

The construction of the spatio-temporal database of the ancient Silk Road within Xinjiang province during the Han and Tang dynasties

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Abstract. As the bridge over the Chinese and Western civilization, the ancient Silk Road has made a huge contribution to cultural, economic, political exchanges between China and western countries. In this paper, we treated the historical period of Western Han Dynasty, Eastern Han Dynasty and Tang Dynasty as the research time domain, and the Western Regions' countries that were existed along the Silk Road at the mean time as the research spatial domain. Then we imported these data into the SQL Server database we constructed, from which we could either query the attribute information such as population, military force, the era of the Central Plains empire, the significant events taking place in the country and some related attribute information of these events like the happened calendar year in addition to some related spatial information such as the present location, the coordinates of the capital and the territory by inputting the name of the Western countries. At the same time we could query the significant events, government institution in Central Plains and the existent Western countries at the mean time by inputting the calendar year. Based on the database, associated with GIS, RS, Flex, C# and other related information technology and network technology, we could not only browsing, searching and editing the information of the ancient Silk Road in Xinjiang Province during the Han and Tang Dynasties, but preliminary analysing as well. This is the combination of archaeology and modern information technology, and the database could also be a reference to further study, research and practice in the related fields in the future.

1. Introduction

2000 years ago, the Silk Road, as the witness of the cultural exchanges between the East and West civilization, had made an outstanding contribution to the East and West economical, political, cultural, and military communications in history. After thousand years of development and evolution, the Silk Road experienced the original stage, developing stage, prosperous stage, waning stage and finally discarded. Han and Tang Dynasties have played decisive roles in the process of the evolution of the Silk Road. Han Dynasty was in the original, developing, and preliminary prosperous stages; whereas the Tang Dynasty was in the heyday of the Silk Road. Therefore, this paper took the Han and Tang



Dynasties as the time domain to the research on the ancient Silk Road. Xinjiang Uygur Autonomous Region is located in the northwest of China, was referred to as 'The Western Region' in the ancient time. In 60 B.C., the Western Regions Frontier Command was established by the central government of the Western Han Dynasty, since then Xinjiang officially became a part of Chinese territory, and became the 'Frontier Fortress' of the Silk Road, which bridged the gap between both Eastern and Western culture in history^[1]. So this paper takes the Silk Road within the land of Xinjiang Province as the spatial domain. , Associated with database technology, by which we could upload the relevant data onto the ORACLE and MySQL database, a Historical Place Name Database of The Ancient Silk Road in the Han and Tang Dynasties could be established. This database could realize the online inquiries for historical place name^[2]. Furthermore, by applying the network information technologies such as PHP, Flex, we could publish the electronic map which includes the information of the ancient Silk Road on the internet for public browsing, inquiring and learning. So that we could finally realize the combination and application of modern information technology and archaeology.

2 The collection and collation of historical data

2.1 The collection and collation of historical data

China has a long history of map compilation, these maps provided lots of important historical data for the study on ancient history and the geographical environment. Meanwhile, other amount of information regarding the Silk Road was recorded in many historical literal references, for example, in Han dynasty, there were *Han Shu: The History of Western Regions* and *Shih-Chi: The History of Dayuan*; In Tang dynasty, there were *Records of the Western Regions of the Great Tang* and *The Topography*. By collecting and sorting these information, it is possible to draw the road map of the Silk Road and determine the position of the countries along the Silk Road during the Han and Tang Dynasties, as well as obtaining the information of the ancient countries in the Western Region.

2.2 The field data Collection

On September 24th, 2012, we went to Xinjiang Akesu and Turpan region and obtained the information of the positions of the ancient GuMo, the ancient Jiaohe city, and the ancient Gaochang city by handheld GPS. As shown in table 1, we corrected the current addresses of these Western countries accordingly.

Table 1. The coordinates of parts of Western Region countries

Place Name	Longitude	Latitude
Gumo	41° 16.4572600'N	80° 14.0172200'E
Jiaohe	42° 57.7022582'N	89° 03.5039473'E
Gaochang	42° 51.1422362'N	89°31.4552735'E

2.3 The collection of remote sensing image

Remote-sensing image technology can be used to macroscopically identify the uncertain area of the aboveground and underground remains, and preliminarily understand the circumstance around the ruins. As shown in Figure 1, This paper selected an ETM Remote-sensing image taken in A.D. 2000. After ERDAS ortho-rectification, it can be used for preliminary analysis of the surrounding environment of the Silk Road in Xinjiang after being interpreted based on visual inspection. Then it could be integrated into a mxd electronic map with a series of point, polyline and polygon shp image layers which were made by ArcGIS based on the location, military and population information of the Western Region countries during Han and Tang Dynasties, and finally being cut into map tiles and published to local map service by WebGIS.

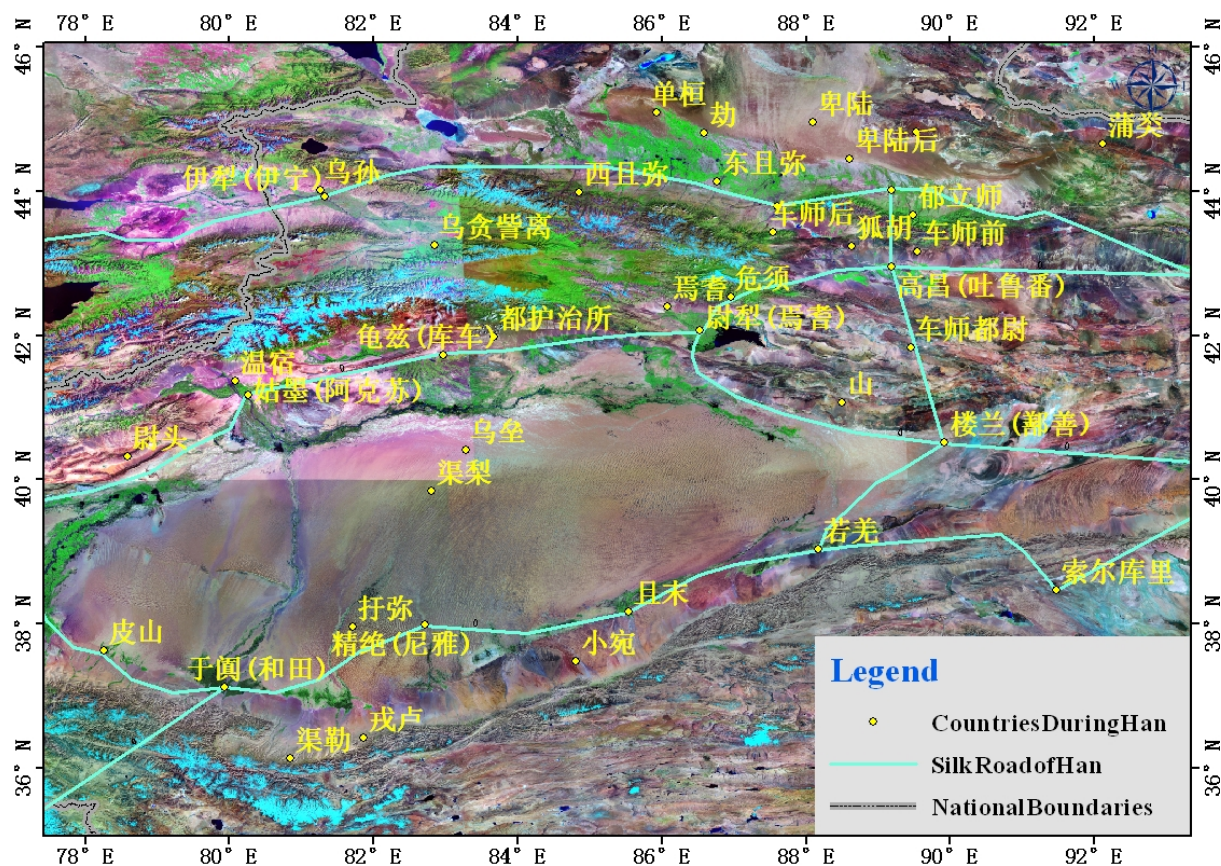


Figure 1. Overview of the Silk Road within Xinjiang based on remote sensing image

3. The design of the spatio-temporal database of the Silk Road during Han and Tang Dynasty

3.1 Structure design of Spatio-temporal database

Currently, ArcSDE + Oracle is one of the most stable and mature spatial data management technology. Due to its efficient and accurate spatial indexing mechanism, people can quickly obtain the information and the position of the terrestrial object, thereby it greatly improved the spatial data query capability^[3]. Meanwhile, ArcSDE + Oracle, which is recognised as an efficient and safe technology for spatial data storage and management, has been widely used due to its massive spatial data storage space, great capability of data processing and concurrency control, which makes less redundancy and higher speed-. With the purpose of the service functions of the electronic map of the Silk Road, we constructed the Silk Road database based on the massive storage space and efficient query capability of the Oracle database as well as the ArcSDE as the spatial data management engine.

Spatio-temporal database of the Silk Road during Han and Tang Dynasties consists of the remote-sensing image sub-database, the basic geographic information sub-database and the thematic sub-database. Figure 2 shows the overall framework of the Silk Road spatial database.

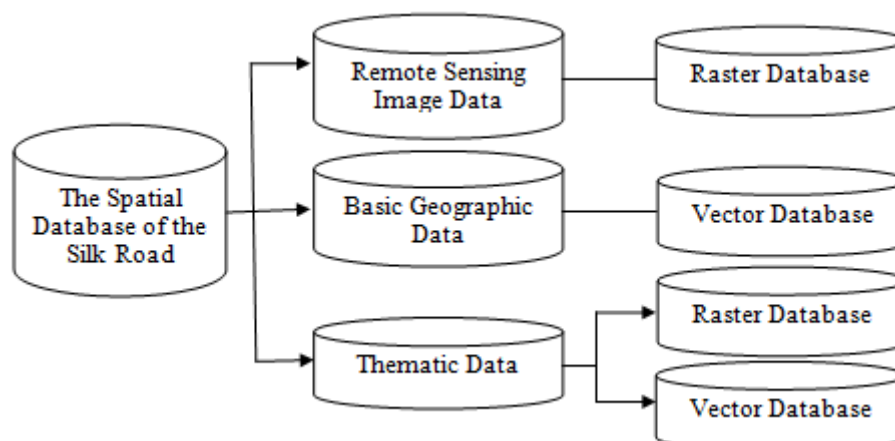


Figure 2. The overall framework of the spatial database of the "Silk Road"

The detailed classification of the temporal and spatial data of the Silk Road database is shown in Table 2.

Table 2. The classification of the Silk Road spatio-temporal data

Serial Number	Data Classification	Data Name	Data Type
1	Remote Sensing Data	The ETM images of Xinjiang	Raster
		City	Point
		Villages and towns	Point
		River	Polyline
2	Basic geographic information data	National Boundaries	Polyline
		The County administrative divisions	Polyline
		Lake	Polygon
3	The Thematic Data of Han and Tang Dynasties	Western Han Dynasty	Point
		Eastern Han Dynasty	Point
		Tang Dynasty	Point
4	The Regional Thematic Data of Han and Tang Dynasties	The Territory of Western Han Dynasty	Polygon
		The Territory of Eastern Han Dynasty	Polygon
		The Territory of Tang Dynasty	Polygon

According to the data format, the Silk Road data could be classified as raster data and vector data. The raster data was the ETM remote sensing image data that being stored in the Oracle database by ArcSDE; the vector data was organized, managed and stored by image layers. Based on the data type mentioned in Table 2, the basic geographic information data and the thematic data can be divided into several image layers, each of which contains one type of data. To manage and store each type of data with each layer could greatly improve the flexibility of the system and data maintenance in the later stages. In this way, it also brings the efficiency to the operations such as data adding, modifying, searching, analysing, and deleting^[4].

3.2 The design of the attribute database

Apart from the service function, the other functions of the Silk Road electronic map such as browsing and inquiring the Silk Road information are implemented by PHP+APACHE+MySQL, which has

outstanding capability in data query. Therefore we designed an attribute database based on MYSQL to support the Silk Road attribute data query^[5], as shown in Figure 3.

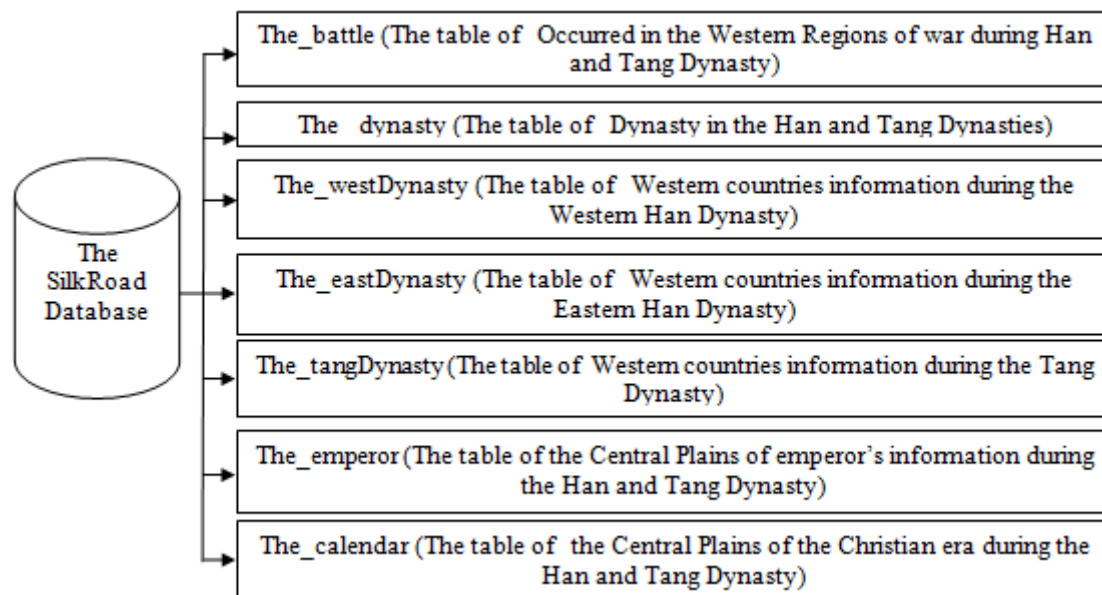


Figure 3. Structure diagram of the Silk Road attribute database

The attribute tables in the Silk Road Database and their internal relationship are shown in Figure 4.

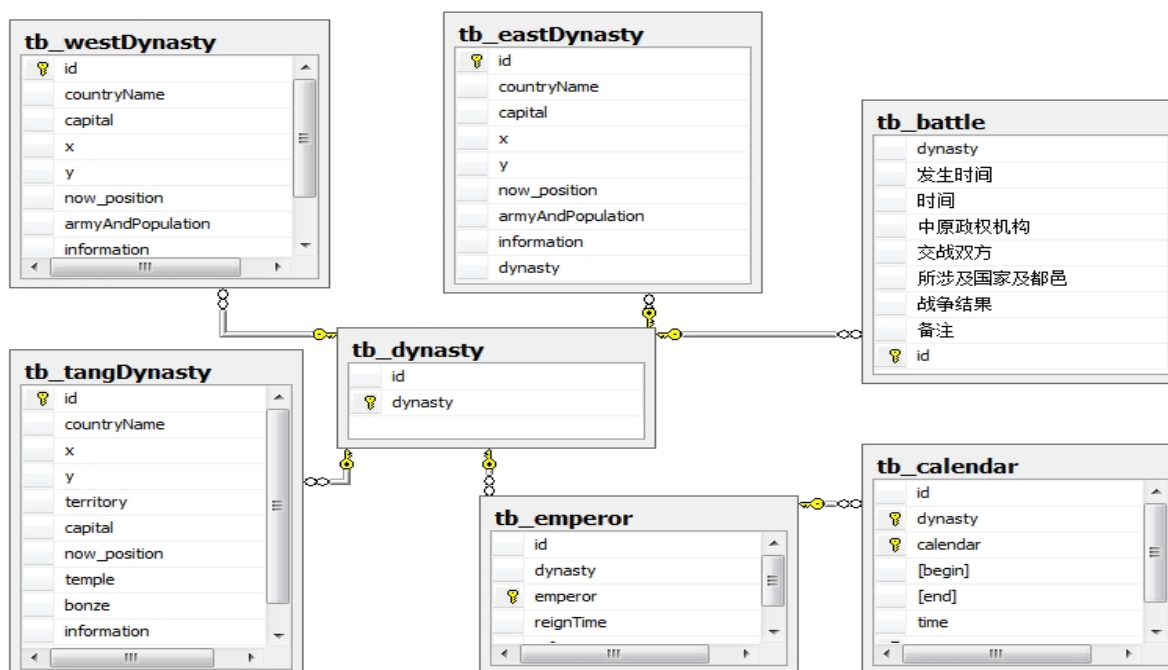


Figure 4. Attribute tables and the internal relationship of the tables

The associative query was implemented by the foreign key association between different tables of the Silk Road attribute database. The main query methods are showing below:

- Query the titles of the emperors of the dynasty, reign time, reign titles and their periods by selecting the dynasty.

- Query the spatial information such as the population of the country, the military force, the era of Central Plains empire, the significant events of the country, the calendar year of the events and other related attribute information such as the current location, the coordinates of the capital and the territory by selecting the name of the Western Region countries.

- Query the dynasty name, emperor's reign time, reign title, significant events and the wars against the Western Region countries during the emperor's reign period by selecting the name of the Central Plains emperor.

4. The implementation of the website features of the Silk Road

Based on the Silk Road spatio-temporal and attribute database, associated with GIS, RS, Flex, C# and other information technology and network technology ^[6], we constructed a Silk Road's geographic information services platform, which could realise the online browsing, querying, editing and preliminary analysing of the ancient Silk Road within Xinjiang during the Han and Tang Dynasties. This is the combination of archaeology and modern information technology, it provides a reference for further study, research and practice in the related fields in the future

5. Conclusion

This paper focused on the ancient Silk Road within Xinjiang during the Han and Tang Dynasties. The collected historical data, field data and remote-sensing image data were input into the spatio-temporal database and attribute database of the Silk Road after collation, then based on these database, associated with GIS, RS, Flex, C# and other related information technology and network technology, the Silk Road historical geographic information services website was established, and we finally realized the online browsing, querying and editing of the Silk Road information. This is the preliminary combination of archaeology and modern information technology, and it opens up a new perspective for the development of traditional archaeology.

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