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ESASGD 2016

GIS-IDEAS 2016

International Conference on GeoInformatics for Spatial-Infrastructure Development in Earth & Allied Sciences (GIS-IDEAS)

Bus route mapping by schematic for HoChiMinh city

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Abstract

Schematic maps bring the visual look to the user because it overcomes the defined rules in traditional map. Schematic maps are applied in many fields, especially in public transport. This study uses network model in GIS and rules in schematic map to create the bus map in Ho Chi Minh City. Network model of bus system were built based on ArcGIS software and ArcGIS Schematic Extension to construct map of bus routes. Results of the study showed advantages of applying schematic map for Ho Chi Minh City bus map. The connectivity of bus map, bus stop and bus station were displayed visually and obviously. Data of bus system were built in GIS can be updated and edited easily. Additionally, users can create different types of schematic bus map for many purposes.
Keywords: GIS; Public transport; Network Model; Schematic map; Routes map

1. Introduction

In process of urbanization, there are more people using public transport, especially under population pressure and the increasing number of individual vehicles. Useful information of bus route for passengers is one of the most basic requirement for bus service.. Presently, finding the bus route by using mobile devices with web browsers give much utilities for users, because these with map browser apps can quickly give information on bus routes by the user needs. However, not everyone can owns mobile devices and to be skillfull enough to use map browser apps on these . Therefore, the bus routes maps in printed form still play an important role in providing information of bus routes.

Schematic maps are highly general maps used for representing routes in a transport system or in any kinds in which streams of objects at nodes in a network play a role, such as cartographic schemas for gas, water or electricity mains (Avelar S., Hurni L., 2006). In worldwide large cities, the public transport system is presented as a schematic map,. in which the contents of main information are highly generalized, particularly the information of the bus routes are described obviously and visually. Besides, these bus route schematics can assist passengers on how to identify where to come a wanted place, such as they will know how many bus stops, bus stations or how many bus routes they have to catch or changes to come a place. Based on the advantages of schematic maps in the public transport system, this study applies this kind of diagram to the bus routes map in Ho Chi Minh City

Designing schematic map is often made by using graphic softwares (such as Adobe illustrator, Corel Draw, AutoCAD,…) by thathowever, takes much time and effort. In other ways, GIS softwares packages can be applied to create schematic map. Since the bus route system data is stored in GIS, these spatial data can be quickly and correctly transformed into schematic forms (Samanah S.S., 2014). In this study, ArcGIS software package with Schematic Extension is utilized..

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2. Data and method

2.1. Data

- **Collecting data**: Data of bus system were built including: bus routes, bus stops and bus stations based on bus routes information of Ho Chi Minh City Public Passengers Management Center and Open Street Map. Because the number of bus routes and bus stops are large, only 18 bus routes, 217 bus stops and 12 bus stations covering a part of the city are collected for this study (Fig. 1)., then the data is standardized and stored in geodatabase.

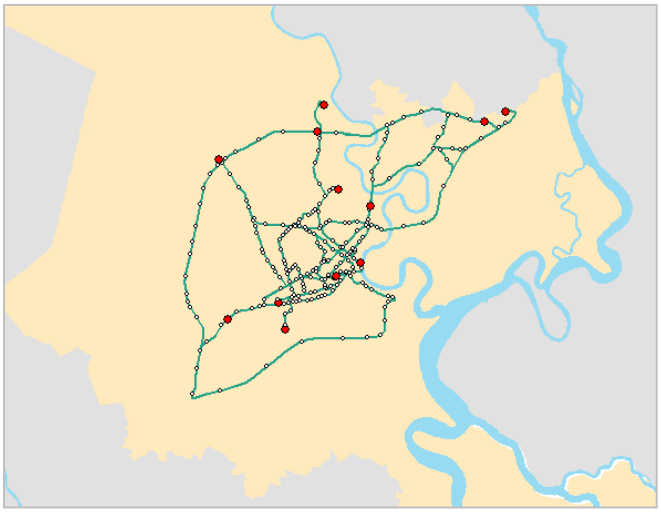

Fig. 1. Data of bus system in Ho Chi Minh City

- **Modelling network dataset**: Network dataset model in ArcGIS is suitable for model transportation network. There are three kinds of network elements in network dataset: Edges (Connect to other elements and are links over which agents travel), Junction (Connect edges and facilitate navigation from one edge to another), Turns (Store information that can affect movement between two or more adges) (ESRI, 2012). In this study, bus system was modeled base on network dataset model, including bus routes like "edges" and bus stops, bus stations like "junctions" (Fig. 2).

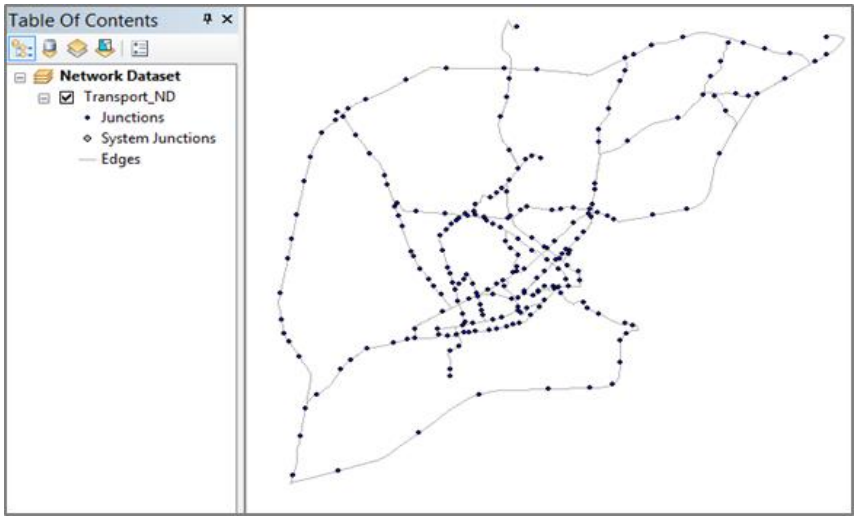

Fig. 2. Network dataset of bus routes

2.2. Schematization method

Information in schematic maps are represented in a different way to topographic or traditional maps. In particular, distance and direction are not displayed in a similar way as in a topographic or traditional map (Berendt, B., Rauh, R., Barkowsky, T.,1998). To make a specific form for schematic map, some algorithms to

transform traditional map of bus routes were appiled. In this study, three algorithms of Geo – Angle Directed, Geo – Linear Dispatch and Separate Overlapping Links were utilized.

2.2.1. Geo – Angle Directed algorithm

Geo – Angle Directed algorithm (Fig. 3) moves the diagram schematic links in alignment direction. For each schematic link, the algorithm searchs for the nearest suitable direction between 30, 45, 90 degree angles and move the links in this direction.

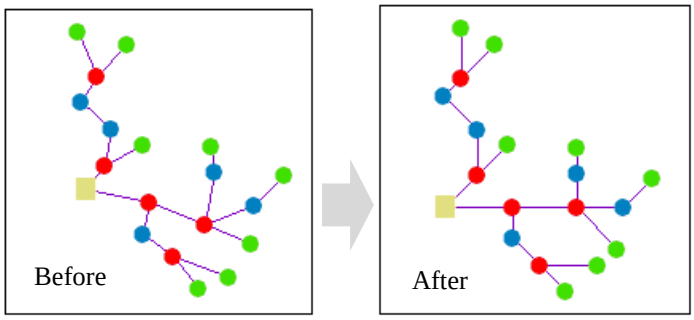

Fig. 3. Schematic link was moved by Geo – Angle Directed algorithm (ESRI, 2012)

2.2.2. Geo – Linear Dispatch algorithm

This algorithm seperates schematic nodes that are close or overlap each other. It moves these schematic nodes linearly along their connected schematic links, and equally the distance between each nodes (Fig.4).

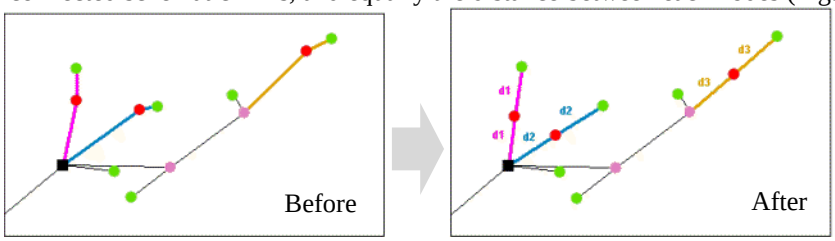

Fig. 4. Schematic nodes was moved by Geo – Linear Dispatch algorithm (ESRI, 2012)

2.2.3. Separate Overlapping Links

Separate overlapping links algorithm (Fig.5) separates shematic links that are overlap and connected to the same origin. Distance between two seperated links according to the parameters set on the option tab.

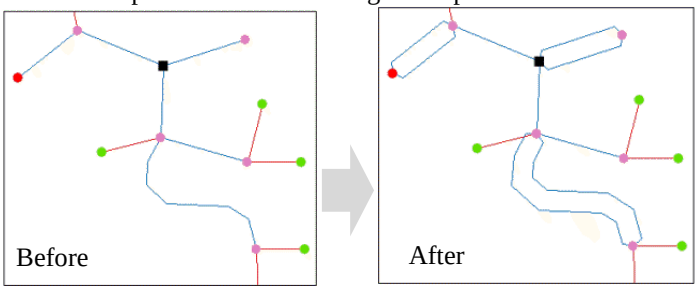

Fig. 5. Schematic links was separated by Separate Overlapping Links algorithm (ESRI, 2012)

3. Result and disussion

3.1. Result

3.1.1. Schematic of bus routes in Ho Chi Minh City

The map of bus routes (Fig. 8) were built by using above algorithms, which is obvoiuosly different to a traditional route map as showed in the leftt figure.

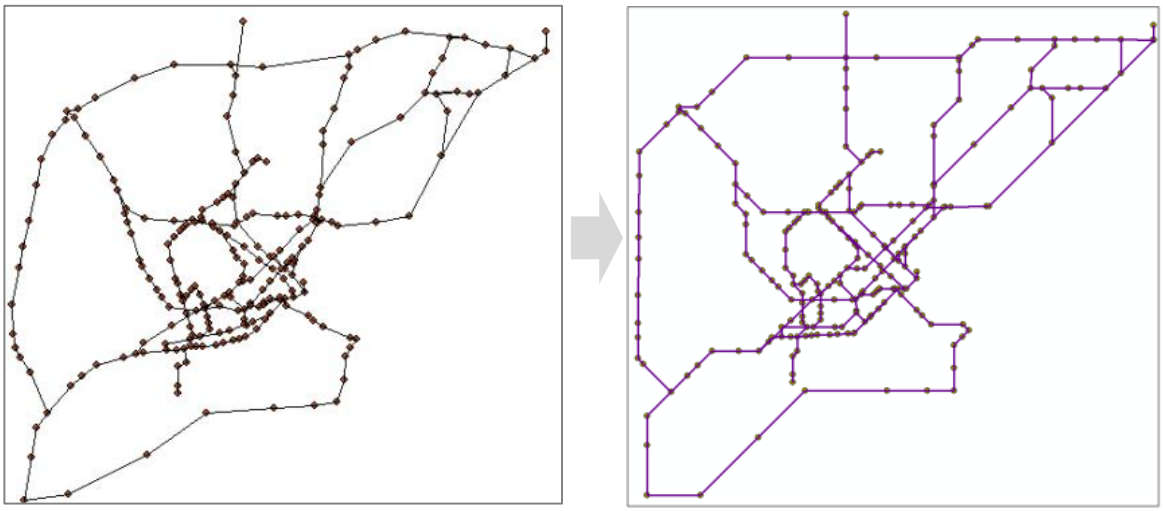

Fig.6 . The difference of bus system network after using algorithms to schematization

In the situation of Hochiminh city, at the center of this schematic, density of routes are much higher than that of in the periphery area. This makes lay-out the schematic is not well proportioned and it is difficult to identify a route at the center. This requires to rearrange the lay-outby manual adjustment in order to read the routes easier (Fig. 7). Then the Find overlapping links tools is used to find overlapping links and using Separate overlapping links algorithm to separate them (Fig. 8).

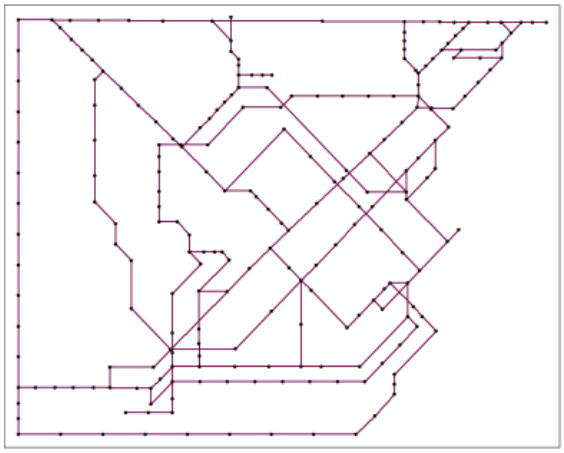

Fig. 7. Schematic of bus routes after adjust

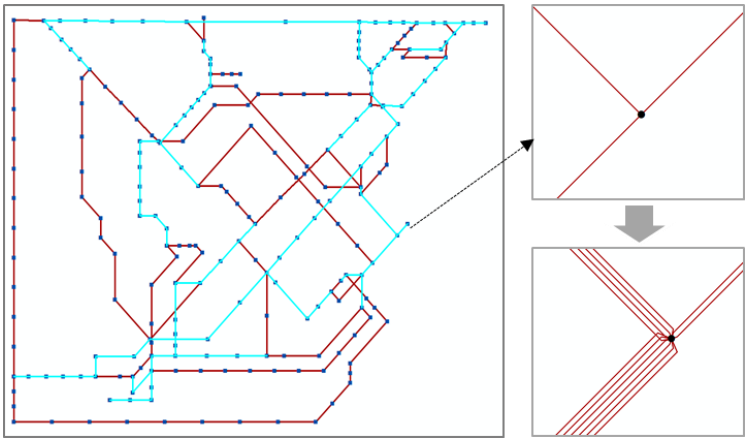

Fig. 8. Find and separate overlapping links

After that, public landmarks in Ho Chi Minh City were added, this support users can navigate easier.

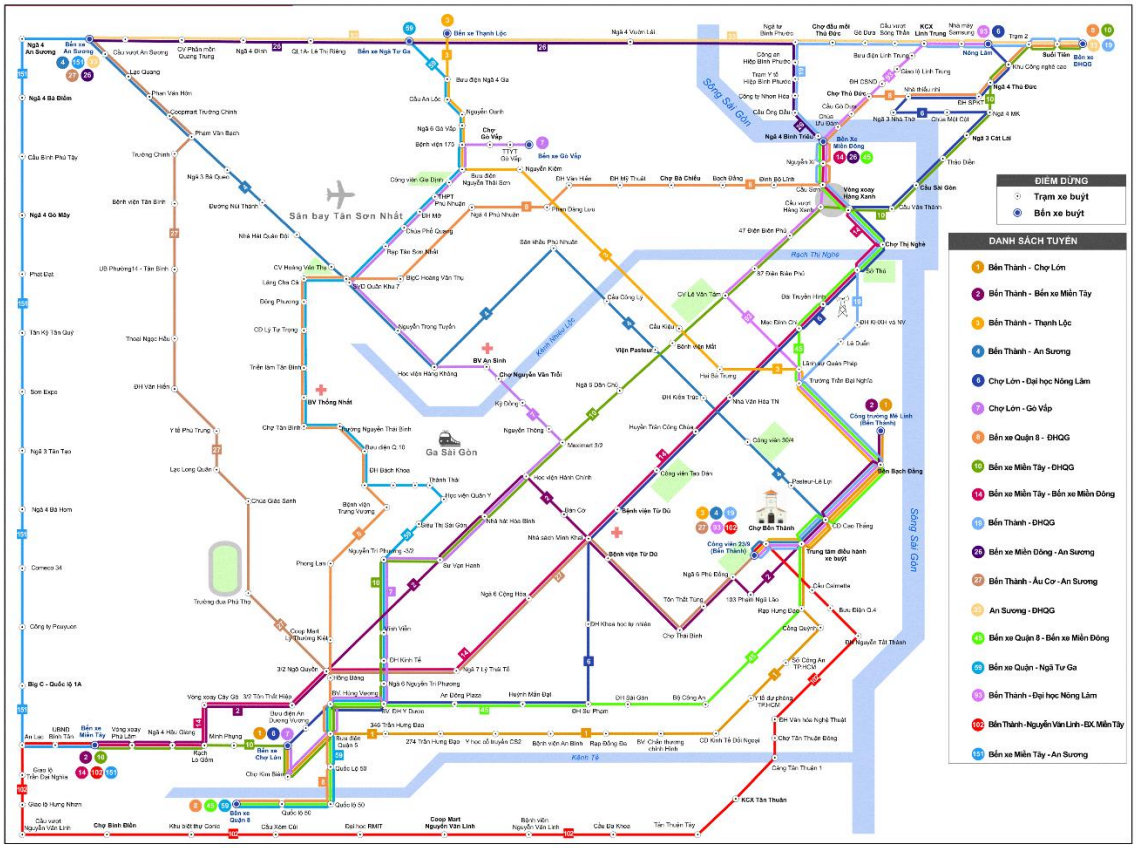

Fig. 9. Schematic map of bus routes in Ho Chi Minh City

In addition, other schematic forms such as: bus routes schematic at a position and schematic for a bus route can be made just based on the GIS data.

3.1.2. Bus routes schematic at a position

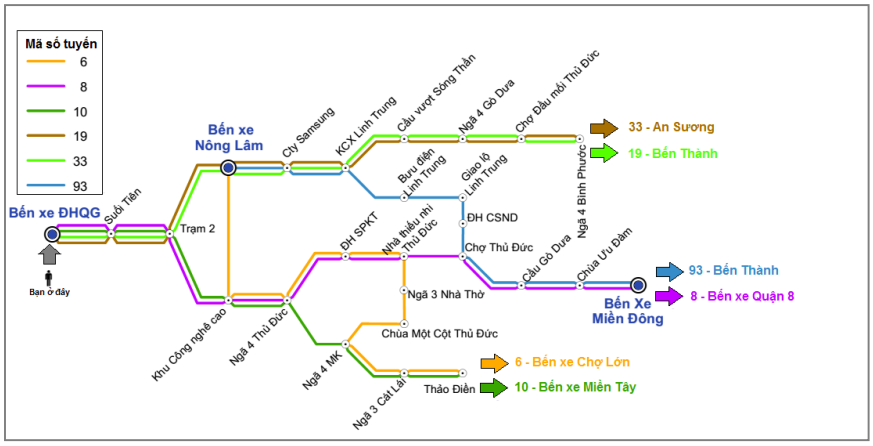

Fig.10. Bus routes schematic map from a position

This is schematic of bus routes at a position using Hierarchical - Smart Tree algorithm. This algorithm creates bus routes schematic to support people stand at a position easily looking for a bus route.

3.1.3. Schematic for a bus route

When we query a bus route in bus system network dataset, we can create schematic of this bus route. This schemtic shows information about bus stops and bus stations of this route.

Fig.11. Schematic map of a bus route

3.2. Discussion

There are more advantages about information-identified speed, aestheticism and clarity as using the bus route schematic-map than doing with the traditional maps. However, there are some disadvantages. Because schematic map are original applied for subway system, the users just concern about the order of stations. For this reason, the information about the names of streets of a schematic map can be minimize. If the users just know the name of the street but doesn't the name of the bus stop, it's hard for them to use schematic map. To solve this problem, some landmarks and main rivers were added to the schematic map to support users identify a place..

Because schematic diagrams are mainly used to design for subway systems, the number of sub-route is much less than 107 bus routes in Ho Chi Minh City. The result is that there are many disadvantages when applying this kind of map to Ho Chi Minh City bus system. If 107 bus routes are showed in a schematic map, only the great map size is able to show all the stations and their labels, while a map must be small enough for users to be handy. As presented above, when there is enough data at large volume , GIS can help to create many types of map automatically and exactly. To solve the problem of the a great number of bus routes in Ho Chi Minh City, a series of route maps can be made by using GIS softwares packages. These maps show the bus systems of each area of the city. These are marked by code to be able to link when it needed so that users can choose a suitable map for their own route.

4. Conclusions

Application of schematic map in GIS not only at visuality information of bus routes but also can be used in managing and controlling bus system. When data of bus routes is built completely for the whole system, managers can control the system effectively, also analyse different situations to arrange routes reasonably. Besides, when bus routes are changed, data can be updated and new schematic can be easily and quickly re-built.

In Ho Chi Minh City, the metro project is being built and going to be put to use in the near future. Thus, the result of this study is applied not only to bus system but also to other public transportation types. When the metro in Ho Chi Minh City is done, combining bus system and metro system into one schematic map will bring great meaning in helping passengers look for the most optimal route in public transit system.

That schematic map helps us improve information provision ability about public transportation types contributes to enhance service quality. Thenceforth, we direct to a target to limit congestion in the city.

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