Establishment of digital river network control platform in Beijing-Tianjin-Hebei region based on integrated platform

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Abstract. The Beijing-Tianjin-Hebei area is the political, economic, cultural, scientific and technological center of our country and an important engine for promoting the economic development. It is the region where human activity of our nation and rest of the world has the biggest intensity to the water cycle disturbance, the biggest in water resources pressure bearing, the greatest difficulty in water resources security guarantee. With the help of 3S visualization technology, knowledge map technology, spatial database technology, it relies on the integrated platform, and the connectivity of the entity water network in Beijing-Tianjin-Hebei area is visualized by information technology, and the digital river network control platform is established. It makes full use of static space to support data with the help of modern monitoring means, and the visualization of monitoring information such as water regime information and reservoir work condition information of Beijing-Tianjin-Hebei area can be realized on the digital river network platform, which provides value service for hydraulic workers to solve their business needs in practical work.

1. Introduction
At present the application of "One Map" is very popular, it has comprehensive management and analysis multi-space-time water conservancy data through the comprehensive use of GIS, service fusion and other technical means [1, 2]. It cannot develop business application mainly with information services. People can only query information on all kinds of information service platforms, when business processes need to be handled; the adaptability of the platform is greatly reduced. So in order to put the business into practice, we do not only need to show the basic information services, but also to customize the business services on a regulatory platform.

With the arrival of the information society, big data, cloud computing, platform, mobile Internet and other revolutionary new information technologies are constantly developing and maturing. To transition from traditional water conservancy to modern water conservancy, we must rely on information tools and take the road of water conservancy information development. In the construction and management of engineering water conservancy, resource water conservancy, people's livelihood water conservancy and ecological water conservancy, water conservancy information is a strong guarantee, and the development and progress of water conservancy must rely on it [3]. It also needs the help of information technology to solve water resources issues in Beijing-Tianjin-Hebei area.

In this context, the network platform in Beijing-Tianjin-Hebei area is designed with the basic idea of possibility of implementation, operation and practicality, focusing on the safety and security of water resources in Beijing-Tianjin-Hebei area. That is, based on 3S visualization technology and...
knowledge map drawing method, the visualization environment of Beijing-Tianjin-Hebei area network is built. Based on the integrated platform, the thematic service mode is adopted to customize the water resources security service on the network so as to provide scientific support for the safety and security of water resources in Beijing-Tianjin-Hebei area.

2. Literature review
All countries in the world have different priorities in the field of river network research. The United States has realized the transformation from digitization to intelligentizing in the construction of network. It mainly carries out the national water configuration network engineering and regional construction of the "intelligent water network", of which the main body is water information service network, taking configuration as the main content of the country (National Smart Water Grid, NSWG) from the Mississippi river to the Colorado river water diversion, so as to solve the problem of spatial heterogeneity of supply and demand of water resources. Australia "SEQ" project (southeast networks of Queensland), started construction in 2008 with a total cost of $7 billion, which is the largest infrastructure in Australia after the snow mountain hydropower projects. It connected the water supply area to water deficiency area in Australia through water pipe, and built an intelligent water management platform, reducing the risk of water shortage and achieving more efficient use of water through regional comprehensive management, so as to respond to drought and to ensure the long-term safety of the water resources. Since 2011, South Korea started the implementation of network project, its goal is to develop the core technology, such as water resources acquisition and processing pipeline network, sub-net of “network” and micro network construction and comprehensive management, combining the distributed-style intelligent water production and supply network with information and telecommunication technology, so as to realize digitization and further intelligentizing on the basis of effectively connecting the regional water resources and existing water network.

3. Study objectives
The study objectives of this paper is to build a river network control platform, which can utilizing 3S visualization technology to realize the space visual expression of entities water network, including Beijing-Tianjin-Hebei region river water system, water transfer network, surface water, groundwater and others, at the same time, it will connect the platform and front-end real-time monitoring information, so as to check real-time monitoring information on the platform, such as river channels, reservoir engineering situation, etc. Water conservancy workers can use this information quickly to make prediction and forecast, which can effectively improve work efficiency and feasibility.

4. Materials and method
4.1. Key techniques
4.1.1. Knowledge visualization integrated platform. With the support of the national "863" key research project, our team has put forward the construction mode of Water conservancy service system based on platform, using component, knowledge map and visualization tool, and developed a set of application support platform products--integrated platform, and has compiled the People's Republic of China Water Conservancy industry standard "Water conservancy information Processing Platform technical regulation (SL 538-2011)", realizes the Water Conservancy application support platform understanding and the technical standard unification [4].

4.1.2. Visualization technology and GIS application. With the development and integration of 3S technology, GIS technology has been applied to various fields and departments in China's economic construction, especially in the water conservancy industry [5]. Visualization technology plays a very important role in spatial data analysis, mainly in the following aspects.

- Visualization techniques in terms of spatial information and knowledge are used to
demonstrate the end result of spatial data analysis. 

- Visualization makes spatial data easier to understand by displaying geometric features and topological relationships in spatial objects.
- Visualization as a spatial data analysis method and tool is often used in spatial data knowledge discovery. Visual analysis can visually display the characteristics of spatial data structure, complex relationships and laws, calculate the spatial properties of spatial objects and generalize the knowledge at a higher level. Therefore, it is widely used in the understanding and representation of spatial data.

4.1.3. Spatial database technology. The construction of "Grid" needs the support of massive data. How to store and manage all kinds of data effectively is the problem to be solved in the construction of "Grid" [6,7]. Data is a mass of structured, semi-structured or unstructured data obtained through sensor devices and communication networks. At present, through the establishment of automatic collection and survey stations as well as the database of water conservancy business in government departments to gradually be built in the field of water conservancy for the application of water conservancy business data to provide basic data support. But for the construction of "Grid" platform, the construction of spatial data warehouse is more important.

GeoServer is a typical open source GIS server and a J2EE implementation of OpenGIS Web server specification. Map data can be released conveniently and users can update, delete and insert feature data using GeoServer and it is easy to quickly share spatial geographic information between users through GeoServer. UDig is an open source desktop application framework, which is built on Eclipse RCP and GeoTools. Based on Java and Eclipse platform, it can edit and view map files in Shapefile format. There are special enhancements to the Internet GIS, web map servers and web feature servers [8]. We can edit and submit data through uDig, such as rivers and lakes, edit SLD style files, set whether to display tagged information, such as river name, etc. and call through openlayers to see our published works map service in the browser.

4.1.4. Component technology and mapping knowledge domain. Component technology is a specification for how to build components and applications from them. It not only realizes the reuse of software components-component, but also realizes the reuse of software framework, which greatly speeds up the development cycle of software. The component method is used to provide service for water resources protection data, to establish the implementation standard of business component, to encapsulate the business, to construct the standard interactive interface and independent algorithm core business component [9]. It makes each business component conform to the input and output model and is classified by business information, computing services, decision-making services and other types according to the functional characteristics of the specific business.

The development of business system adopts graphical programming, describes and organizes the application in the way of topic through knowledge graph, simplifies the complicated, tedious and time-consuming language programming into the mode of menu or icon prompt and connects various business components with lines by selecting components with visual description characteristics. The service composition framework and workflow are introduced into the application framework, the corresponding job model of the service is formed through business orchestration, and the data flow is used as the programming method of the water conservancy business. The sequence of execution of the program is determined by the data flow direction between nodes in the program block diagram (the icon represents the task, the connection indicates the data flow direction, the generated program is in the form of block diagram), which realizes the connection between the input stream of the superior service component and the output stream of the lower service component and completes the data information exchange between the service components by the data flow mode. The data information is processed through the algorithm inside the business component to form a kind of business service environment characterized by professional topic, personalized service that can be edited, reused, and the flexible mechanism is formed. The deployment of business applications is rationalized through an
on-demand spatial information service platform to facilitate the implementation of the service node scheduling scheme and is also conducive to the development of water business application refinement and stratification research [10].

4.2. Construction of digital river network platform

4.2.1. Research area overview. Located in the north China region (36° 03’- 42° 40’ N, 113° 27’- 119° 50’ E), Beijing-Tianjin-Hebei urban agglomeration region includes Beijing, Tianjin and Hebei province and its east is near Bohai with leaning on Taihang mountain in its west, Yanshan connecting its north and its south facing the north China plain. As the largest and most dynamic area in the north, it includes 11 prefecture level cities in Beijing, Tianjin and Hebei province and its land area is 225600 square kilometres. It has complex landforms in the territory, plateau, mountain, hills, basins, plains and other types of complete with its ladder tilt terrain from the northwest to the southeast. The climate is a typical continental monsoon climate which has huge difference in winter and summer with concentrated rainfall.

With the rapid growth of global population, industrialization and urbanization, the security of water resources has become a worldwide challenge coupled with the impact of global climate change. As the physical carrier of the water circulation system, the solid water grid is the objective basis of all the regulation and control behaviors and measures of the water cycle. Both flood control, drought resistance and disaster reduction, allocation, conservation and protection of water resources and the construction of related management systems can be unified into the software and hardware construction of the "natural-social" dual water grid system. Water Grid project is not only the synthesis of all kinds of water conservancy infrastructure, but also the integrated platform of water resources management system and its decision support system. At the same time, driven by the trend of information technology, big data, cloud computing, digital earth, intelligent earth, Internet of things and other related concepts and many information technologies have been used in the field of water resources. As the intersection of these two focal points and frontier fields, grid has been taken as an important way to solve regional water problems in many countries and put into practice.

4.2.2. Oscache. First, we can digitally express the physical connectivity of rivers by using ArcGis software. The river vector data can firstly be obtained from the Geographical Information Monitoring Cloud Platform (http:www.dsac.cn). Then, select a research area and determine its boundary range by selecting the same coordinate system and making the first and second large river loaded on the map of ArcGis and the shp file of river system is cut according to the scope of study area. Then the river style is modified and the mark is added with the main water system network being established. Sequentially load three, four and five level of rivers to get the final study of the regional river network. Finally, we can use the same method to load the lakes, reservoirs and other large water areas in the study area into the river network according to their actual correspondence so that the geographical location of the actual river can be matched one by one to realize the digital presentation of physical water grid. As shown in figure 1.

Secondly, using uDig software to edit the basic data of water grid and edit the style files and save the XML files to SLD file format by referring to the style standard established in ArcGis. As shown in figure 2.

Thirdly, upload the spatial data file and edit the style in the GeoServer by setting up the GeoServer server of the Grid and we can see the grid map service that we publish in the browser by calling through the openlayers. As shown in figure 3.

Finally, based on the integrated platform, the two-dimensional GIS components are customized on the platform and the published river network data and related spatial data are called according to the requirements to obtain the two-dimensional map of Grid, which meets the needs of the subject and can continue to customize the relevant business components on the map to achieve water services. As shown in figure 4, the right side of the figure is the network, clicking on the river or lake icon can be
queried river regime information, the left side is the river system connectivity diagram, including reservoir, river, water function area, etc., clicking on the different areas can also query the corresponding monitoring information. As shown in figure 5, the right side of the figure shows the real-time monitoring information of the selected node.

Figure 1. Digital river network in Beijing-Tianjin-Hebei region.

Figure 2. River style editor by uDig.
Figure 3. River network map publish.
5. Results and discussion
The main results are as follows:

- Downloading the Shp data of the river system in the Beijing-Tianjin-Hebei region from the Geographical Information Monitoring Cloud Platform (http://www.dsac.cn), and the network of rivers is obtained by using ArcGis software. Releasing the network of rivers to geographic server after editing the type of network of rivers basic data.

- Using the component knowledge graph technology, the edited network of rivers is made into component, visualized presentation of which is implemented on the integrated platform, and building the regulate and control platform of the digital river network.
Through database connecting the front-end monitoring information, real-time monitoring data can be inquired and presented on the regulate and control platform of the digital river network, so that water conservancy workers can carry out the forecast work quickly and efficiently.

6. Conclusion
Based on the integrated support platform, the digital river network control platform of Beijing-Tianjin-Hebei area is constructed. The use of modern information technology, combined with all kinds of data resources, can be used in water conservancy work monitoring, prediction early warning, simulation, information reporting, comprehensive evaluation, assistant decision-making, command and coordination, information dissemination and evaluation of the functions of the visual expression, and can support the management of various types of water services business. The integrated decision-making service provided by the platform can be integrated into various kinds of heterogeneous water conservancy data, so as to realize information and application integration, decision-making research and knowledge visualization. However, this platform still has many deficiencies. Therefore, a number of technical difficulties need to be further solved in the process of platform development.

7. Recommendations
The visual expression of river system can be realized on the network platform, which can help the water conservancy workers to quickly and efficiently check the necessary monitoring data information, and has a great help for the forecast. At the same time, the related water conservation business and services can be developed on the network control platform, and water conservancy workers can display their daily work processes on the platform, realizing information processing of the traditional business, which is of a certain help and reference to the promotion and development of the modern water conservancy business.

Acknowledgment
This research was financially supported by National Key Research and Development Program of China (2016YFC0401409), The National Natural Science Foundation of China (41471451, 51509201, 51679188).

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