Roadway Sign Based on GIS

Chia-hao Chen, Dr. Tien-yin Chou, Dr. Ker-tsung Lee, Dr. Da-jie Lin
Mr. Lan-kun Chung, Mr. Tsung-lung Lee, Mr. Yu-cheng Chang

Abstract

For decades, the Taiwan government has constructed a complete highway network for the purpose of providing passengers with more route choices and enhancing the quality and efficiency of transportation. Since in the past the roadway network were not systematically planned, road signs were plagued by inconsistency. Therefore, in this project, we made a spatial roadway network based on GIS. So repeated or meaningless information will not influence passengers and then further features of the highway network can be developed.

Introduction

Over the past decades, the Government has completed an overall freeway system including two North-South National freeways, 12 East-West freeways, and western coastal highway in Taiwan area. So that passengers for the mid and long trip have a variety of route choice in the coming future. Signs and location designs in the network system are far more complicated and significant than those on the single route system. Recently, sign location and text are designed by manual processes. Since the highway network is getting more complicated, the authorities who plan roadway signs cannot just consider the "point" but must consider the "line" and "polygon". Accordingly, a systematic and objective tool is necessary for sign design. This study emphasizing on developing sign design system based on GIS is used to facilitate sign design and solve existing problems.

Principles of roadway sign design

The overall highway sign design including six features- consistence, hierarchy, coherence, uniformity, readability, and alternative is based on the concepts that passengers need to refer to maps to find the destination and signs should display gradually. Also, map use means people should develop a habit of reading maps and collecting route information before leaving so that people can get hierarchical and coherent information according to the systematic design. Several features are interpreted as bellows:

1. Consistence
   In order to facilitate recognition, different signs mounted on the same pole should be consistent, and the existing sign should divide into direction and lane.

2. Hierarchy
   Sign texts should be classified according to the hierarchy; destinations shown on the signs have to be consistent with highway level.

3. Coherence
   Signs mounted on different poles and surrounding guide signs should be coherent to avoid confusing passengers while driving.

4. Uniformity
   The number of guide signs with the same significance should be unified to prevent from any excess or insufficiency of signs. For example, if guide and informational signs with the same significance display over six times, it doesn't meet the uniformity criterion.

5. Readability
   The response time of reading and judging guide signs will affect the acceptance of information. Thus, readability means the number of signs and words that drivers can read under standard speed limit. In case of over six

guide signs within visible range, it doesn't meet the readability criterion.

Tools of system development

The system of roadway signs is based on Windows 2000 and adopts ESRI ArcGIS 8.X as a development platform. In the creating stage, we use ACCESS as the back-end database; also, we employ Macromedia Flash MX 2004 for system interface. The built-in ArcObject of ArcGIS and VBA are used to integrate with back-end ACCESS databases to enhance comprehensive data processing.

Methods of spatial analysis

Spatial analysis

1. Preparation tasks

a. Investigation on major landmarks

According to the landmark information together with available picture data and on-site survey, different layers of location could be built by different levels and attributes to facilitate spatial analysis and searching and to recognize specific information.

b. Establishment of roadway crossing point

To establish crossing point can rapidly get and judge the spatial information of crossing point and search surrounding connecting roadways. Meanwhile, passengers can see if roadways cross or not to prevent overpass from parallel crossing.

c. Coding roadway

For integrating roadways, it is a need to add an attribute by road names and levels in current road layers. Coded roadways possess major code and minor code. The former is used to judge and query roads at the same level or name; the latter is used to judge the direction and coherence of the roads we have found. This method could recombine road line and benefit road search.

2. Analytic methods

After coding, each roadway has only code that can search an overall roadway collection, and then recombine and sort roadways through the sequence of code or spatial location.

A. Search by major landmarks

We can gain individual roadways surrounding intersection according to the mode. By using the roadways to search the length and width along the center of roadway, a buffer will be created. The landmark shown within the buffer is the major target.

1. Designate intersection and search either target roadway or major roadway.

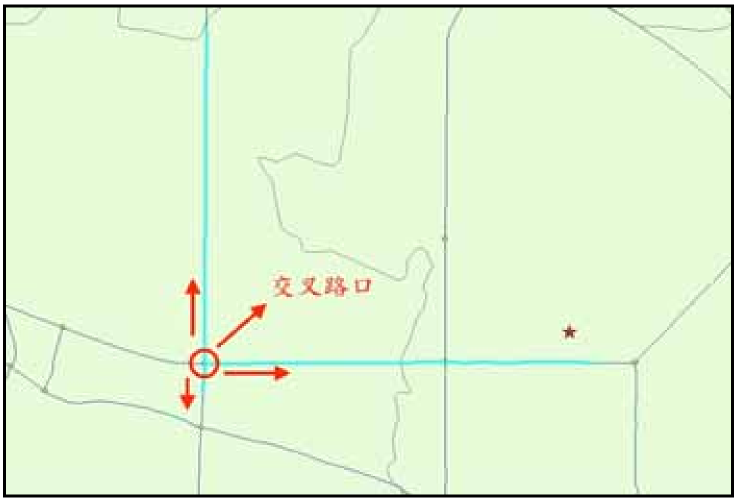
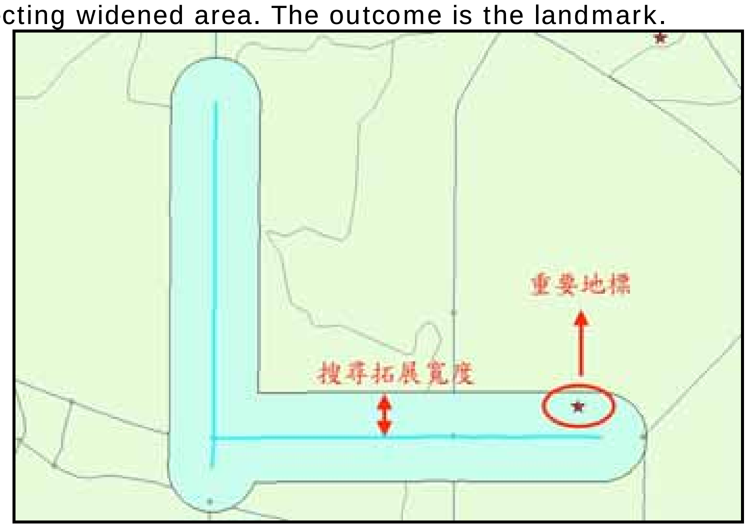


Fig. 1 Search intersecting target road.

2. Designate road length and search width, and then search main landmarks intersecting widened area. The outcome is the landmark.

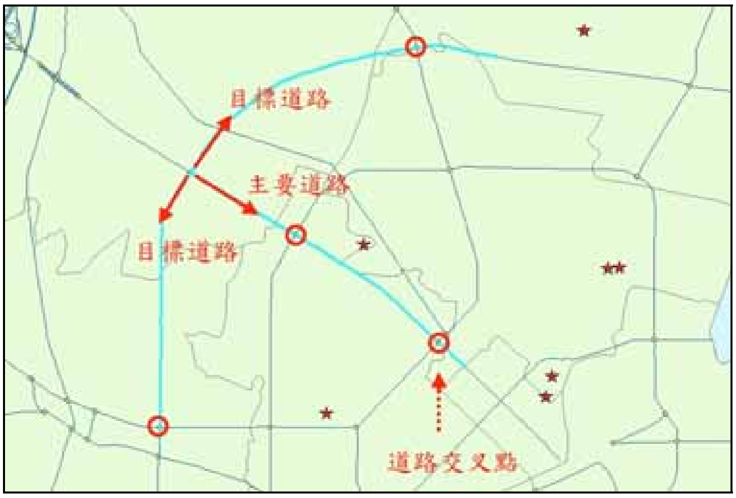


B. Search by intersecting roadways

As the same way shown above, we get major and target roads near the intersection and search either major roads or together with intersecting target roads, and also designate length. While searching, we should check if the location of intersection setting in the preparation process cross with the road for the purpose of judging major or target road intersecting with other roads. Also, we use the location of intersection as a condition that we further search surrounding roads crossing with intersection.

1. Designate major roadway.

2. Designate both major and target roadway and then search simultaneously.



C. Search by surrounding border

We get major and target roads near the intersection and search either major roads or together with intersecting target roads according to the mode, and also designate length and width along the road center. If we don't search the width along the road center, we merely get the information of intersection boarder; oppositely, we can get the information within the widened area.

1. To select main roadway and set the buffer width as 0 to obtain the intersecting border whose crossing point is used to calculate roadway length.

Fig. 2 Select major roadway and set buffer width as 0.

2. Select major road and set fixed width. If the road intersects with the border, the intersection is used to calculate the road length. Oppositely, if the widened area intersects with the border, it is a need to search whether other roadways intersect with the border, and set the crossing point as the calculation basis. If no crossing with the border, the shortest distance the crossing points within the buffer is treated as length of calculation.

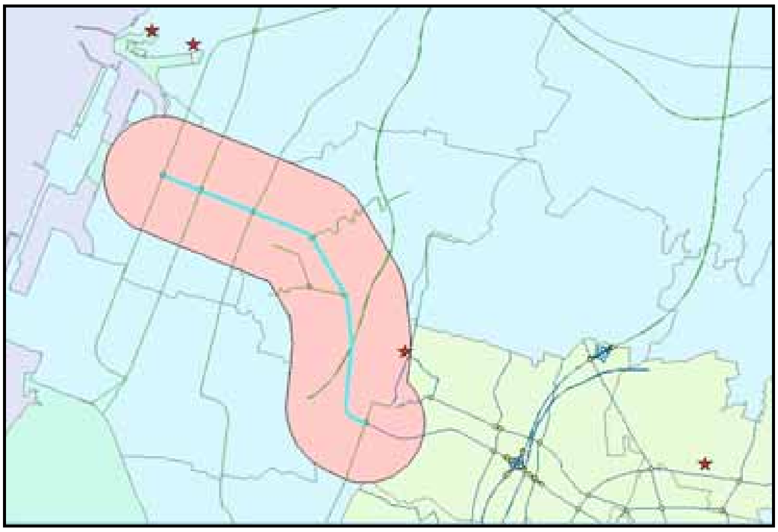
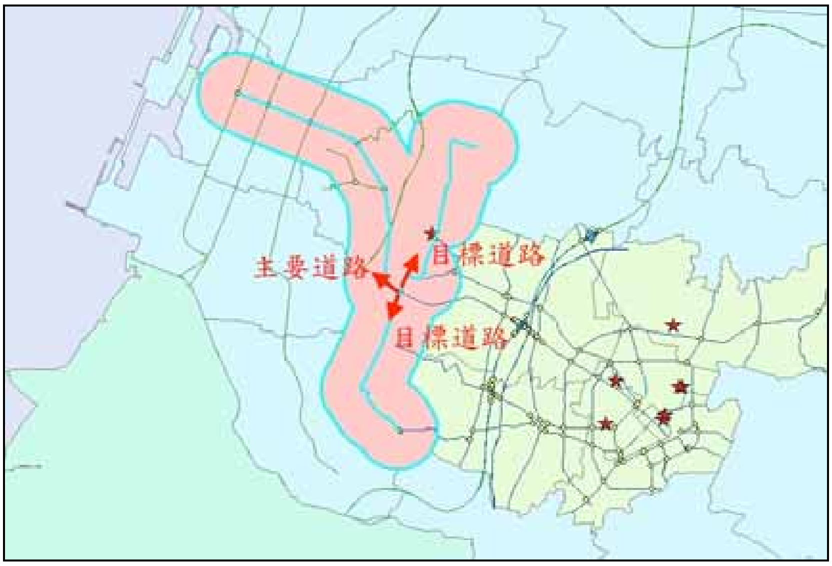


Fig. 3 Select major roadway and set buffer width.

3. Select main roadway and target roadway, and set buffer width.



Conclusions

1. The maintenance and construction of roadway signs are taken charge by different units; therefore some problems relating to construction and management still exist at present.

2. Currently, sign location choice and contents mainly rely on manual process. We suggest using the Fuzzy Theory to view, adjust, and plan roadway sign system in the future.

3. The correctness of system output is depending on the data completeness. Thus, roadway data collection and establishment are supposed to take charge by the authorities of City/County Government and are integrated by the Central Government.

4. Suppressed by insufficient or incorrect original data, the results of spatial analysis are quite different from the expectancy. In addition to the time and accuracy of data, it is also a matter of ineffective roadway network in the past. Therefore, it is a priority to build complete primary data.

Author Information

Chia-hao Chen
GIS Research Center, Feng Chia University,100 Wenhwa Rd., Taichung, Taiwan, R.O.C,Taichung, 407 ,TW ,+886-4-24516669 302 ,sky@gis.fcu.edu.tw

Dr. Tien-yin Chou
GIS Research Center, Feng Chia University,100 Wenhua Rd., Taichung, Taiwan, R.O.C. Taichung, 407 TW +886-4-24516669 100 jimmy@gis.fcu.edu.tw

Dr. Ker-tsung Lee

Feng Chia University,100 Wenhwa Rd., Taichung, Taiwan, R.O.C. Taichung, Taiwan 40724 ,TW ,+886-4-24517250 4660, ktlee@fcu.edu.tw

Dr. Da-jie Lin
Feng Chia University,100 Wenhwa Rd., Taichung, Taiwan, R.O.C. ,Taichung, 407 ,TW ,886-4-24517250 4670 ,dajielin@fcu.edu.tw

Mr. Lan-kun Chung
GIS Research Center, Feng Chia University ,100 Wenhwa Rd., Taichung, Taiwan, R.O.C. ,Taichung, 407 ,TW ,+886-4-24516669 300, peter@gis.fcu.edu.tw

Mr. Tsung-lung Lee
GIS Research Center, Feng Chia University,100 Wenhwa Rd., Taichung, Taiwan, R.O.C., Taichung, 407, TW, +886-4-24516669 306, jones@gis.fcu.edu.tw

Mr. Yu-cheng Chang
GIS Research Center, Feng Chia University, 100 Wenhwa Rd., Taichung, Taiwan, R.O.C., Taichung, 407, TW, +886-4-24516669 305, ivan@gis.fcu.edu.tw