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# Web-based 3-D GIS for Location Query in Real Estate Application


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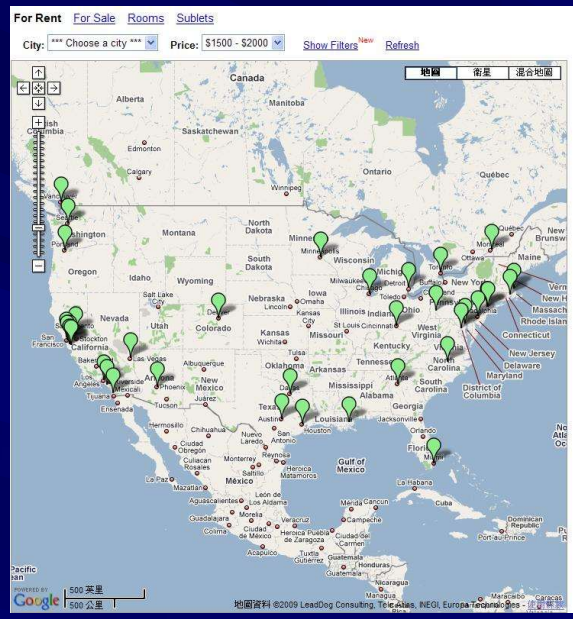
# Introduction

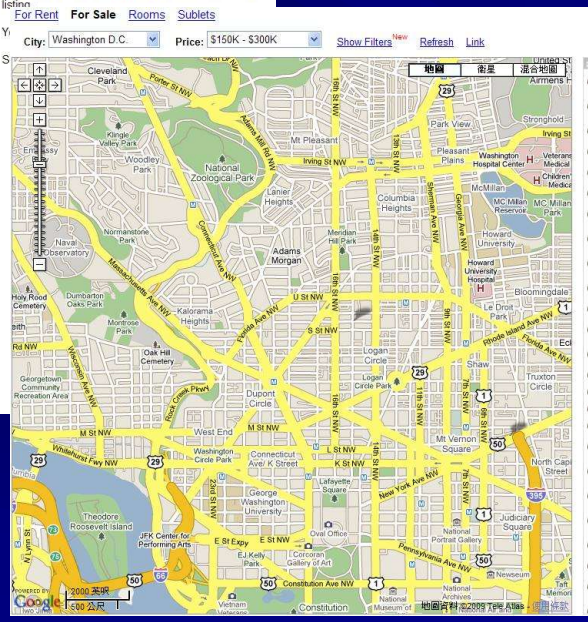
- Decision-making
  - Rational and efficient
  - Real estate market
  - Location, Location, Location
- 3-D GIS
  - GIS
  - Photo-realistic city model

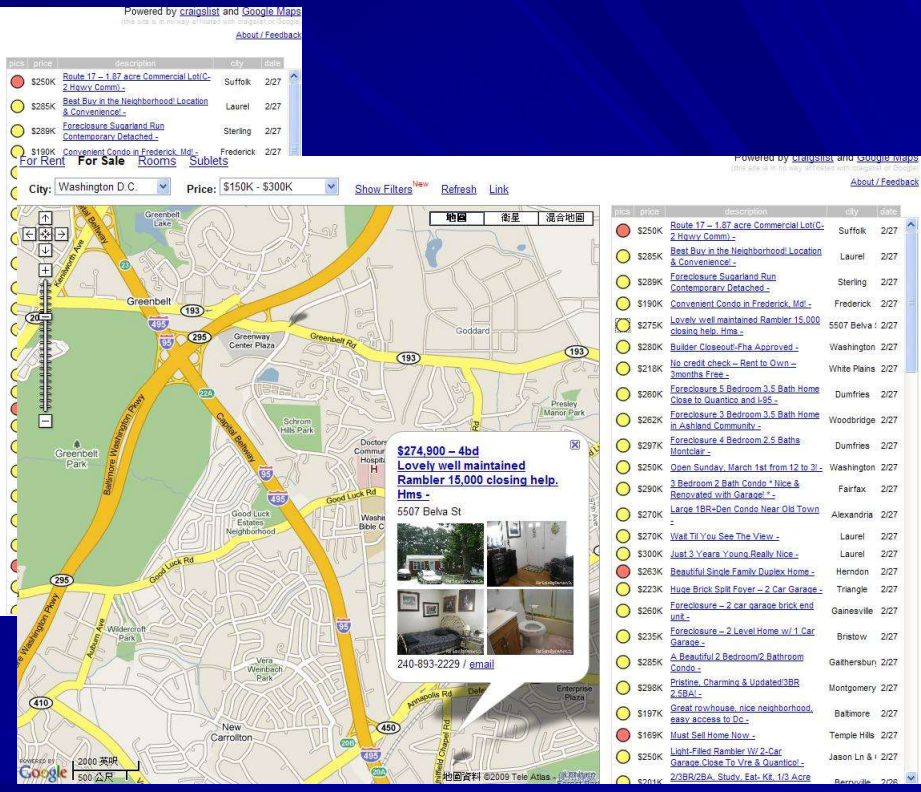
# Real estate query

Only texts, pictures or videos ⟵ by Seller designing

Sellers-orientated system




Introduction | Modeling | System | Results | Conclusions

# Goal

Two goals in this study:

1. Photo-realistic city modeling

2. Location query system in real estate application

# GIS-based Photo-realistic Cyber City

- Cyber City
  - Duplicate city's functions
- Photo-realistic city model
  - vs. virtual city model
- GIS-based city model
  - vs. computer vision-based
  - Geometry and attributes
    - Spatial query and analysis

# Challenges

| | Bottleneck | Status |
|---|---|---|
| 1 | Large quantity of geospatial data | Geometries, Attributes, Textures, Terrain(s), Topologies |
| 2 | Low performance of Client's GPU | Rendering |
| 3 | Narrow bandwidth of the Internet | Data transmitting |
| 4 | Limited computation ability of Servers' CPU | Serving for many Clients |

# Building Modeling

- Multi-scale building models
  1. Block model
  2. Generic texture model
  3. Photo-realistic economic model
  4. Photo-realistic detailed model

# Performance of models

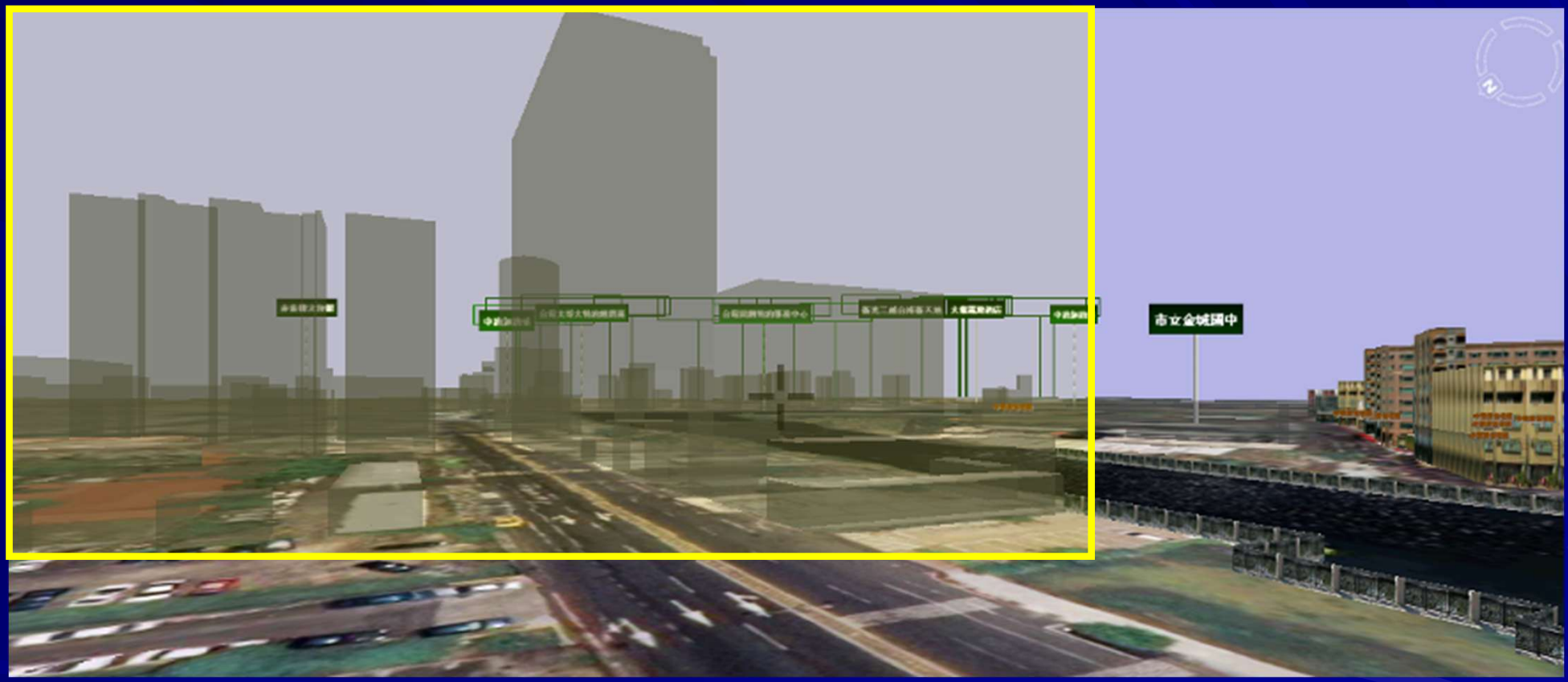
| Model Type | Characters | Loading | Performance |
|---|---|---|---|
| Block | Only nodes, no texture. | GPU | Highest |
| Generic texture | Texture stays resident in GPU. | GPU | Higher |
| Photo-realistic economic | Texture stored in Server. | GPU & bandwidth | Middle |
| Photo-realistic detailed | Texture stored in Server. | GPU & bandwidth | Low |

# Multi-scale building modeling strategy
## - depend on importance

| Model type | Distribution | Modeling |
|---|---|---|
| Block | **Outside** of the interest area | Assign building height |
| Generic texture | **Not** along the main roads | Extended from block model<br>•Roof : realistic texture<br>•Façade : generic texture |
| Photo-realistic economic | **Along** the main roads | 1.Generate block model<br>2.Assign roof type<br>3.Create billboard.<br>4.Photo-realistic texture mapping |
| Photo-realistic detailed | 1.Adjacent to the **junctions** of the main roads.<br>2.**Important** landmark buildings. | 1.Extended from economic model with detailed architecture.<br>2.Create arcade.<br>3.Photo-realistic texture mapping |

# Distribution

# Block model
## -Vertical façade and plate roof without texture



# Generic texture model
# -Vertical façade mapped generic texture

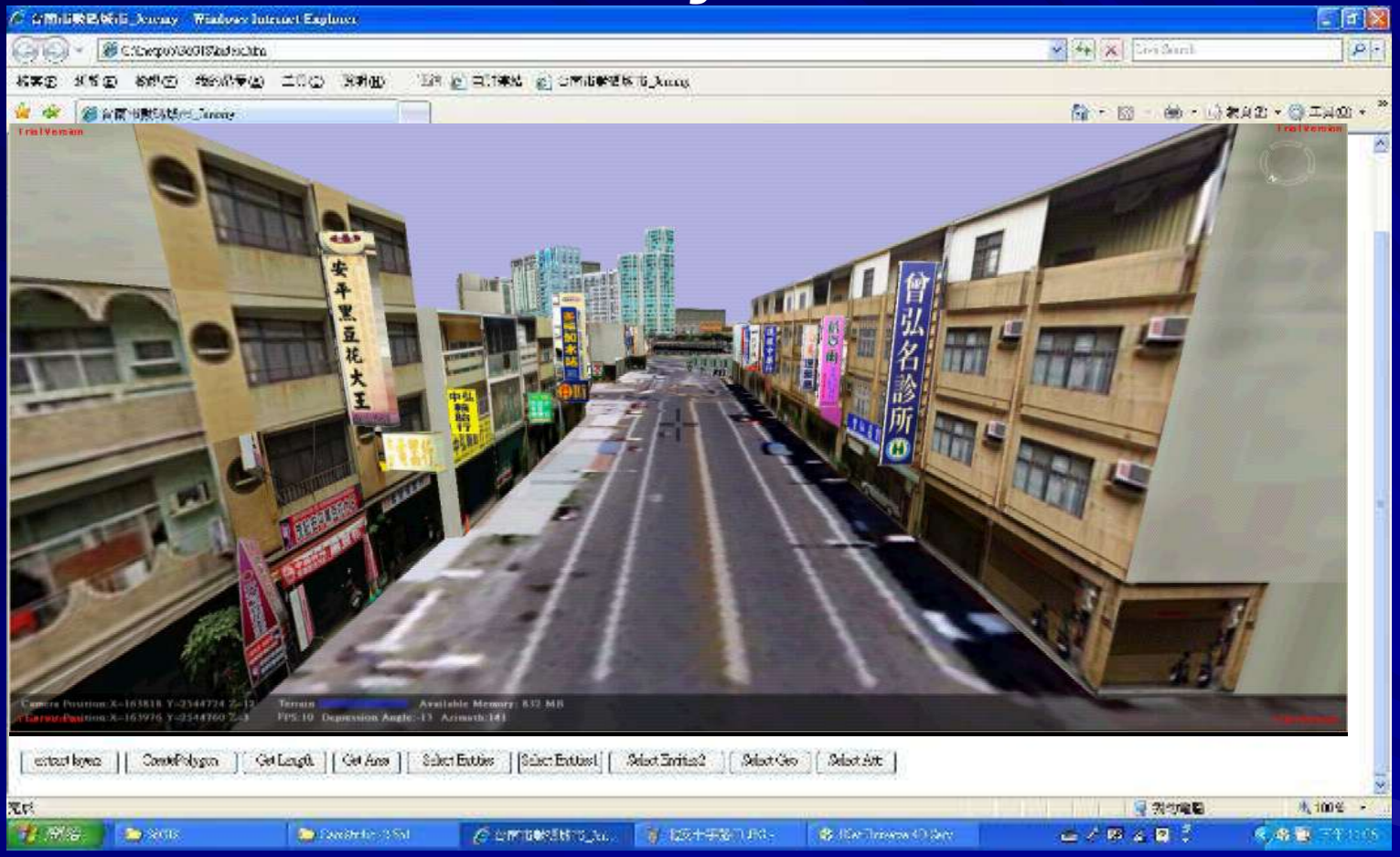

Generic textual model

In situ actual photo

# Generic texture model
# -To meet the overall visual effect

(Wen-Ping Road, Anping)

# Photo-realistic economic model - Realistic roof, façade and billboard



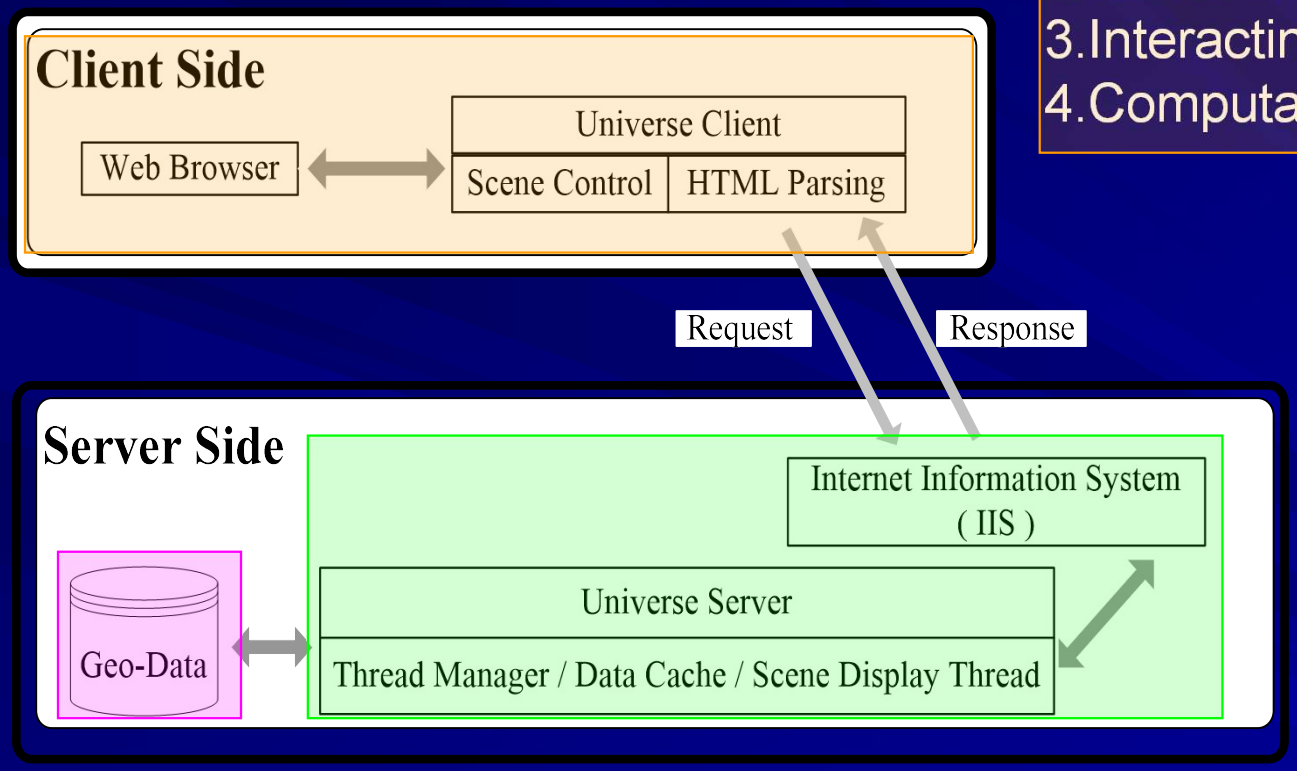

(An-Pei Road)

# Photo-realistic detailed model
## -Detailed geometry with photo-realistic texture

(Tainan City Hall)

# System

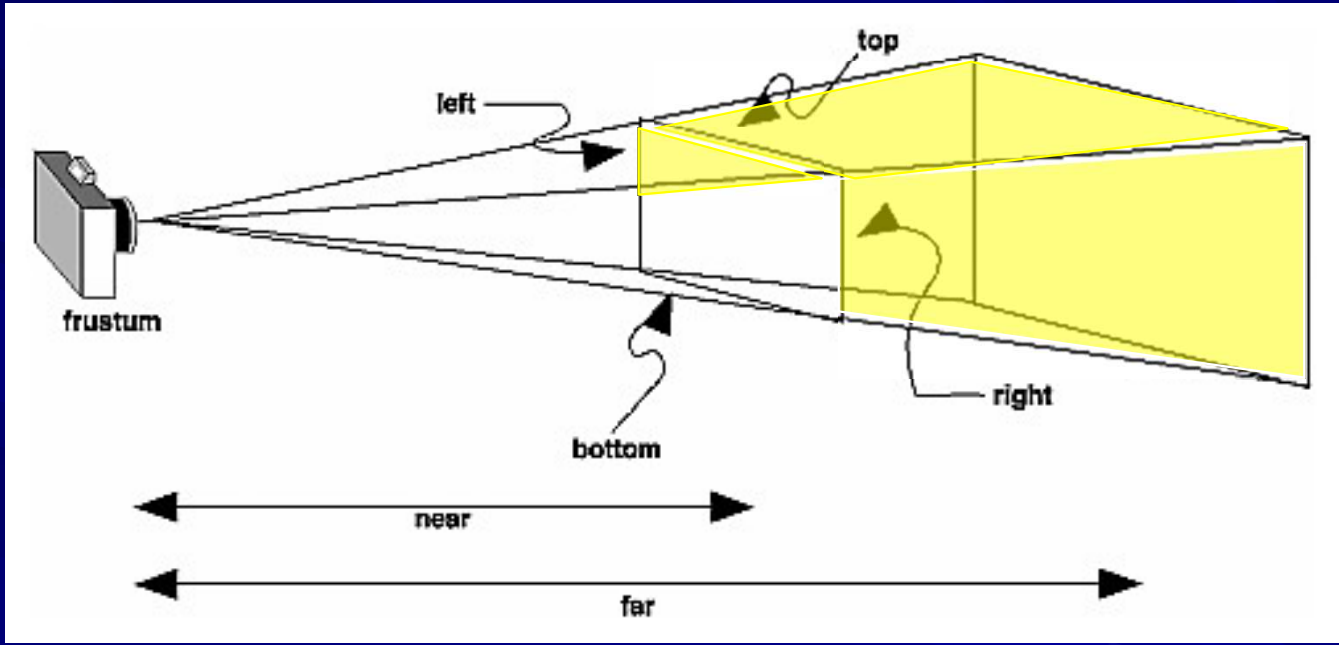
1.Request
2.Rendering 3-D scene
3.Interacting
4.Computation and spatial analysis




1.Extracting visible data
2.Image pyramiding and Compressing
3.Data transmission

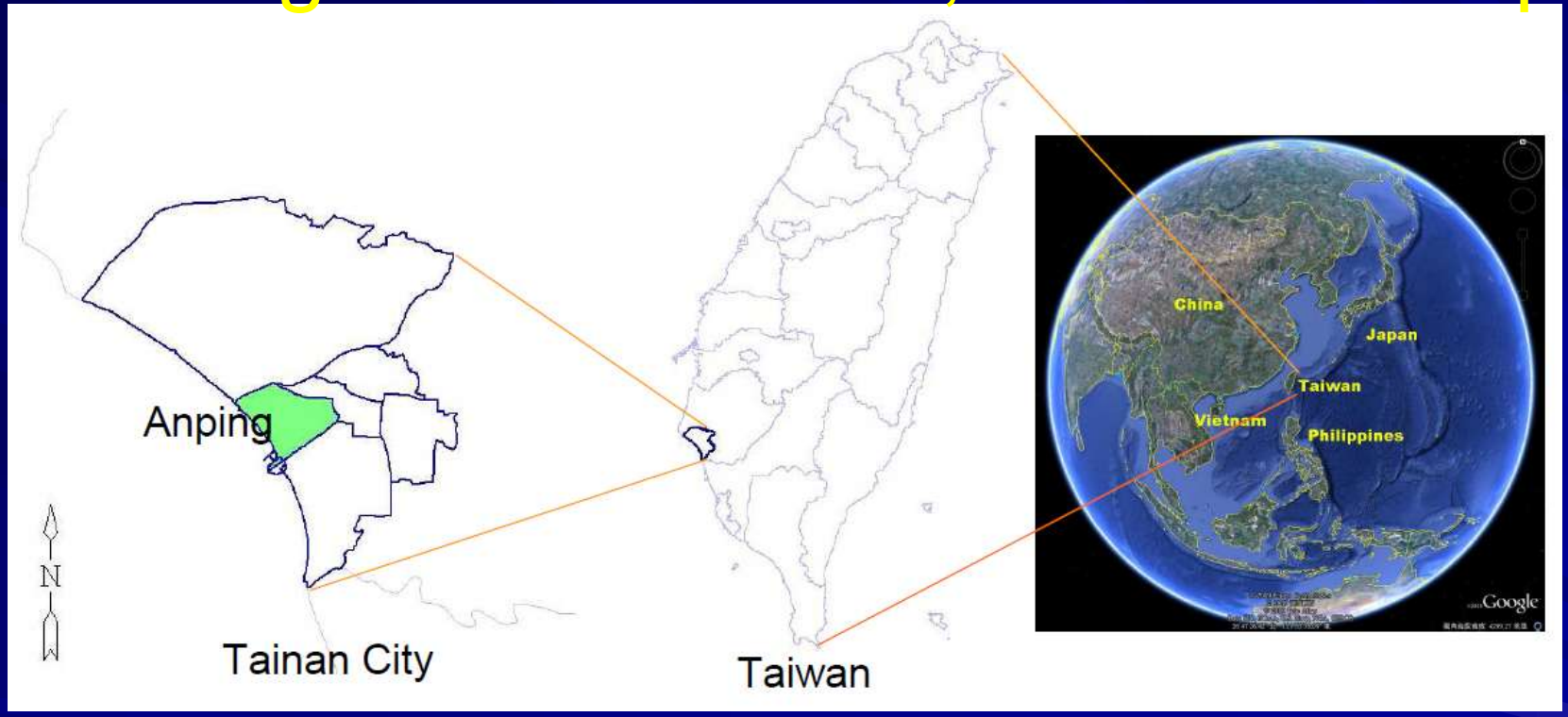
1.Preprocess: format transformation, re-projection, re-sampling, data analysis.
2.Real-time data delivering
3.Receiving request and provide data

# View-frustum



# Test area

"Getting to know Taiwan, starts with Tainan.
Getting to know Tainan, starts with Anping."




**Total Area: 11 Km$^2$ Total length of the main roads: 42.6 Km**

# Materials (1/3)
# -Basic

| No. | Item | Feature |
|---|---|---|
| 1 | Aerial ortho image (GSD10cm) | Grid |
| 2 | Digital elevation model (5m x 5m) | Grid |
| 3 | Route network map (1/1,000) | Line |
| 4 | Street address map (1/1,000) | Point |
| 5 | Road junction map, Anping | Point |
| 6 | Building/Architecture map (1/1,000) | Polygon |
| 7 | Topographic map (1/1,000) | Polyline |

# Materials (2/3)
# - multi-scale building models

| No. | Item | Feature |
|---|---|---|
| 8 | Block model | Polygon |
| 9 | Generic texture model | Polygon |
| 10 | Photo-realistic economic model | Model |
| 11 | Photo-realistic detailed model | Model |

# Materials (3/3)
# - The thematic maps of real estate

| No. | Item | Feature |
|---|---|---|
| 12 | NIMBY maps (a total of 13 layers) | Point |
| 13 | Zoning map (two layers) | Polygon |
| 14 | Landmark map | Point |

# Tools

| | |
|---|---|
| GIS 3-D modeling | PilotGaea Scene Producer™ ,Taiwan. |
| GIS Web Server | PilotGaea Universe™ ,Taiwan. |

# Location environment condition

- NIMBY (Not In My Back Yard)
  - 13 thematic layers
    - Dump, gas station, gas tank, grave field, the haunted house, factory, mobile base station, parking tower, taoism temple, high-voltage power line, radiation contaminated house, salt-sand house, and substation.
- Zoning

  Main division / Sub-division
- Land mark

# Location query system in real estate -not only a realistic 3-D viewer

- Buffer zone analysis
  - Location query
    - Assigning radius and layers
- City tour in 3-D scene
  - Automatic browsing
    - between scenic spots
    - between road junctions
    - between addresses
    - between  the defined by users on window
- Spatial measurement
  - 3-D
    - Distance
    - Area
    - Height
- Other spatial analysis
  - Profile analysis
  - Slope analysis
  - The shortest path determination
  - View-shade analysis

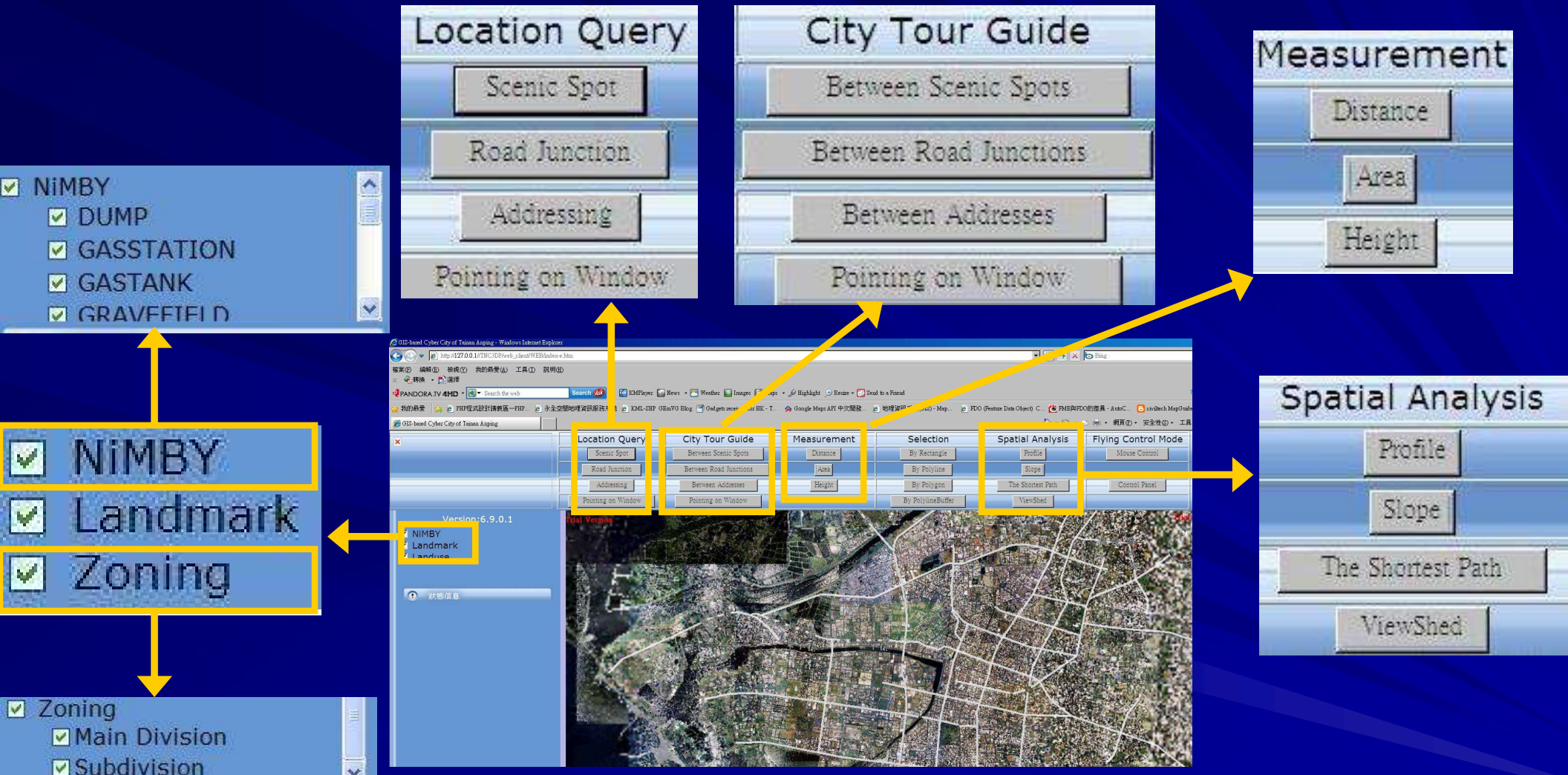
# Reconstruction strategy (1/8)

Total (*in situ*): 14,500 buildings

Reconstruction:

3,500 photo-realistic building models

# Location query system in real estate(2/8)



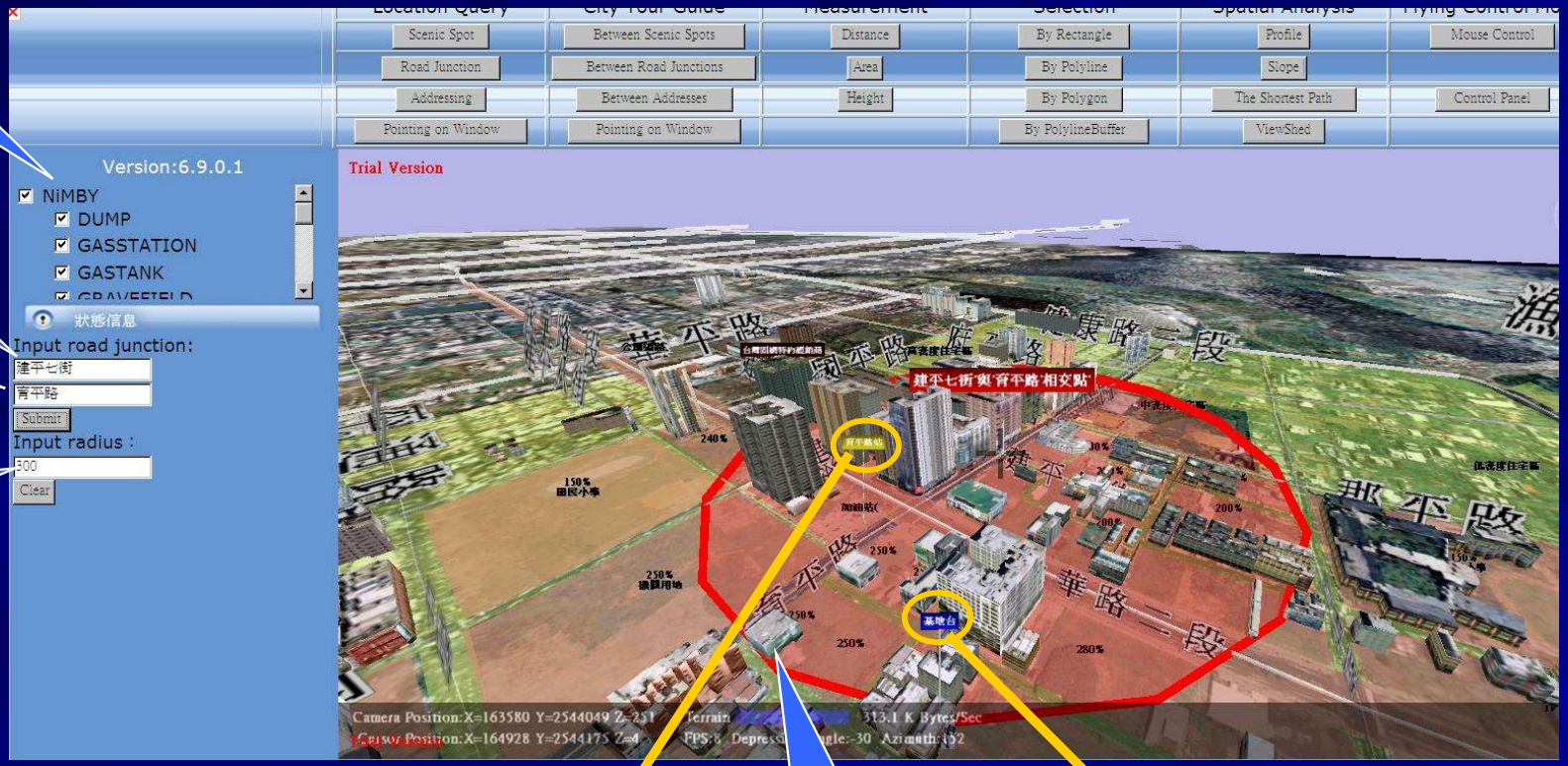
# Location query- Road junction buffer zone (3/8)

NIMBY

Road 1

Road 2

Radius = 300 m




Yu-Ping Gas station

Buffer zone

Mobile base station

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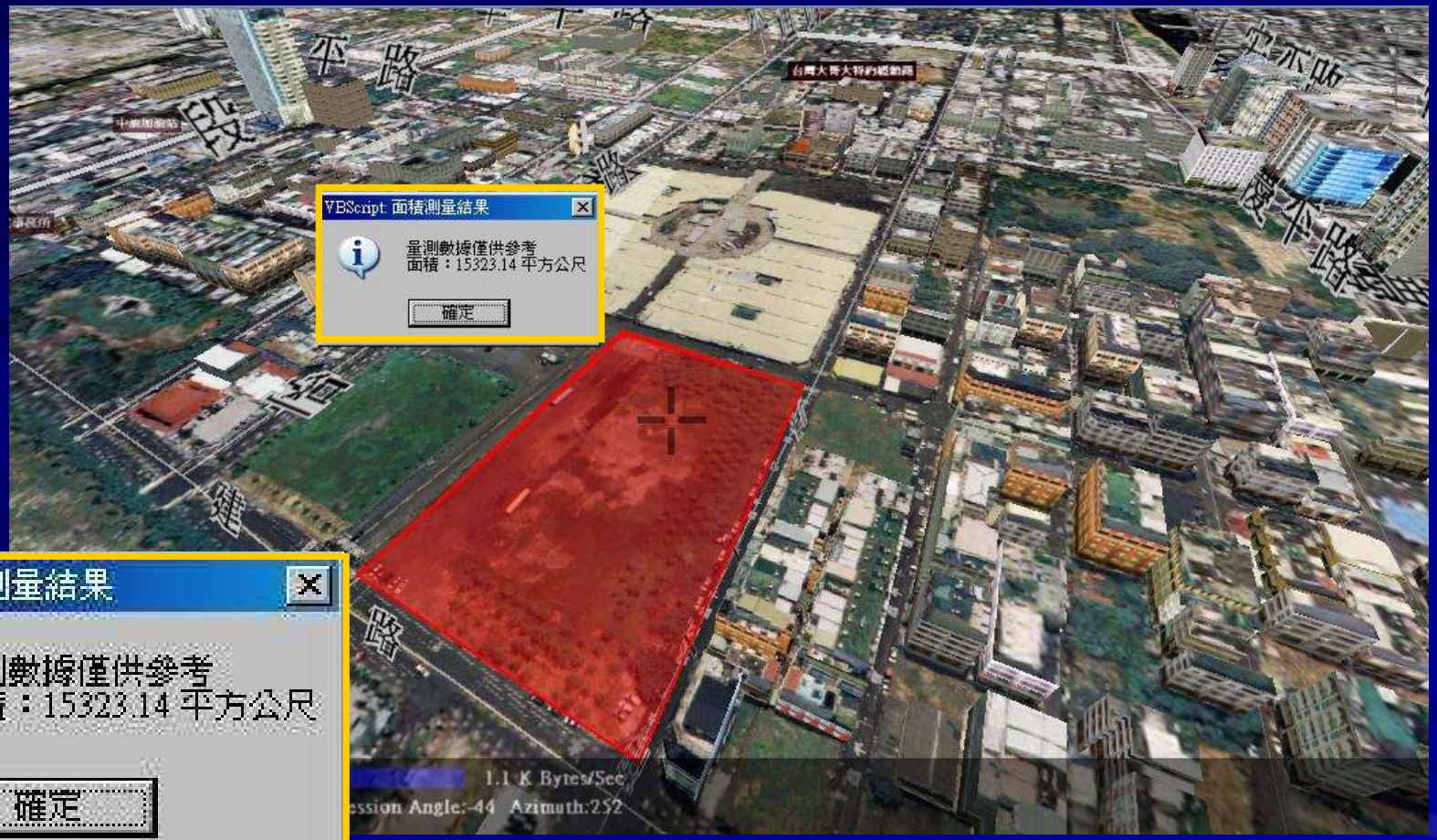
# Location query- scenic spots buffer zone (4/8)

# Area measurement (5/8)

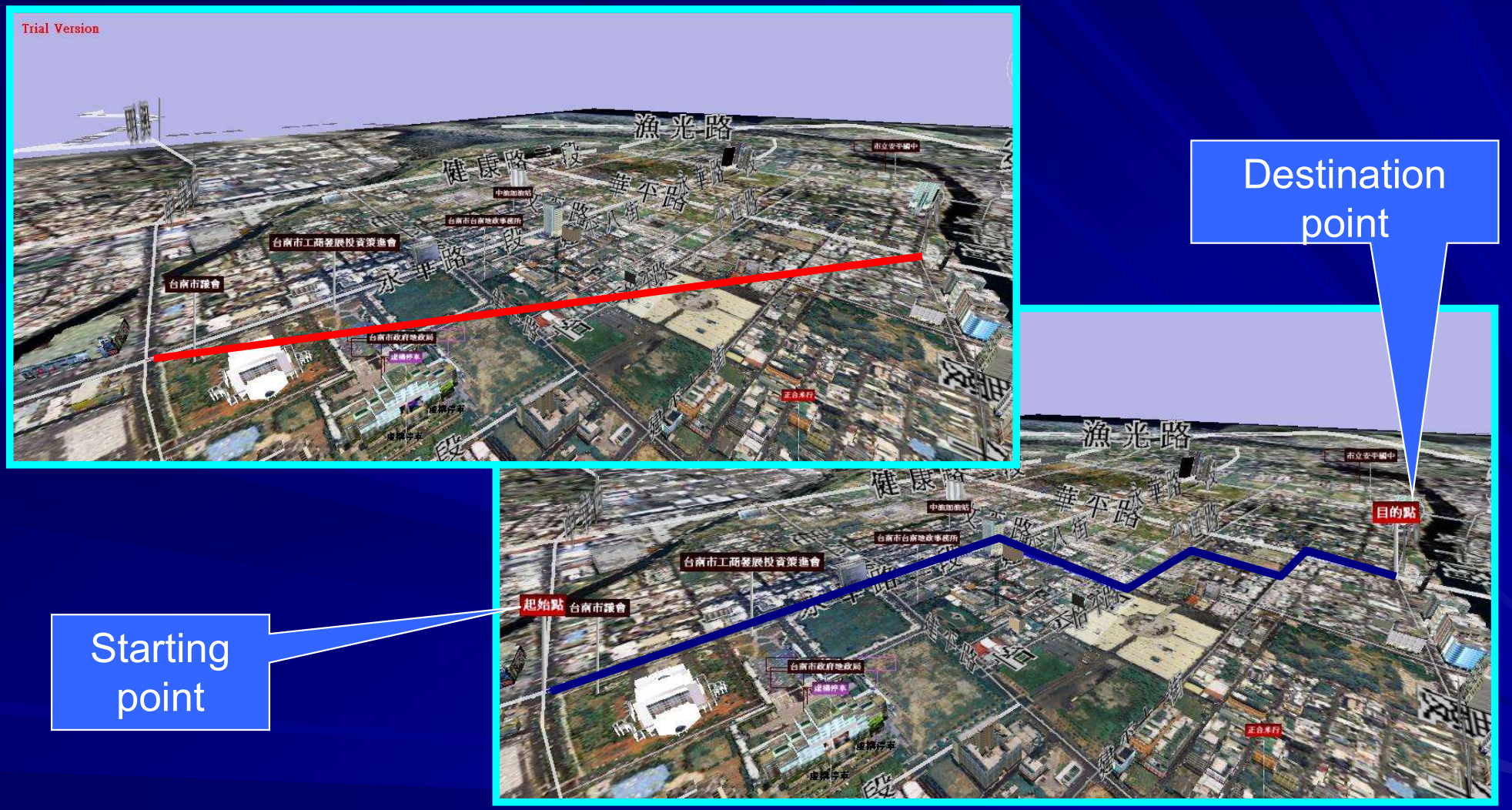



VBScript: 面積測量結果
量測數據僅供參考
面積：15323.14 平方公尺
確定

# Height measurement (6/8)

# Flooding potential (7/8)
# -Terrain profile analysis

# The shortest path analysis(8/8)



# Conclusions
# -Reconstruction

- Compatible with 3-D Web GIS
- Detailed representation in geometry and texture
- High performance rendering
- Cost-effective

# Conclusions
# -Real estate application

- 3-D photo-realistic viewer as well as query system
- A buyer-orientated system
- Displaying location information in 3-D scene
- Flooding potential
  - via profile and slope analysis
- Web 3-D GIS
  - A suitable tool for Real estate
  - Determining platform first, then modeling tool
  - Integrating multiple applications on a city model

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Thanks for your attention