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Scenario building for urban disaster management based on the integration of CIM and Big data- The progress of CJISTCP

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Abstract:

Urban disasters are characterized by diversity, complexity, man-made, and magnification, which have severely restricted the sustainable social and economic development. In recent years, China has attached great importance to urban disaster emergency research, improved urban governance, emergency management system, and disaster prevention, mitigation, resistance, and relief capabilities. The cooperative units from Nanjing Normal university, Shandong Eastdawn Digital Data company and Asia Air Survey company in Japan, begun a China-Japan Intergovernmental Science and Technology Cooperation Project (CJISTCP) (2021YFE0112300) on October 1, 2021. The project is expected to promote the resolution of technical bottlenecks in urban disaster process monitoring and the rapid construction of 3D scenarios in emergency disaster response in both countries, and drive the advancement of related industrial technologies such as CIM(City Information Model) and big data integration and mining applications in disaster management.

We plan to introduce the progress in three aspects which we focus in our project, both from China and Japan:1. Brief introduction of the real-scenario 3D City and CIM construction; 2. The integration methods of 3D City model and the big data; 3. The application of scenarios and VR for disaster management and emergency response.

1. Brief introduction of the real-scenario 3D City and CIM construction

From 2018, Beijing City Sub-center, Guangzhou, Nanjing, Xiamen, and Xiong'an New District are listed as pilot projects using the BIM (Building Information Model) system and CIM platform. The development and application of CIM-related technologies such as big data, Internet of Things, and GIS are listed as encouraged industries in 2019. Ministry of Housing and Urban-Rural Development of China released "City Information Model (CIM) Basic Platform Technical Guide lines" in 2020. Shandong Eastdawn Digital Data company as the unit in the project mainly focus on 3D city and CIM construction, and their contributions can be concluded as follows: first, AI interpretation based on high-resolution satellite remote sensing data, which is mainly applied to the real 3D urban data update of large scenarios such as Beijing, Haerbing, Wuhan. Second, more than 30 3D cities real scenario construction based on oblique photogrammetry, and Lidar scan. A lot of these 3D cities have been used in urban disaster management, early warning and emergency response.

The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) of Japan aims to realize the digital twin. In May, 2019, it formulated the "Preparation Plan for MLIT Data Platform". In April 2020, the 3D data platform MLIT Data Platform 1.0 was opened to the public. The platform offers accesses to various technologies and 3D data from the government and the private sector. In terms of disaster emergency response, the MLIT is coordinating data from the Shared Information Platform for Disaster Management (SIP4D).

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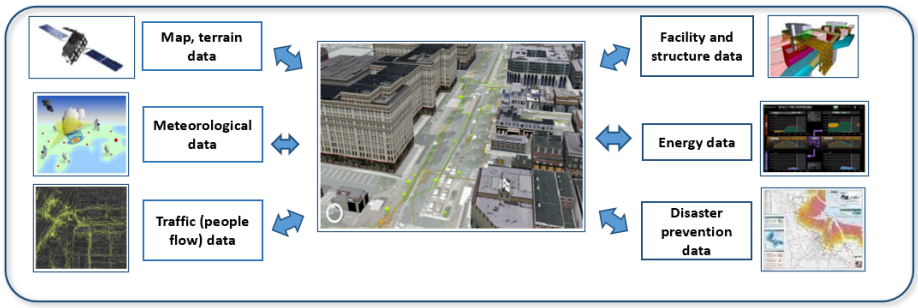

Figure 1. Data Platform of the MLIT in Japan

2. The methods of 3D City model and the big data integration

Knowledge graph is constructed employing disaster emergency knowledge extraction, representation, fusion and reasoning. Scholars have carried out many theoretical studies on disaster mechanism models, disaster risk assessment, emergency response mechanisms, etc. The research on the ontology and knowledge graph of some disasters such as urban waterlogging and epidemics has already started.

In practical applications, surveillance cameras are often deployed in various locations on urban streets. Surveillance videos can record the occurrence and development process of urban disasters and provide support for emergency managers to make correct decisions. This project adopts the method of video enhancement for virtual scenario, integrates real video and virtual three-dimensional scenario, builds three-dimensional video, and integrates video AI analysis results into three-dimensional video, to provide support for the full-link process of disaster emergency scenario construction, expression, analysis and decision-making.

3. The application of scenarios and VR for disaster management and emergency response.

China is actively promoting the application of real-scenario 3D City and VR for disaster prevention and reduction. Our project mainly concentrates on urban waterlogging, pavement collapse, fire, fog, and epidemic disease. In order to meet the requirements of simple three-dimensional scenario construction and browsing at the city level and support the downloading of three-dimensional architectural scenario data, this study designed a system platform that can realize the construction and visualization of three-dimensional urban architectural scenario.

On July 19, 2022, the Ministry of Emergency Management and the State Administration of Mine Safety of China, notice on the 14th Five-Year Plan for Mine Production Safety, encourage the development of VR training materials. Nanjing Ustep Information Technology Co.,Ltd, as the XR+ industrial solutions leader, taking coal mining industry as an example, design and built the VR training system for staff training, accident warning, emergency avoidance and multi-person rescue. Now this VR training system has been used in about 20 units in China.

Disaster scenario construction based on Plateau platform released by Japan's MLIT, combined with 3D GIS technology, is the primary method for disaster information representation and simulation in Japan. Disaster risks can be visualized in an intuitive and easy-to-understand way through 3D city models. On the basis of Plateau platform, Asia Air Survey Co., LTD., etc., has implemented 3D visualization of disaster risk information, assigned heights to estimated flood and produced flooded area maps of about 50 cities all over the country, including the 23rd district of Tokyo, and tried to superimpose them on 3D city models. We will also introduce some cases based on VR, such as Disaster relief medical support platform mechanism, VR disaster site motion sensing training system, Tsunami disaster preparedness exercise platform, and "Natural Disaster Investigation Training" in Japan.

The project has been launched for 15 months, it is expected to promote the resolution of technical bottlenecks in urban disaster process monitoring and the rapid construction of 3D scenarios in emergency disaster response, and drive the advancement of related industrial technologies such as CIM and disaster big data integration and mining applications. In the future, it should be necessary to establish relevant standards to promote data integration and application for disaster management and emergency response.

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