FOREST FIRE FIGHTING COMMAND AND DECISION MAKING SYSTEM STUDY BASED ON 3S TECHNOLOGY—TAKE JIAOHE CITY IN JILIN PROVINCE AS AN EXAMPLE

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ABSTRACT:

The forest fire fighting command and decision making system of Jiaohe City in Jilin province is developed out by synthetically using 3S technology. By using 1: 50 000 DEM (digital elevation model) and American ETM satellite image superposition, it fabricates electronic sand plate map of the area, superposes road, stream, reservoir, toponym, inhabited area and other geo-information and guard station, inspection station, watchtower and other forestry infrastructure and connects respective attribute database simultaneously. By using an integrative system of GPS, data transfer and call functions, it can realize forest inventory control, watchman inspecting post, real-time fire control command and measure of distance, area, desquamation excavated volume, intervisibility analyses, flooding analyses, query gradient, slope aspect and other geography parameters as well as localization observation and other three-dimensional analysis functions.

1. INTRODUCTION

"3S" is a general integration of global positioning system(GPS), geographical information system(GIS) and remote sensing (RS). GPS is a kind of firenew modern localization method. Combination of GPS, airmanship and modern communication technology causes revolutionary changes in space positioning system aspect. GIS is one conjoint new type spatial information technology of geosciences spatial data and computer that is developed rapidly in recent years. It combines spatial position of object in real world with relevant attribute organically to meet user's management for spatial information and to carry out a variety of aid decision making by means of specific spatial analysis function and visualization expression. Space remote sensing technology is one high-tech with comprehensive application possessing high speed, real-time and other features of information acquisition and processing, at the same time it also has high precision and quantification and other features in application. Writer and other persons use 3S technology combination to successfully develop out forest fire control commanding and decision making system of Jiaohe City in Jilin province (Figure 1).

2. SYSTEM FUNCTION GENERALIZATION

The system is developed out by adopting Beijing Lingtu Corporation's VRMap3.0 software platform to carry out the secondary development on Visual Basic 6.0 Chinese version. It generates three-dimensional electronic sand map by superposing 1: 50 000 DEM (digital elevation model) and American Landsat ETM satellite image. On three-dimensional electronic sand map, it superposes road, water system, inhabited area, toponym label and other fundamental geography information and guard station, inspection station, watchtower, bridge, forestry bureau infrastructure and others, and reveals them with three-dimensional mode.

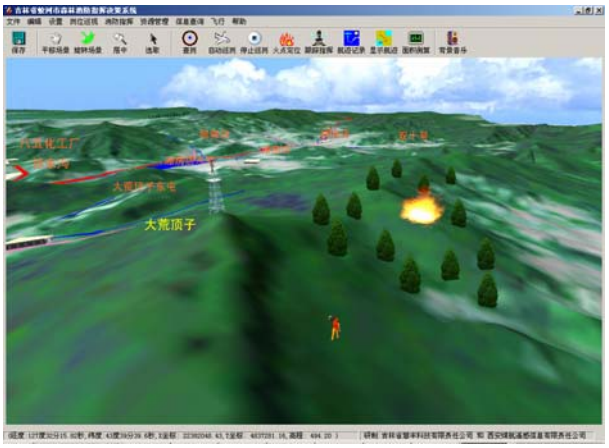

Figure 1. forest fire control commanding and decision making system interface

System user interface is friendly, which can realize three-dimensional random roam, realize appending, deletion, modification and other edit operations for road, inhabited area, letter label, watchtower and other ground object models and realize delaminating and superposing display or concealment for road, water system, forestry bureau boundary scope, etc.

System can connect GPS equipments to realize the post examination and automatous inspection for watchman. It can realize a real-time trace command for fire fighting crew by using the intersection method to decide fire point automatically and to delineate fire scope, to measure fire area and others. It

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can realize the configuration and management for watchman, fire extinction team personnel by intuitionally showing watchman, fire fighting crew, fire point and all others on electronic sand map in 3D model mode and can query relevant attribute information of various watchtower, watchman and fire fighting crew.

System can realize import for two dimensional SHP formatted file for forest map, fire risk grade graph, forestry plot, administrative map and other thematic maps, can realize deletion, appending, modification and other operations and can realize query for various mottling attribute informational and control whether various thematic maps are showed with separable layer mode after joining attribute table.

Where water system, road and inhabited area are coded by sorting in area, it can realize query by connecting the attribute information of various ground objects, carry out localization search for watchtower, toponym, watchman and fire extinction team and carry on conversion latitude and longitude geographical coordinates and plane rectangular coordinates.

At the same time system possesses three-dimensional analysis functions of measuring distance, area, excavated volume, intervisibility analyses, flooding analyses, query gradient, slope aspect and other geography parameters and localization observation and others.

User can define a random flight route to realize three-dimensional flight, reserve flight route for next time to flight along route, record roam path and carry out playback, and export the browse window content for a high resolution image printout.

3. REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM TECHNOLOGY APPLICATION

The digital elevation model (DEM) is established by adopting 1: 50 000 state regular topographic map. By adopting satellite remote sensing image as surface chartlet, it reflects the same surface configuration as the field and is clear at a glance for stream, vegetation, road, inhabited area and other information. By using the geographic information system technology to superpose both, it forms the three-dimensional electronic sand map of the region.

Because a variety of information (including road, stream, building, residential area and others) in electronic sand map are fabricated using satellite image renewal, the marked geo information are very exact, which furnishes detailed reliable gists for fire fighting commanding and would not occur the command decision error caused by inaccurate geo-information. Three-dimensional electronic sand map can make forestry area become solid and make stream, highway, bridge culvert, building and other ground objects assume an intuitionistic, tridimensional and vivid show. Commander can simulate a flight visit on different height and at arbitrary angle, in this way commander can master a variety of geo-information and data quickly, at the same time it is convenient for making out correct commanding decisions because electricity, water, correspondence and other infrastructure information are showed in three-dimensional sand map.

It can randomly simulate fire field and smog on three-dimensional electronic sand map. Commander can work out a concrete scheme of attacking a fire according to landform and relief of mountain, shorten time of transporting troops and make it to be thrashed early, with its size reduced, and finished.

It can carry out the marking once again for newly-built highway and redirecting stream on three-dimensional electronic sand map by using GIS technology to ensure practicability and authenticity of electronic sand map. It can append road width, pavement situation and others, convenient for query and search of attribute information. In three-dimensional electronic sand map it can directly query relevant information of each location, such as the watcher name, telephone and other information of watchtower, various forest plantation fireproofing background and others. It can measure the distance of beeline and curvilinear between two random spots on electronic sand map to calculate the fire scene area and also search out longitude and latitude co-ordinates and rectangular coordinates at the same time.

System can superpose the administrative map, fire risk grade graph, forest right property graph, forest map and other thematic map to realize the intuitionistic management for forest resources.

When a fire occurs, with an azimuth reported by two random watchtowers that can observe fire situation, system can ascertain the fire position automatically by intersection method and set a simulation fire point. Commander can observe the relief of mountain, stream and pond, road traffic and other field situations on different height and at a variety of angles by using aero-browse. And it can judge out the fire developmental direction and fire widespread speed according to this day's climatic conditions, judge out the fire field distance away from highway quickly and exactly at the same time, find up the optimal routes of transporting troops and work out the optimal schemes of attacking fire. Commander can also judge out marching speed and time of transporting troops of various teams of attacking fire, thereby master the troops of attacking fire in hand, furnish vigorous indemnification for putting out a hill fire quickly and make it become three early and two fast in deed. After fire is stifled, we can exactly figure out the fire field area on the electronic sand map and can make out the label on the electronic sand map at the same time to furnish reliable data for future reference.

4. GPS TECHNOLOGY APPLICATION

System adopts an integrative system of integrating GPS, data transmission and interphone call function. By combining electronic sand map, very short wave communication system with global positioning system (GPS) together, it can realize the connection, disconnection, track playback and other various functions of telecommunication equipment and GPS, which furnishes a fast and convenient mode for instant monitoring and exact positioning. System device is divided into two parts of communication command administrative center and mobile terminal. Administrative center is a hardcore part of the system with the core of computer and data transmitter, which can call and query mobile individual concrete information, or swap data or instruction among mobile bodies. Mobile body is an individual who works in the open or fieldwork. They can receive GPS satellite positioning information and carry out mutual communication with the center, make administrative center have an entire and intuitional understanding for remote operation or present fire field situation, convenient for

commanding dispatch. For system configuration and connected relation, see Figure 2.

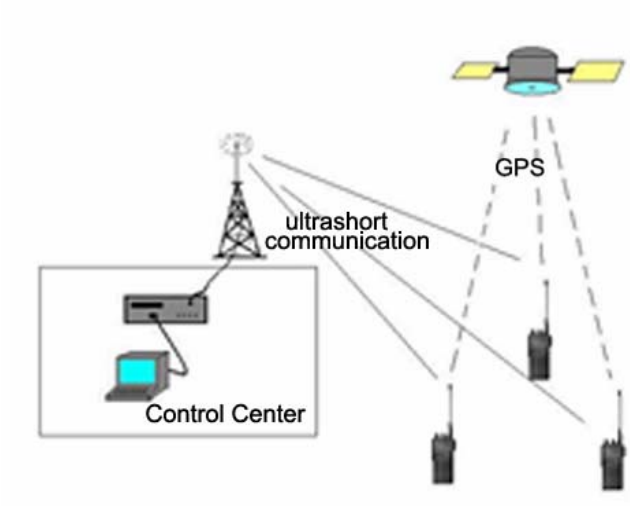

Figure 2. Hardware configuration for forest fire control commanding and decision making system

Data transmission equipment and computer use RS - 232C interface, which is formed by data converter, data transmission ultra-short wave broadcasting station, outdoor high gain antenna, AC and DC stabilized voltage supply and special software package and others. It can be realized to contact with mobile terminal via the high power radio station and FFSK synchronous data transmission mode.

Mobile terminal adopts an integrative machine of hand-held GPS positioning and communication to make interphone, communication control unit and GPS receiver perfectly combined together, convenient for carrying and operation.
GPS equipment actions in fire control command are mainly showed in the following several aspects:

1. It is used to conduct march of fire suppression team. What GPS satellite positioning tracking system accomplishes is a real-time tracing, whose locating points and march track can directly be showed in electronic sand map of control center. If march route of fire suppression troop appears a warp, via instant show of march track and direction, headquarters can contact the troop quickly and correct the error in time, thereby warrant troop to walk on the best route in shortest distance and rush for fire field in the most short time. It entirely solves the problem of former troop disorientation in mountain at the same time. Control center can instantly announce the surrounding landform, relief and other geo-information in the march route by interphone to remind the fire fighting crew to tend towards benefit and avoid harm, which plays an important role for fire suppression troop in marching, especially for safety of a night advance team.

2. It is used to track and monitor for the fire suppression development situation. System can carry out a real-time monitoring in overall process and omnibearing and master time of start, on route and arrival of fire suppression team at any moment, convenient for troop to direct and arrange prevention in time after arrival to avoid to arrange arms out of time and delay fire suppression opportunity. It can real-time observe situation of arriving the site of fire suppression team and completed process of entire fire suppression working so as to carry out adjustment with different situations in time, thereby procure an optimal fire suppression effect. By using this system in reasonableness when in fire field disinterring, it is convenient for implementation and surveillance of responsibility. Responsibility section located by this system can be directly reflected in the control center, so can its disinterring track, Control center can master the disinterring situation of each responsibility subgroup and thereby validly avoid a fire field afterburning because of a non-attendance disinterring.

3. It is used to exactly calculate fire-field area. After mountain fire is stifled, during arranging corps for guard of fire field, this system can directly display the formed track of guard process on electronic sand map of fireproofing control center, by which it can figure out the fire-field area in the first time and shorten the calculation time. It substitutes that formerly person specially assigned was sent to calculate the fire scene area after fire suppression is terminated, reducing the devotion of manpower and material resources and indirectly saving the fire suppression expense. In addition, digitized processing is more precise than manual calculation, slashing the estimation error.

5. CONCLUSIONS

Via application practice in Jiaohe city of Jilin province, it is proved that it is a good practice to apply 3S technology to forest fire control command, possessing merits of saving cost, quick and high efficiency, science and exactness and others. It is suggested that it should be popularized in departments of forestry.

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