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SURVEY REPORT

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SURVEY ON WATER RESOURCES INFORMATION SYSTEMS

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Abstract: Water is an integral part of life as well as the economy. With the depreciation of water resources, the demand for quality water is increasing day by day. Water utilities are important to provide good quality water, but due to antiquated or lack of adequate infrastructure it becomes difficult. Along with this, water gets wasted due to soil erosion, polluted water resources, concretization, industrial waste, leaks, pipe bursts, etc. Hence, it is challenging to manage the water scarcity. To manage all these issues, water utilities must come up with smart water management solutions and techniques. In this paper, a survey of different water resources information systems is presented.

Keywords: attribute data; GIS; real-time monitoring; spatial data; water resources

I. INTRODUCTION

Water is one of the most important resources for sustainable development of all living things on the earth. Considering the growing population, effective storage of available water resources and its analysis to abide growing demands becomes very much essential.

Water is a natural resource and we cannot yield it, but we need to use it properly. As per the survey, irrigated agriculture and industry use about 70% and 23%, respectively, of the water used worldwide, while households only use 8% [1]. More regions face the problem of droughts, drastic seasonal changes, evaporation and rapid population growth. Because of these, growing population face challenge of finite water resources. Also, lack of fresh water is becoming a hurdle for economic progress and social stability. A mechanism is required, that will predict the amount of water that can be made available for consumption, distribution, storage for different purposes like industrial, domestic and agriculture. By using this mechanism, water management can be done effectively.

Water resources management is a complex task that is extensive in data sources scope and entails the use of a wide range of data models. With the development of technology, new technologies are used in water resources management. GIS and database technology can be merged to manage water resources. Database technology can process and analyze non-spatial data; GIS technology can process and analyze spatial data, and visualization techniques are used to represent the data. The system helps in assessment, anticipation, control and supervision of water quality, and provides a basis for the future decision making and policy making [2].

Internet of things (IoT) is a collection of devices which enable us to sense, data collection and management and monitor the system without being physical with the devices. These systems comprise of sensors, networks, storage devices and computer systems. For the development of society, we need to bring together technologies which will provide accuracy, scalability and optimized automated system. Smart water management system is only possible with help of IoT which includes sub-systems like monitoring the flow of water, management of valves, fault detection within valves, data analysis through observations from different meters etc [3].

II. LITERATURE SURVEY

A. *An IoT-based system for water resources monitoring and management* [4]

An integrated system based on Internet of Things (IoT), for water resources monitoring and management, is described in this paper. The system consists of three layers: information perception layer, information transmission layer and application layer. Information perception layer has Sensor network for monitoring water information. Information transmission layer does real-time information transmission. Application layer stores water information.

The perception layer uses multi-sensors for data collection which is based on IoT. It is constructed using hydrological measuring equipments like water meter, flowmeter, water level gauge, hydrological monitoring station, and water quality monitoring station. The collected data is then stored on the remote terminal unit (RTU). The middleware layer uses real-time operational database (RODB) to manage the data and performs OLAP operations on it. Application gateway (AG) and IoT application infrastructure (IoT-AI) are also used in the middleware layer for services and applications. Application layer consists of application support platforms and WebGIS-based data application. ArcGIS server is used to manage network service.

The features of this system include hydrological management, water pollution monitoring, ecological monitoring, disaster monitoring and prediction, weather observation and forecasting. Users can get water resource information service by using the browser. In software, visualization interface, Interactive map, attribute information query and statistics function are also developed for users.

B. Research on the management of water resources introducing GIS technology under the mode of water saving [5]

In this paper, the system for management of water resources is designed using GIS technology and advanced network technology. The system provides real-time monitoring of water quantity and quality. It provides decision making support for real-time scheduling and allocation of water resources. Factors like weather, moisture and other natural information, socio-economic factors of the area under consideration and requisition for water resources are considered.

The monitoring instrument is linked to the database. The database includes analysis of spatial data, managed in spatial database engine of ESRI, and attribute data, managed using SQL Server 2005 platform. Data is transmitted to online data collection component. The database is linked with the knowledge library and to comprehensive information management, analysis and decision support component. The remote-control equipment is linked to real-time control management. The monitoring technology makes use of GPS, RF, water level sensors and AI. The online data collection and information management components form sub-parts of monitoring and management system. The analysis and decision support component and real-time control management components form sub-parts of assistant decision system. They are then connected to the water resources monitoring centre.

The features of this system are to set alarm as per a value, prevent water theft and so on. It also has real-time monitoring feature and visualization of data.

C. Development of Water Resources and Environment Management InformationSystem based on ArcIMS[6]

The system described in this paper makes use of ArcIMS along with java technology to enhance its analysis capacity. This technology is suitable for small to big industries alike. The system helps in real-time monitoring and early warning. Socio-economic factors, land utilization and environmental factors are taken into consideration for the system design.

The system designed is a distributed system, which consists of clients who send a request to ArcIMS Server and server-side components that respond to the client browser. The system consists of four databases, namely, spatial database, attribute database, methods of database and mode database. Point queries and rectangular queries are answered by the system.

The important features of this system include expert decision making and intelligent information retrieval system. The information is displayed on the map using iso-surfaces and contour lines.

D. Design of water resource management information system based on Web GIS [7]

In this paper, the system for management of water resources is designed using Web GIS and Database technology. The system provides information about water quality, pollution sources, water need and supply information.

The system uses advanced computer software and network technology. The system management department consists of SQL Server MapInfo and Map Xteme components. The management department consists of MIS/MapX components. They are linked to the spatial database engine and spatial IMS using TCP/IP and HTTP protocols. They are finally connected to central DBMS. It answers various queries like water quantity, water quality, area hydrological inquiries, policies and regulations. Chorogram analysis and region rainfall analysis are also some of the factors taken into consideration.

The features of this system include analysis information like demand and supply of water and water prediction analysis along with real-time monitoring of groundwater, reservoir and drainage outlets.

E. Research on water resources automatic monitoring and management system [8]

The automatic online water quality monitoring and analysis system includes spectrum free reagent inspection technology, physical sensor technology, automatic control technology, communication network technology and data analysis technology. It uses Delphi technique as the developing tools and object-oriented programming. System databaseusesSQL Server 2005. The database design uses ORM (Object- Relation Mapping) mechanism to map and process all forms to objects and ensures the data security, correctness and project control standard.

The water auto-monitoring management system is divided into 3 parts, namely, water quality monitoring analysis module, hydrology monitoring analysis module and system management. Water quality monitoring analysis uses WMDService service, including monitoring parameters data and fingerprint map data. The hydrological data analysis uses HydrologyServer service. The water quality monitoring analysis module uses a form of chart to present data collected by water quality monitoring equipment to users visually. Hydrological monitor feedback parameters include velocity, flow rate and water level. System management includes alarm information inquiry, database configuration, user management, etc.

The features include monitoring the river section water quality, water level, flow velocity and flow quantity and other parameters. They are monitored automatically, online in the real time. The system shows the water quality parameters and the changes of the hydrological parameters directly and alarms the water quality mutation and over standard. It is implemented with graphic, voice or text messages and gives 3D view analysis for water quality fingerprint graph.

III. CONCLUSION

This paper surveys various water resources information systems.It is observed that various models are developed for handlingwater resources. The table below summarizes the surveyed papers.

Table I. Comparison Study of Technologies Surveyed

Ref. No.	*Technology Used*	*Advantages*
[4]	1.Wireless sensors 2.JDBC 3.WebGIS 4.ArcGIS	1.Conventional traffic monitoring and real-timetraffic monitoring 2. Hydrological management 3.Water pollution monitoring 4.Ecological monitoring
[5]	1.GIS	1. Hierarchical map display 2.Graphics zoom, roaming and navigation 3.Graphics operations based on spatial object
[6]	1.ArcIMS 2.Java	1.Hierarchical framework for GIS 2.Interactive maps and metadata catalog 3.Supports multiple users at once
[7]	1.Web GIS	1. Analysis and forecast subsystem 2. Message service subsystem 3. Pollution monitoring 4. Operational control subsystem 5. Feasibility analysis
[8]	1.Delphi 2.SQL server 2005 database	1. Monitoring automatically on-line in the real time 2. Fingerprint graph

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