ROAD FACILITY INVESTIGATION BASED ON MMT

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ABSTRACT:
Through analyzing the current city facility investigation, this paper introduces a technological workflow and quality control system of road facility investigation based on the Mobile Mapping Technology (MMT). An example of Beijing City facility investigation is given and essentials of executing facility investigation based on MMT are outlined. Furthermore, the application mode of digital measurable images (DMI) acquired through MMT is analyzed and the interface for DMI data storage, management and application is designed. Applications testify that DMI contains vast amount of scientific, natural and cultural information which can be adopted by city management departments like utilities, city planning and road agencies, etc.

1. INTRODUCTION

In recent years, the pace of city construction and development is picking up. Newly-constructed and rebuilt roads are increasing daily. However, problems are existed in many ways. For example, there lacks of road map data, drawings differ from facts, status of road facilities are unclear. The situation brings quite a big challenge to daily maintenance work. To improve maintenance management of road and affiliated facilities, it is of great importance to acquire comprehensive data of the status of road facilities and build up scientific and standard road management system so as to realize resources share.

At present, road facility investigation is mainly done by manual survey, which is inefficient and time-consuming. Usually when the investigation is finished, the road status has already changed greatly and therefore the investigation fails to provide accurate and up-to-date data. What's more, manual survey has some hidden quality troubles caused by manual operations. As quality control requires much workload, it is impossible to execute a close-loop quality check of the investigation data, which directly causes differences between investigation data and facts and thus affects the investigation result.

Using MMS to acquire and process city road facility data concretely upgrade capture speed, capture mode, data volume and post-processing to a higher level. MMS is able to capture and survey on demand geometric elements (lanes, sidewalk, etc.) and attribute information (pavement material, acreage, width). It further provides high-resolution 3D road images that allow you to compare acquired data and a fact thus forms a close-loop data QC system. Furthermore, the images contain vast volume of social, economic and cultural information that can be used by other city management department.

Through analyzing the current city facility investigation, this paper introduces a technological workflow and quality control system of road facility investigation based on the Mobile Mapping Technology (MMT). An example of Beijing City facility investigation is given and essentials of executing facility investigation based on LD2000-RH series MMS are outlined. Furthermore, the application mode of digital measurable images (DMI) acquired through MMT is analyzed and the interface for DMI data storage, management and application is designed. Applications testify that DMI contains vast amount of scientific, natural and cultural information which can be adopted by city management departments like utilities, city planning and road agencies, etc.

2. METHODLOGY

2.1 MMS workflow and scheme of road facility investigation

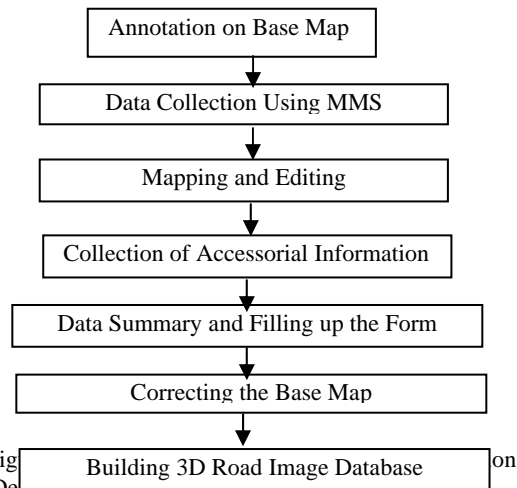Figure 1 shows the workflow of city road facility investigation using LD2000-RH series MMS.

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The Detail workflow is described as flowing items:

1) Annotation on Base Map
Based on digital base map, one can check against the name, coding, direction and start and end point of the annotated roads according to their names and thus guide MMS investigation task.

2) Data Collection Using MMS
Based on annotated base map, MMS is used to collect road data including CCD images, video data and GPS data, which constitute raw data for post processing. In small alleys where vehicles cannot go in, portable MMS can be used to collect data.

Figure 2 shows different models of LD2000-RH series MMS

3) Mapping and Editing

Following data collection are post processing and editing of data that exports needed mapping element such as green belt, medians, pavement position and geometric shape, etc, as Figure 3 shown.
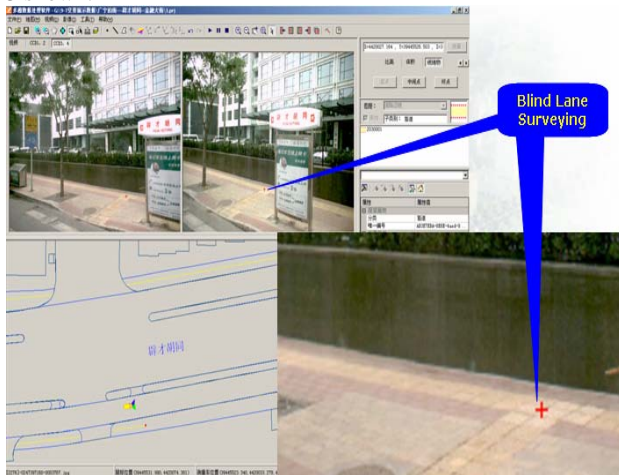

Figure 3 Road Facilities Surveying

4) Collection of Accessorial Attribute Information

Refer to road files to collect assessorial information such as the construction time, contractor, pavement structure, material and depth of the road etc.

5) Data Summary and Filling up the Form

Summarize statistics of the length, width and acreage of motor vehicle lanes, non-motor vehicle lanes, sidewalk and medians according to roads and sections. Filling the forms together with collected assessorial information.

6) Correcting the Base Map

Correct the base map by viewing the images. For example, correct road directions, correct name of the start and end point, annotate roads that were not annotated on base map, as Figure 4 shown.
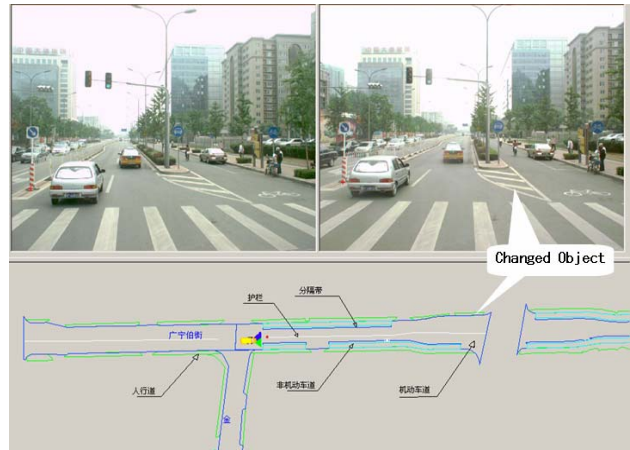

Figure 4 Correcting Base Map with DMI

7) Building 3D Road Image Database

Trim MMS-collected images and videos and set up geo-referenced 3D road image database. Index list is provided to facilitate re-examination of the investigation data and other applications.

2.2 Accuracy Analysis of Road Facility Investigation by MMS

To validate the accuracy of road facility investigation by MMS, we have chosen some typical facility elements on a city road and collect them respectively by MMS and conventional method. The result shows as below (see Table 1).

Table 1 Accuracy Analysis Results

Area	Acreage Survey with Conventional Ruler (m^2)	Acreage Survey with MMS (m^2)	Acreage Error (m^2)	Relative Error (%)
Parterre 1	943	947	4	0.42
Parterre 2	380	388	8	2.11
Parterre 3	664	674	10	1.51
Vehicle lane	946	935	11	1.16
Sidewalk	1606.5	1606.1	0.4	0.02
Total acreage	16025	16317	292	1.82

The above table shows that the relative error of MMS doing road facility investigation is within 2%. The accuracy increases along with the investigated area. Obviously, MMS is advantageous in road facility investigation of big areas.

3. APPLICATION

Known as a rapid geographic information collection technology, MMS can work as an optional method for road facility investigation. Despite conventional GIS data, MMS furthers provides CCD images and videos and set up visuable image database for city roads. On the other hand, since MMS images are geo-referenced, which means the attribute information and images of the road asset are referenced to its exclusive coordinate, making searching one another extremely convenient, updating data is also very convenient. If you compare images taken at different times, you can easily find places where are different from their original status and judge damages and arrange maintenance accordingly. In this way, the visuable images captured by MMS are effective supplement of city road investigation. These images can be further used for city

planning, maintenance decision-making and digital city management etc.

MMS-based visuable images can be used in the following areas.

3.1 Release of Visuable Information of City Road

MMS-based visuable images are condemned as city holograph. The detailed holographic images contain vast volume of minable information. Release of visuable information of city road allows people to view the scenic spot (alley) and learn about the real environment, as Figure 5 shown.
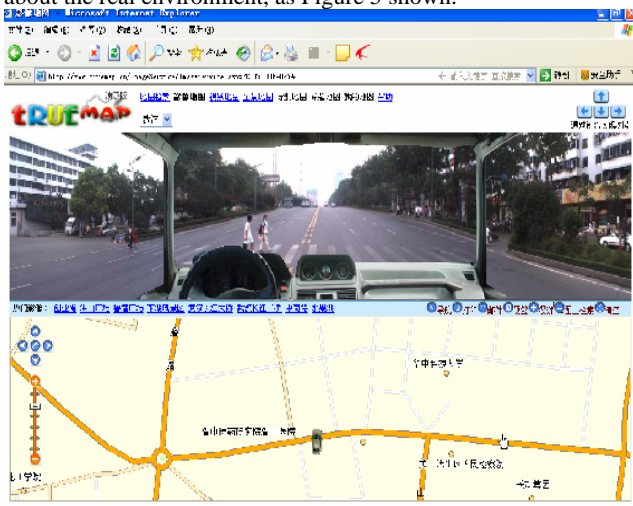

Figure 5 Release of Visuable Information of City Road

Through the information release platform, the management and users can sit in their computer chairs and still be personally on the scene even without going outdoors. You will feel to be on the road surface of your interested place. You can search any place that is of your interest and set up your own city museum.

3.2 Visuable Digital City Planning and Road Maintenance

City planning and management departments may need detailed geographic information and images of areas on the sidewalks. "Grid management" of cities may suggest field workers to patrol the street and take pictures of violation behaviours such as littering and send them back to the command centre where operators compare the pictures with those in the database. The visuable road image database can assist decision makers in road maintenance budgeting, as Figure 6 shown.
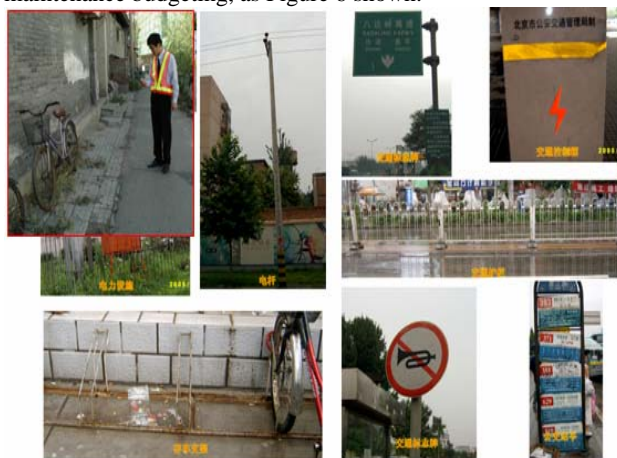

Figure 6 Visuable City Management and Maintenance budgeting

MMS-based images are visuable (real scenery, various social and cultural elements), measurable (length, transport capability),

minable (mining the visuable data whenever needed). The images contain detailed information that are needed by the police (shops, telephone booth, fire hydrants…), by the environment protection and city management department (bulletin boards, garbage bins, green belts…at different time period) and by road agencies (road status, maintenance information at different time period).

3.3 Visuable City Facility Management

MMS can provide visuable images of city facilities, which are linked to geographic coordinate. The information can be imported directly to facility management system and realize visuable city facility management, as Figure 7 shown.
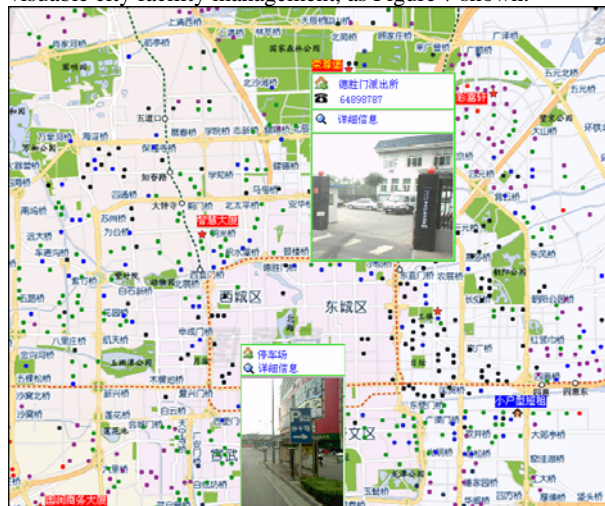

Figure 7 Visuable City Facility Management

All in all, people are no more satisfied with symbols, texts or numbers when geographic information is concerned. Spatial information has become the new pursuit. High-accuracy and measurable road 3D images that contain richer information are an indispensable part of the future information industry. The road 3D image database captured during road facility investigation will play a more and more active role in digitization of government affairs and thus lead to more and more applications.

4. CONCLUSIONS

As a road surveying technology, MMS can rapidly and accurately complete the task of road facility investigation. Using MMS can greatly improve work efficiency and decrease labor intensity. Safety is assured and cost is considerably reduced. Compared to conventional road survey method, the visuable road 3D images captured by MMS records the real scenery of the city at a specific time. They are a "city holograph" with a time dimensionality, which can be used in areas of city road facility investigation, maintenance, city management, emergency response, digital city and city planning. General format is adopted to allow users to integrate the images into their existing management systems. Furthermore, thanks to its high efficiency, MMS makes data update a much easier task.

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