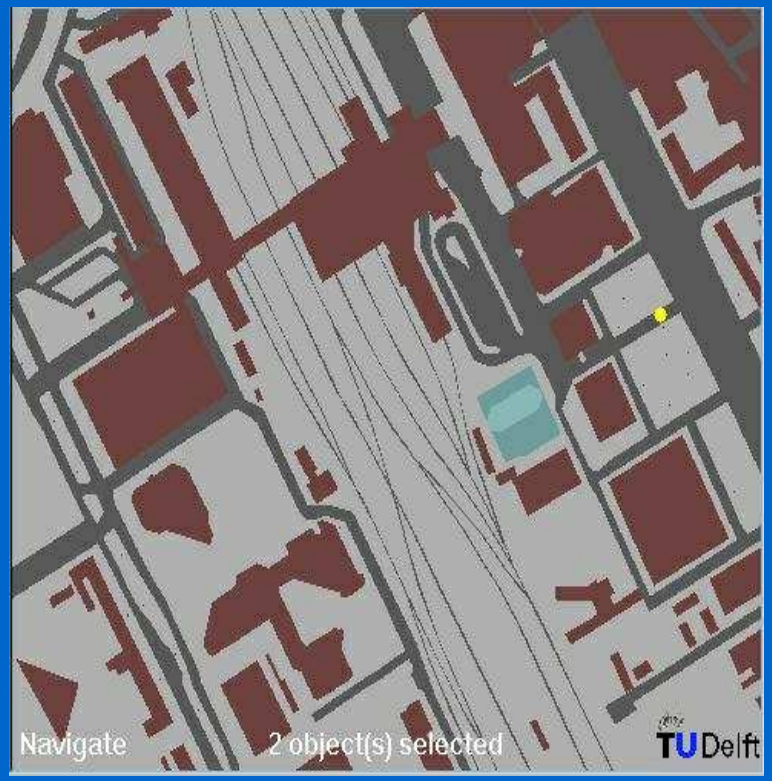
Adding Dimension to 2D Data

- Needs of adding dimension to 2D data
  - Despite the fact that more 3D data is becoming available, much of the data currently in a typical GIS is 2D
- Way of adding dimension to 2D data
  - The connection to the geodatabase provide us access to attributes that can be used to transform 2D geometry into 3D



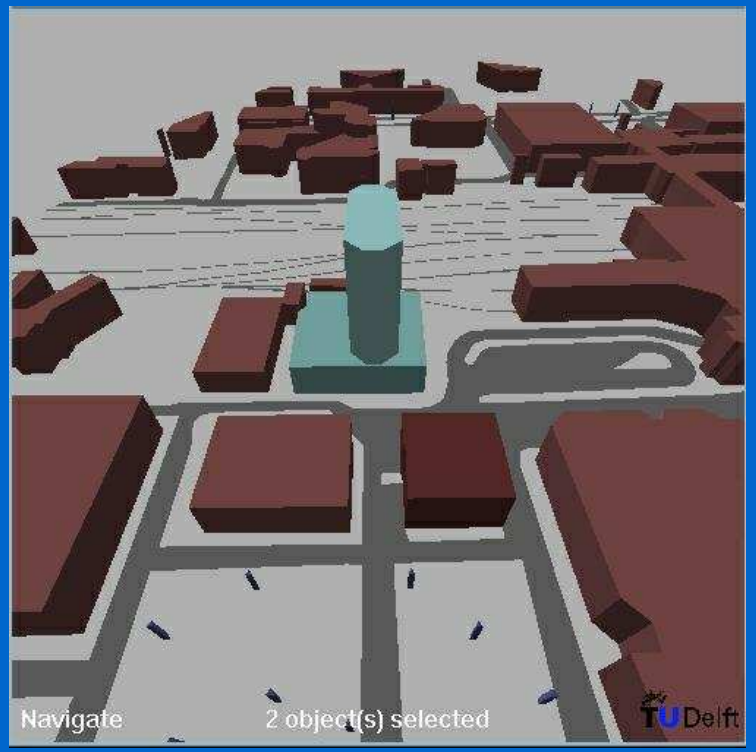
3D GIS View Concept

- Plan View
  - In this view, geographic data is visualized in a conventional cartographic map format.
  - Spatial objects are represented by 2D points, poly-lines, polygons and symbols.
  - Thematic data is visualized using standard text annotation and classification techniques. The *plan view*, as described here, is comparable to the basic visualization in most of today's GIS systems



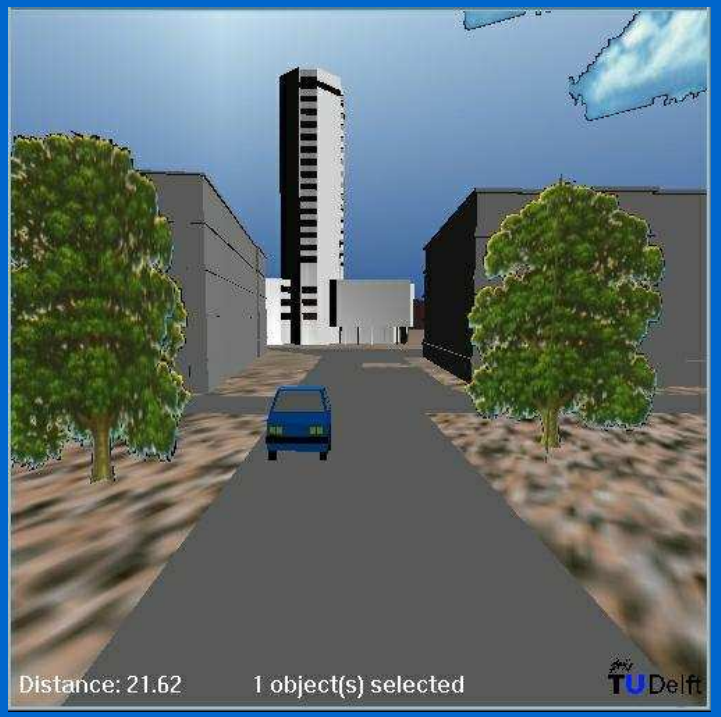
3D GIS View Concept

- Model View
  - The *model view* offers a so-called bird's eye view on geographic data which makes it possible to visualize 2.5D and 3D data.
  - Visualization in this view is kept simple and the user looks down on the model from the bird's eye viewpoint, as if it is an ordinary 3D-scale model.
  - A 3D-scale model offers an overview on the area of interest, giving users the ability to make changes to the model without losing sight of the (overall) effects of these changes.
  - Visualization in the *model view* is aimed at just that type of functionality: to let users 'model' their 3D geographic data.



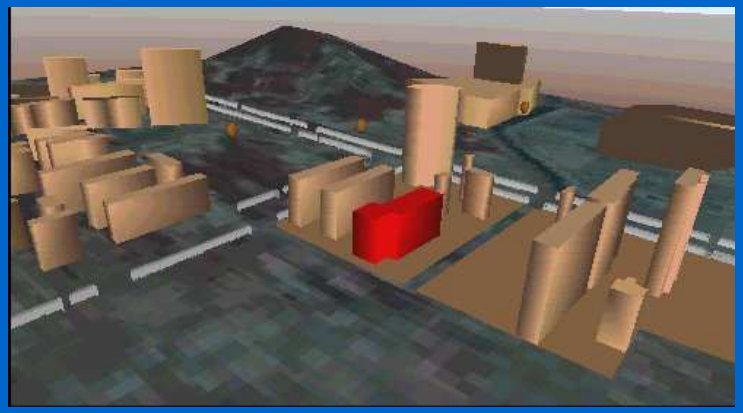
3D GIS View Concept

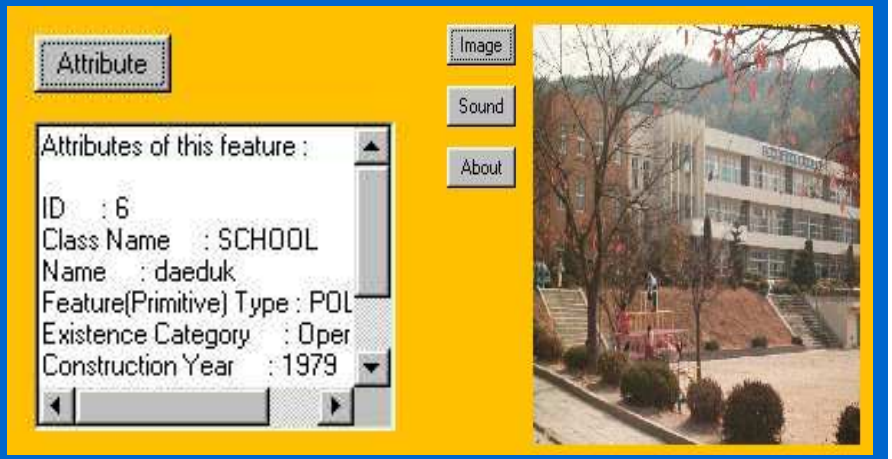
- World View
  - This is the first person view on the area of interest.
  - The purpose of this view is to give a realistic impression of the changes in the landscape, using both visual and audio output.
  - The user can 'walk through' the geographic data, which are visualized using detailed 3D CAD models and textures.



3D Geographical Operation

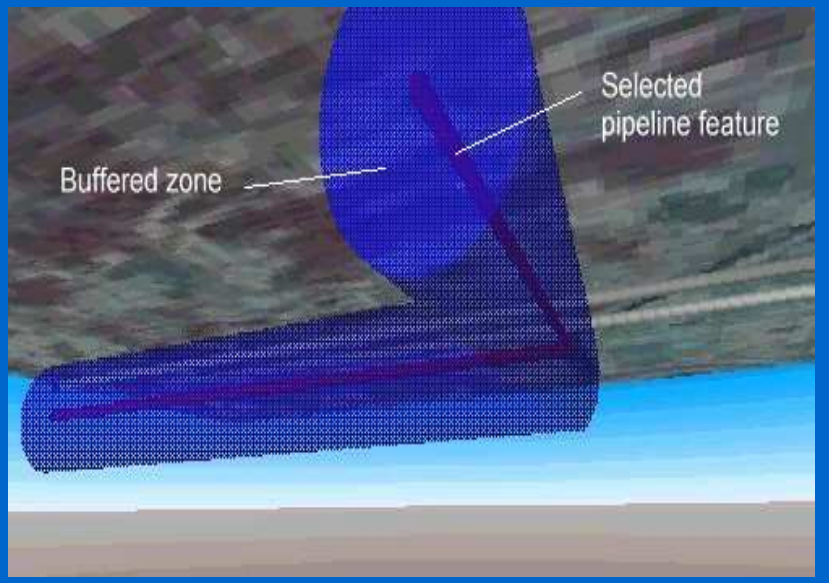
- 3D feature consulting
  - Each 3-dimensional feature visualized in 3D GIS has sensor detecting the mouse input.
  - Event handler catch the events from sensor and identify the 3D feature on which the event occurred.
  - Then the feature is consulted for attributes, sounds, and images through each output module.
  - Event handler also alter the appearance of selected feature for user notification.





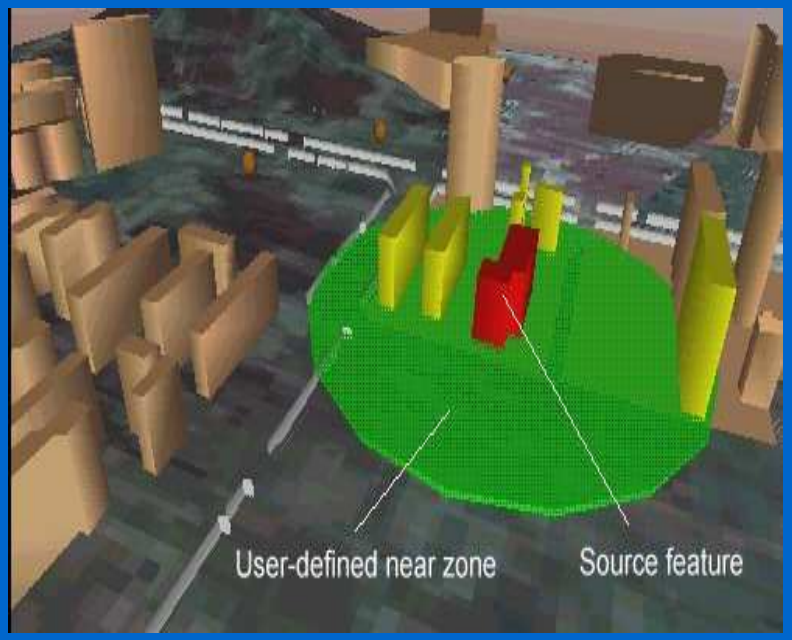
3D Geographical Operation

- 3D buffer operation
  - Buffer operation for 3D geographic features is available for a lot of 3D spatial query and thus, plays important role in decision making process.
  - 3D buffering on point-shaped feature can be applied for the analysis of 3-dimensional pollution area caused by point sources.
  - Analysis process is visualized using Sphere node of 3D GIS data model.
  - 3D buffering on line-shaped feature can be used when decide position for laying the water-pipe, gas-pipe, electric cable, or telephone cable under ground.



3D Geographical Operation

- 3D near operation
  - Near operation is to find features located within an extent from a source feature.
  - For example, a query to find all buildings within 100m area from selected point (or feature) is possible
  - Near area and features of query result is visualized by coloring.
  - Attributes of those features can also be consulted



3D Geographical Operation

- 3D Lantern operation
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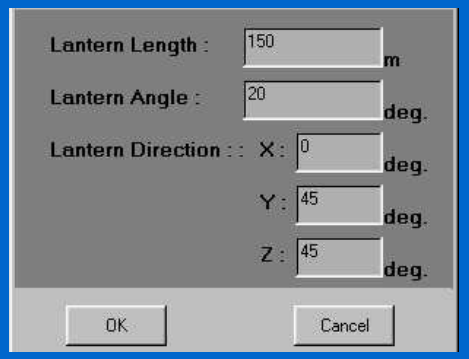

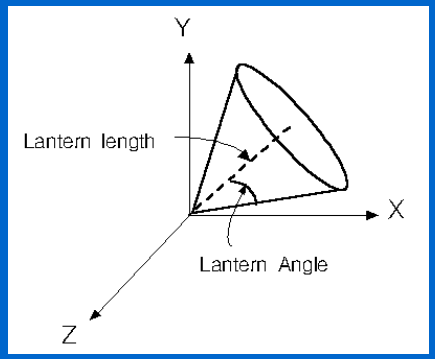

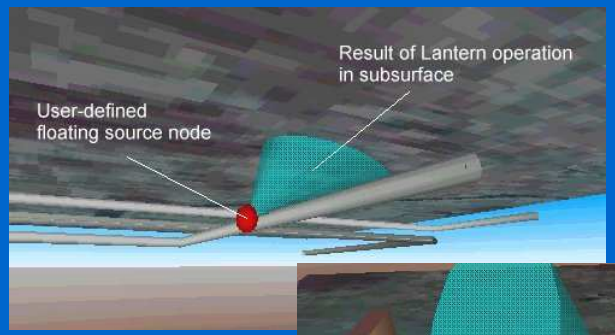

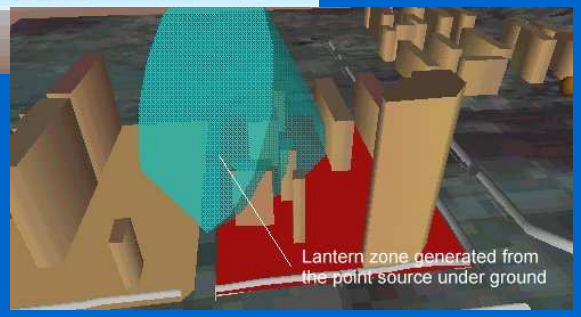

Two Kinds of 3D GIS

- Geometric modeling based 3D GIS
  - Individual objects are assembled to create a 3D landscape or a 3D city
  - Usual form of 3D GIS
- Image Based 3D GIS
  - Image based rendering GIS
  - Video image GIS