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Research on monitoring system of water resources in Shiyang River Basin based on multi-agent

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Abstract. The Shiyang River Basin is the most populous, economy relatively develop, the highest degree of development and utilization of water resources, water conflicts the most prominent, ecological environment problems of the worst hit areas in Hexi inland river basin in Gansu province. the contradiction between people and water is aggravated constantly in the basin. This text combines multi-Agent technology with monitoring system of water resource, the establishment of a management center, telemetry Agent Federation, as well as the communication network between the composition of the Shiyang River Basin water resources monitoring system. By taking advantage of multi-agent system intelligence and communications coordination to improve the timeliness of the basin water resources monitoring.

1. Introduction

Water is both the survival of natural resources and regional development strategic economic resources. shiyang river basin in gansu province is in the hexi inland river valley has the largest population, more developed economy, the water resources development and utilization, water supply high degree of serious conflict, ecological environment problems serious areas. With the gradually intensified the contradiction between the people and water, the parts of the ecological environment is worsening. This shows real-time monitoring of water resources and rational utilization is very necessary in the Shiyang River Basin.

With the continuous development of science and technology, so that the river basin water resource monitoring becomes more and more easy, although the basin water resources monitoring is important, but the rational planning of water resources and utilization of the more important. Although the introduction of GSM technology can make the monitoring data communication more efficient, but the control center and telemetry station to a certain lack of intelligent, which will greatly reduce the real-time monitoring [1].

Multi-Agent theory is that the last decade developed a new technology, which has some intelligence, this paper intends to establish a Multi-Agent Shiyang River Basin Water Resources Monitoring System, through the make full use of good intelligence Agent system and communication coordination to improve the efficiency of the monitoring of river basin water resources.
2. Agent and multi-agent theory
Agent is a class in a particular social environment capable of sensing the environment, and through flexible, independently run a series of design goals, autonomous computing entity or program. Agent as autonomous individuals, in certain goal-driven, with some kind of self-control of their own behavior and internal state, and as accurately as possible to understand the user's true intentions, to take a proactive behavior, efficient use of the environment available data, knowledge, information and computing resources to provide users with fast, accurate and satisfactory service.

Multi-agent system refers to the Agent through collaboration to carry out certain tasks or achieve certain goals Computing System Agent to work together to solve problems more than their own individual ability, they are autonomous, distributed run. Multi-Agent Systems focused on coordination between independent Agent intelligent behavior between them to coordinate their knowledge, goals, skills, planning to produce the appropriate behavior or solve the problem in the problem solving process, in order to common global goals, the agent share the knowledge about the problem and solution methods. Multi-Agent System Requirements exchange between agents in the system with smart or self-organizing capacity (such as reasoning, planning, learning, etc).

3. Shiyang River Basin water resources monitoring system based on multi-agent theory
3.1. Research on water resources monitoring system structure model based on multi-agent theory
Based on Multi-Agent Basin Water Resources Monitoring System by the basin water resources monitoring and management center, telemetry points, as well as the communication network between them. The management center is the core part of the monitoring system, It's task can be divided into more than one task, based on Multi-Agent basin water resources monitoring system, build a multiple Agent Management Agent Federation; The same telemetry task also point can be decomposed into more than one task, thus establishing a telemetry Agent federal; According to the dispersion of the telemetry point , the management center and Communication network between the telemetry point using the GSM wireless network to connect. The Work process management subsystem to collect information on the monitoring points, the decision subsystem accordingly to determine the optimal operating condition combinations, the final system to complete the appropriate monitoring and management. Management Agent coordinate to the work of each module in this process, the Communication Agent has played the role of communications between the entire system. Telemetry agent put the river basin water changes through the communication network feedback to the information center, and then information center feedback to the management center to make a decision. Subsystems and modules built by location relatively decentralized, each module has a relatively independent function, its function is only to achieve the overall system capabilities and services. Each module in the system to share system resources for communication, coordination and completion of the entire system of control tasks. The system model in Figure 1.
3.1.1. *Management center agent subsystem*. Management agent subsystem structure model, it's also a control multi-agent systems, In contrast, the function of Agent in the system optimization algorithm agent, Database Agent, Information Storage Agent. Detection information from the monitoring system, the decision-making system, the Management Agent of the system's first call information is stored Agent, check the monitoring of flow, level, and other information if the information is stored in the information storage Agent. If the given information in the Information Storage Agent is not required for analysis and calculation, to be called directly from the database Agent optimization results transmitted to the execution system. If the given information by the monitoring system does not exist, information from the Management Agent coordinate optimization algorithm agent to optimize the calculation of reasonable run program transmitted to the execution system, and monitoring information and the corresponding optimization results are stored in the storage agent and database agent for later use. As a result, because the information stored Agent and database Agent are exists, it can quickly and accurately make the according to the complexity of the watershed, water resources information decision optimization. The subsystem model in Figure 2.

![Diagram](image-url)
3.1.2. Communication networks and communication coordination. Base on multi-Agent river basin water resources monitoring system and GSM internal communication coordination, Completed by the Agent of the communication between them. The key to communication coordination is to coordinate communications between the Management Agent Federation and telemetry Agent Federation. due to Watershed measurement points were scattered although in the wired network communication efficiency is high, but the specific implementation of it was very difficult, so using the GSM wireless network to communicate. The wireless network of communication and cable network is different, in order to realize the communication, need to be in two kinds of management Agent internal set a communication control module, as the GSM network data communication interface. So as to realize the GSM wireless network communication coordination. Management Agent Federation and telemetry agent Federation both have a Management Agent within them, each management Agent in their federal internal is a manager in charge of the federal internal task decomposition and communication and coordination between agents, and also responsible for communication with the outside world coordination, communication coordination of the entire system is actually to Management Agent in the Management Agent Federal and telemetry Agent Federation within the Management Agent.

3.1.3. Telemetry agent federation. Telemetry of multi-agent agent subsystem, communication coordination of specific implementation process: The system is composed of management Agent, water quality detected Agent, Water Level Monitoring Agent, water volume monitoring agent, water regime monitoring Agent and Information treatment Agent consisting of a controlled multi-agent control system. first the information to a function Agent, this function agent to complete tasks, and corresponding Agent produce feedback information, and then send the information to other Agent, until the entire subsystems monitoring task completion, testing information get arrangement, analysis, storage, and through the management Agent, communication Agent transmission to other systems. Each functional Agent to accept the Management Agent task information, and then complete the task, then feedback this information to the Management Agent. In order to achieve to communication and coordination between multi-agent. The subsystem model in Figure 3.

![Figure 3. Telemetry subsystem](image_url)

3.2. Agent classification system and its function
The whole model system of Agent can be divided into management Agent, communication Agent and telemetry Agent three categories. Management Agent is responsible for the coordination of functions between each subsystem, it assigns tasks to each internal Agent and receive their completed the task of results, and then its results were analyzed, the task is completed to finalize the system will also need to pass to the other subsystems send information to the communication agent. Communication Agent is primarily used for communication and coordination between the Agent. In multi-agent
system, each Agent has a communication interaction. If not classified to the establishment of each of the two communication network between agents, the communication network of the whole system is very complex, the use of the Communication Agent to make the whole system the communication network is simple, fast and efficient communication. Management Agent is a system control unit, used to coordinate and manage the telemetry subsystem. Telemetry Agent accept task from the Management Agent, And through it's own some of the features to accomplish the task, and then reply to the management of the Agent services for the entire system tasks.

![Monitor system operation flow chart](image)

Figure 4. Monitor system operation flow chart

4. Application examples
Shiyang River Basin water monitoring and water resources scheduling, there are some problems, it is difficult to achieve all of the water allocation targets. Due to the lack of effective means of water dispatching river basin, it can not reasonably be the deployment of the middle and lower reaches of production and living water, Midstream and downstream parts of some of the river channel conveyance losses, and water delivery efficiency is low, serious deterioration of the ecological environment. Regional water mounting imbalance, Water resources use efficiency is low. Before the total water supply of the Shiyang River Basin 2.877 billion m³, of which 5.4% of the total water
consumption of industrial water; irrigation water consumption accounted for 86.4%; grass water consumption accounted for 4.5%; urban domestic water consumption accounted for 1.6%; rural life water consumption accounted for 2.1% [5]. Shiyang River Basin irrigation water is obviously higher, industrial and domestic water proportion are markedly low.

By hand-simulation data analysis, monitoring and dispatching of water resources in the Shiyang River Basin, and more adequate and reasonable use of basin water resources. First telemetry Agent accept the task come from the monitoring center management Agent, from the status quo of the basin (water regime, water level, water quality, water volume) Telemetry Agent subsystem data collection and feedback to the Information Management Agent coordination through communication, information management Agent and then collect the feedback information to the integrated transmission to the monitoring center monitoring system center to receive information for intelligent analysis, to find the optimal solution, then the decision-making and the command is issued to each subsystem, the system continuous cycle, in order to achieve the Shiyang River Basin water resources monitoring and optimization of management control. Come to the Shiyang River basin-wide total water consumption of 2.247 billion m³, of which 16% of the total water consumption of industrial water; irrigation water consumption accounts for 74%; domestic water consumption accounted for 4%; ecological water use accounted for 6% from the data analysis. So that water resources utilization too higher. (See Figure 4).

5. Conclusions
In recent years multi-Agent theory is a hot topic of research in the field of distributed artificial intelligence, Multi-Agent theory in the water monitoring system, a preliminary study. This article, innovation is combined with intelligent multi-agent theory and the Shiyang River water resources monitoring theory, the establishment of a Multi-Agent theory of the Shiyang River Basin water resources monitoring system analog applications. In this multi-agent systems, with different objectives Agent work together, mutual coordination and consultation to get the job done. Can see, based on the Agent of Shiyang river basin water monitoring system to enhance the Shiyang river basin, the utilization ratio of water resources of river basin water resources monitoring and rational utilization, water resources monitor and rational utilization of play a role.

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References
[2] Zhao T H and Qi X Y 2007 Micro Computer Information 23 (4-3) 54-56