CONCEPTUAL MODEL OF WATER RESOURCE CONTROL SYSTEM OF WATER RESERVOIRS

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Current publication is dedicated to problems of reducing the losses due to floods and droughts. As known, water reservoirs constructed on river basins are widely applied for mitigation of floods and droughts.

For the Republic of Azerbaijan, problems of mitigation with droughts and floods are actual, as summer seasons are accompanied by droughts, and spring and autumn seasons are accompanied by floods. The main river of Southern Caucasus is Kura River, basin of which covers Armenia completely, and Azerbaijan (79.8%) and Georgia (52.4%) partially. Upper current of Kura from the border with Georgia is currently regulated with Shamkir and Yenikend water reservoirs. Mingachevir water reservoir (with volume of 15730 million m^3 and surface of 605 km^2, height of the dam is 77m) is formed with middle currents of waters of Kura, Iori and Alazan rivers. Following is the map of the basin of Kura river (Fig.1):

Fig. 1. Map of Kura river basin

Task assignment

Many problems of exploitation of water reservoirs are connected with their functioning in extreme conditions. i.e. with preparation of rules of water reserve usage in low-flow period, and passage of high waters in the flood/high waters.

Covering tasks of water reservoir control and formalizing all details of exploitation of water reservoirs is not only impossible, but also impractical due to system considerations.

Maximal allowable evacuation of water reservoir for increasing its anti-overflow effect must be considered during forecast of high waters.

Conceptual model of rational control system of water resources for irrigation of agricultural lands during the hot seasons of the year and protection from mud flow and flooding, as well as production of electrical energy, can be divided in following component parts which are depicted on functional scheme of the model (Fig. 2.):

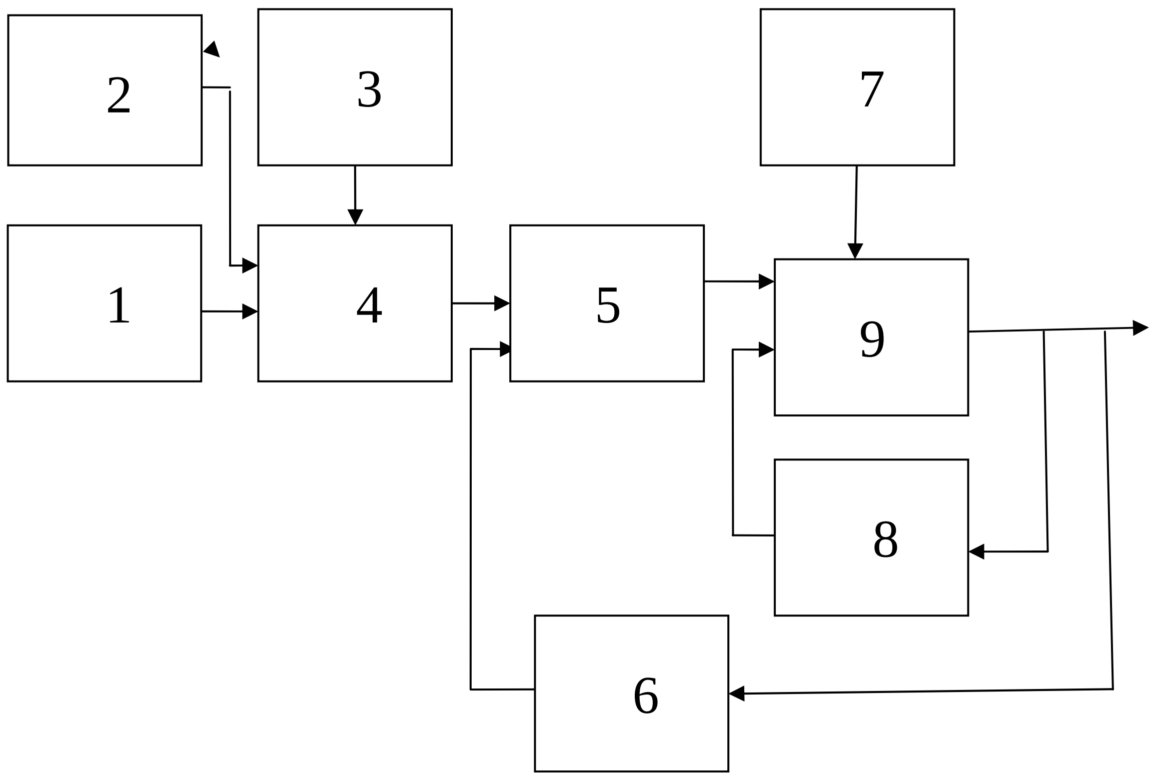

Fig.2. Functional scheme of conceptual model of rational water resource control system

Current researches consider development of a computer model of rational water resource control system in order to minimize the damage caused by floods and mud flows, accumulation of a sufficient volume of water in the water reservoir for irrigation during hot season of the year and processing of maximal amount of electrical energy.

Conceptual model of control system consists of following 9 components:

1. Digital model of terrain of the surface of the Earth
2. Module of hydrometeorology forecast
3. Geomorphologic model of Earth crust
4. Model of water flow on Earth surface
5. Model of forecasting of desired water level in the water reservoir
6. Module of water resource consumption
7. Module of water ingress into water reservoir in real time scale
8. Control module of water level in water reservoir
9. Model of water reservoir

Module 1 is the digital model of terrain (DMT) of the Earth surface of river basin, which will allow to determine the form and slope angle of declines, which is necessary for determination of direction and power of movement of rain precipitation on the surface of Earth.

Module 2 provider hydrometeorology forecast of weather conditions (information about atmospheric precipitation, temperature and wind) on the territory of river basin in short-term, middle-term and long-term plan.

Module 3 is the geomorphologic model on Earth crust, which allows to evaluate the density and viscosity of surface water depending on composition of the ground and properties of absorption of water by the ground.

Module 4 realizes the model of water flow on the surface of the Earth and is implemented with consideration of digital map of terrain, hydrometeorology forecast of weather conditions and geomorphologic Earth crust model of river basin surface. Appointment of module 4 consists of modeling of ingress of forecasted amount of water in the water reservoir in real time-scale.

Module 5 carries out the calculation of desired water level in the water reservoir with due consideration of assumed and current ingress of water into the water reservoir, as well as consumption of water resources.

Module 6 is a model of consumption of water resources for irrigation and processing of electric energy with consideration of prohibition of flooding in lower reach of the water reservoir.

Module 7 is a model of actual ingress of water into the water reservoir in real time scale.

Module 8 carries out rational control of water level in the water reservoir. The essence of control consists of adherence to desired level of water in the water reservoir. Optimal control is reached by tracking of desired level of water. Desired water level in the water reservoir is a multi-criterion functionality, which is optimized by module 5.

Module 9 is the model of the water reservoir. Volume of water resources in the water reservoir can be calculated based on the scale of level gauge or based on the area of the mirror of water reservoir.

Conclusions

1. Conceptual model of water resource control system of water reservoirs providing integrity of information provision is proposed.
2. As each region has its own specifics due to the terrain of Earth surface and basin of each river can its own climatic mode (presence of glaciers and snowpack in the mountains and lack of water in summer seasons), it is reasonable to consider these factors during development of rational water resource control system of river basin.
3. In order to develop a universal method of evaluation of flooding process, it is necessary to develop its model with consideration of digital map of terrain of the area, geomorphologic properties of the surface of the Earth, dynamics of movement of surface (continental) waters, and hydrometeorology forecast.

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