# Internet Trail Map and its Application

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## Abstract

This paper analyzes the characteristics of electronic map, combined with mobile Internet technology, as a new variety of thematic map, proposes the concept of map, and discusses the characteristics, classification, application domain and future exploration direction. And the academic characteristics, classification, application fields and exploration direction of the map are discussed, and the definition of the map is discussed, Focus on the definition of trail map, according to the target object's state is divided into static and dynamic two categories, according to the distribution of the characteristics of point, linear, surface and body shape object trail map, and according to the industry, the role of features, the dimension of the application field and potential application of a large number of forecast, and finally to the research direction of the trail map is expected to do.

## Keywords

## 1. Introduction

In daily life, we contact maps may be one of the most mapping products, with the development of computer technology, network technology, image processing technology and the increasing popularity of portable mobile terminal, as the main form of expression of the surveying and mapping results -- the map look more important, such as how to use the "Internet+" which is a new idea to accelerate the surveying and mapping results in social service and the people's livelihood, is a worthy of Surveying and mapping industry to pay attention to the problem.

Science of Surveying and mapping is a service to people all aspects of life science, from daily life to travel, from construction to scientific research and so on, all cannot do without the shadow of Surveying and Mapping Surveying and mapping results. The traditional surveying and mapping includes two major areas, the former refers to the study of measuring equipment and how to use the basic theory and the corresponding equipment people need to solve the localization problem, which mainly studies how to determine the positioning result by means of the corresponding display to the user, allowing the user to make decision timely and accurately according to these results, at the same time, the greatest degree of these measurement results play role. Because the measurement, the development and application of technology in the current state by drawing the overall science and technology the level of development, the traditional surveying and mapping is intertwined with each other or completed by the operating personnel of one person, which makes the workers labor intensity big A large increase, also dispersed workers business energy, unable to concentrate on the completion of a project work. The development of modern computer technology, it makes the simulation of map products in the transition of traditional electronic digital map products brand, has undergone a fundamental change to the user service, because of many advantages of the electronic map itself with popularity mobile internet terminal, so that in recent years the rise of digital map - map with new varieties, namely the trail map.

This paper analyzes the characteristics of the electronic map, the combination of mobile Internet technology, according to the needs of many, as new varieties of thematic map, put forward the concept of trail map, and the map of the academic classification of trail characteristics, applications, and research direction are discussed, hope to provide reference to study the map products and how to better serve the society all aspects of life.

## 2. The concept of the trail map

The map is the universal language of mankind, is the art and music, parallel cross race, the three general media of cross culture. Although the text, language, culture and other large differences, but the map works difference is very small, people in the thousands of years of cultural development, with the deepening understanding of the objective world, has produced a large number of the academic achievements, the definition of the map is difference from different scholars,such as Chen, Wang, Tian and so on is discussed, the main reference specification [1-7], using standard [4] on the map "map is defined, follow certain mathematical rules, will be the object of geographic information, through scientific generalization, and the use of symbol system representation in some vector graphics to convey their number The distribution law and development of quantity and quality in time and space "No matter which definition is used, there is no case in the field of view; the map has strict mathematical rules, after a scientific and rational map generalization, complete symbolic system, the carrier of geographic information, such as the carrier of these four basic features.

History has proved that the map as a human understanding of the objective world, one of the transfer of spatial-temporal information, not only has not been replaced by other forms, but with the progress of science and technology, the precision of map making performance continues to improve, more diverse forms, applications continue to expand, drawing theory becomes more and more mature.
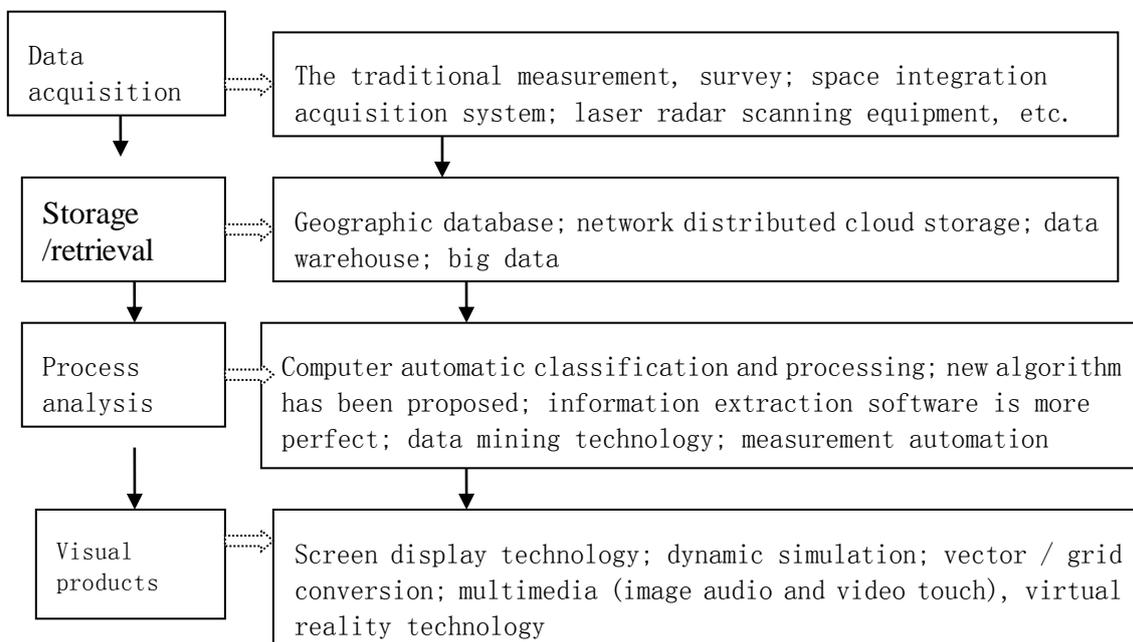


Fig.1 technological support system of trail map

A map in the construction of production, scientific experiments, daily life indispensable tools, the development of computer technology electronic map. Based on the mature electronic map refers to the digital recording can be displayed on the screen is the symbol of the digital map[1], map service in various industries have laid a solid foundation of theory and tools, the dynamic non-grade zoom seamless, stacked, multimedia display, network sharing, multi dimension is proposed and used to simulate the characteristics of the trail map, provides the basis and application of the Internet as well.

The electronic map reading, storage, dissemination, management, update, Self Publishing map information provide the technical support of powerful [1].

The trail map is a digital map with time series record object position information and attribute information, is a kind of interactive electronic map system based on Internet, is a kind of thematic map. The main trail map records the position of the target object at a time and attribute information, such as driving track record of Typical Trail map the wild animal protection activities, records and so on.

The map is not without trail, but with the needs of social life, in the new product today emerged in modern integrated science and technology rapid development.

Reference Peng academician of the literature [8], combined with the understanding of the trail map, summed up the technical basis for the trail map, see Figure 1.

The classification of the trail map can be classified according to the classification of the map:

## 2.1 Typing according to the moving states of objects

According to the moving state of the target object can be divided into static trail map and dynamic trail map.

Each location information dynamic map contains trail record time information based on time sequence parameters and position related attributes of records, almost all of the dynamic target motion trajectory tracking files of this type are driving record for vehicles transporting dangerous goods in time the record information is important for the field; the static map is trail the position of the target object relative to the fixed position or varies slowly with time of the state, the time information relative to the same record file is a constant, such as a certain area for a certain period of the minerals distribution, special plant distribution records.

Obviously, the static trail map is ignored because of the time lapse of the dynamic trail map.

## 2.2 Typing according to the distribution characteristics of objects

According to the distribution characteristics of the target object can be divided into points, lines, face shape and body shape object trail map.

Point object refers to the map for the distribution of the performance of a positioning target trail map, itself is a point and some conditions as a point two, the former as a measurement control point, a lamppost, a wild animal's location, such as the small scale the display object a small area, such as excavation or exhibition, scenic spots, and the object itself has a certain scale, but at this time just to show that its existence is not intended to show its details now regardless of size characteristics like. The distribution of trail map linear object, is connected orderly state exists in space, on the map as a starting point, end point and line number direction change, or straight or curved, and some even for the space curve. The static target, such as River Road, coastline, dynamic objects such as hiking trail, the protective activity of animal tracks, also now ignore its width characteristics.

Face object refers to the changes of the target area changes over time, or the local position changes with time synchronization changes, showing for the possession of range, the spatial distribution characteristics of continuous, on the map is a geometric feature map, of course, this ignores the thickness parameter. For example according to the underground mineral distribution in the surface region, to determine the scope of ore mine construction and the need for the resettlement of villagers from the scope of mining area, and groundwater depth mining may involve.

Body shape distributed object can be thought of as the space geometry extending from a base on the physical or conceptual product is volume characteristics, such as blasting may affect the nearby large range the daily lives of people.

Obviously, point like, linear, planar, body object can be transformed into each other under certain conditions, such as the face object in the city scale reduced to a certain extent appear as points or lines. In general, can be considered as zero dimensional point object, line is one-dimensional or quasi one-dimensional, area is as two-dimensional object, a body is a three-dimensional feature.

### 2.3 Typing according to the service field of objects

In accordance with the industry can be divided into production type, resource type, monitoring type, service type, emergency type and other categories, and each can continue to divide a more detailed level. Apparently, according to the standards division map type can not be exhaustive list.

### 2.4 Typing according to the characteristics of the role of objects

According to the characteristics of the role of trail map can be divided into two kinds of practical tools and Instrumental tracks map refers to complete data acquisition, trail map editing, map analysis and production function of the trail map processing software products currently on the market, there is no such specialized software, software but it is part of the single function has many, such as GPS tools with data acquisition function, ArcGIS has data editing, map making and function the function of spatial analysis is not very suitable, Google Earth also has some simple analysis.

In order to complete a specific practical production, test, trail map products and services to the development of the city. For example, the taxi line record sharing system, credit card system can record real-time bus passengers in the bus route optimization design, optimization of the departure time interval in the project to play a role.

All trail maps include a single PC, network, mobile terminal, server control, communication server and other products.

### 2.5 Typing according to the dimension of the display of the trail map

Can be divided into 2D, 3D, 4D and other means. The two-dimensional plane position display relationship trail map; 3D is to simulate the three-dimensional model as the main means of display or trail map; map in addition to display the current trails of four-dimensional spatial distribution characteristics, combined with the historical data show the change process of a certain period of time. Other from the display can be divided into simple divided into planar display, image display, physical simulation, as well as virtual reality and other means.

## 3. Application areas of trail maps

As a thematic map of the trail map is a rookie, in support of the Internet technology and computer technology, new varieties to demand driven development, will in future production, scientific research, production, life, play a major role in design and development and other fields, the revolutionary progress will lead to some areas, according to table 1 below application of trail map, can be roughly divided.

Table1: List of application of trail map

| type | Example of a trail map | Main factors | Potential use |
|---|---|---|---|
| point | ATM machine trail map Automatic ticket vending machines, vending machines, prepaid card recharge points, gas stations, traffic accidents, attractions, shopping spots, electronic eye, surveillance radar, communication tower, the War legacy mines and dangerous goods, etc. | The location, terminal number, deposit / withdraw machine number, setting time, road traffic, daily maintenance time, daily deposit number record, fault record, safety accident record, whether WeChat can shake, can transfer etc. | Optimization of ATM regional layout, strengthen security measures, provide funds according to the calendar, collaborative ATM machine layout line |
| line | Taxi trail map (bus card up and down the station point, the elderly and children's activities, monitoring the suspect mobile phone activities, the protection of animals, etc.) | The taxi real-time location information, passenger status, running track record, landing location and time of guests, guests general information, traffic information and road and weather conditions, emergency | Determine the waiting time and place, avoid risk and congested road planning location of bus station, bus line transformation, time interval adjustment etc. |

| | | record, | |
|---|---|---|---|
| Point +line | Medical rescue trail map (in case of police, emergency treatment, disaster rescue, animal protection, traffic accidents and other emergency records, etc.) | Real time location of medical ambulance, real-time traffic status, emergency hospital information, emergency hospital doctors and patients state, the stock of emergency medicine, etc. | First aid object to get treatment in time, save the loss to the lowest |
| Point+ area | Rare waterfowl waters trail map (giant panda, golden monkey mountain.) | Rare waterfowl trail activities, daily real-time record, salvage place and way, tracking loop information etc. | In advance to prevent, to ensure timely |
| | …… | | |

Table 1 is just the tip of the iceberg of many applications, hoping to take this thinking, expand the broader application areas.

## 4. Related theories and research directions of the trail map

The trail map theory has not yet been carried out systematically, according to the relevant theories of cartography, combined with the application of objective trail map, and puts forward some personal views, hope to get the effect.

### 4.1 Subject system

Complete definition, function and classification, research methods, research content, and related disciplines, and the main research tasks.

### 4.2 Mathematical foundations

Reference system, projection selection and multi scale data representation.

Considering the global relations, proposed by WGS84 reference ellipsoid, even to Europe's location using GALILEO, COMPASS and GLONASS China positioning system in Russia, the direct use of the ellipsoid height. If the land elevation based on the projection plane rectangular coordinates, recommend the use of UTM projection, try to avoid using the Gauss projection. Multiple scales are only considered when selecting the output factors, because the digital map based on the screen display does not exist in the concept of mapping scale, there is no scale accuracy of the problem.

### 4.3 Data sources

Due to the practical characteristics of the trail map, it is impossible to carry out the data collection standard of traditional surveying and mapping.

Data is divided into two categories of spatial data and attribute data. The former is accomplished by means of measuring equipment and measuring means, and the latter is done by means of investigation, statistics and other means by non surveying and mapping professionals.

Spatial data collection can be done by professional mapping agencies, can also have a complete measurement of non personnel, but must pay attention to collect additional information. Such as the data acquisition date, time, weather, equipment manufacturers and models, parameter data acquisition equipment settings (such as time reference, coordinate system, projection mode, positioning mode) the dynamic or static data acquisition, acquisition, responsibility institution / person, update mode, data maintenance mechanism, which can confirm the preliminary information availability status of the data. Compared with other equipment to collect data during the same period, also can determine the systematic bias of the equipment and the staff working attitude, sense of responsibility, and to determine the submitted to the responsible person of the late data which is used.

And this work is not necessary to do the routine measurement work.

In addition to high resolution satellite images, based on aerial photography, airborne LIDAR scanning, vehicle LIDAR data using system, tilt photogrammetric, widely used data comprehensive satellite positioning system, space acquisition system, greatly enriched the types of geographic data, but also increase the workload of data management, post retrieval, analysis and processing. Record elements can refer to table 2

Table 2 list of factors of trail map record

| acquisition methods | Data type | Records factors | General elements |
|---|---|---|---|
| Conventional ground survey | Distance, angle, elevation or three-dimensional coordinates | Projection belt, high projection, set up site information, etc. | Job date and weather, operator's name, type and number of instruments, parameter setting, annual inspection data, processing software and version |
| Satellite positioning technology | Latitude or longitude coordinates or Projected coordinates | Differential, CORS data parameter, measurement and so on. | |
| Satellite images and aerial images | Digital image (raster) | Platform type, auxiliary facility parameter and record file | |
| lidar | Point cloud | Flight parameters, GPS, POS and platform | |
| Ground laser scanning | Point cloud | Stationary station or mobile station, equipment manufacturer model | |

## 4.4 Types of softwares of trail map

According to the theory of map generalization and development of editing and mapping software Classification, simplification, exaggeration and symbolic is the basic work of the traditional map generalization, with the development of computer graphics, fuzzy mathematics, graph theory, fractal, neural network, wavelet analysis, filtering, modeling the development of basic theory, a lot of achievements have been used for map generalization in [1], computer software, automatic summarization technology is rapidly developed based on [9].

The data matching problem should be studied mainly from the historical data of the positioning data, the matching of the current data, the matching of the heterogeneous data, the topological relations, and so on, to make a comprehensive choice, to determine the reasonable scale system, and the mapping elements.Research and development of new matching algorithm, cross platform, cross system software development and testing standards.

## 4.5  Drawing symbol system and representation method

formulate a unified system of symbols and representation, or strive to achieve this goal. Here it is best to follow the digital map of the symbol library, in the case of no increase in the number of symbols on the premise of the map mapping work.

## 4.6  The theory and method of map analysis

Using the existing GIS spatial analysis theory and tools, this paper puts forward the theory and method for the analysis of trail map.

The information fusion algorithm of multi-source data is a very difficult problem.

## 5.  The prospect of the trail map

Trail map is a new map variety based on Internet technology, it will play an important role, but its development faces more problems and challenges, there are many practical problems to be studied and resolved.

In addition to the point of view of the theory of the above map, the following issues need to be solved. (1) How to make use of the historical data in combination with the historical data, to predict the future trend of the algorithm?

(2) Security issues. Surveying and mapping data belong to the national secret data, how to solve the problem of security and security services to be solved.

(3) Upload data, how to reward the contribution of the system ?

(4) the legal disputes and claims of copyright law ?

(5) the fuzzy state of the geographic object itself and the vector data of the trail map vector data fusion of the civil affairs, public security, urban construction, planning is not consistent.

Expect colleagues to build a trail of map building.

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