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Computer Science: Application of technology/IoT in hydropower dams

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Abstract. As time passes by, we barely see how much time it costs people to stay at work, fixing problems that happen every day. As people we should do more about humanity and technology is the door that opens opportunities for us to do this. Technology today is transforming every human daily life routine and it's only the beginning of what technology can bring. By 2020 we know that technology will connect the unconnected by introducing the real idea of Internet of Things. Every little, tiny thing all over the world will be connected, but also big and important projects like hydropower system in industry revolution. Hydropower is the key of all great revolutionary machines that are produced. They give us energy to live by. Hydropower is the route to accomplish every process we start every day. Every country has at least a single hydropower. So why don't we make them more reliable and efficient at low cost? Technology is the future so we should invest more in the future of light. We will see a chronological list of the impact of technology in hydropower. So we will see some main examples what is practically done about information technology application in dams. What is the future holding for technology application in hydropower systems?

Keywords: Hydropower, technology, humanity

Introduction

A **dam** is a barrier that stops or restricts the flow of water or underground streams. Reservoirs created by dams not only suppress floods but also provide water for activities such as irrigation, human consumption, industrial use, aquaculture, and navigability. Hydropower is often used in conjunction with dams to generate electricity. A dam can also be used to collect water or for storage of water which can be evenly distributed between locations. Dams generally serve the primary purpose of retaining water, while other structures such as floodgates or levees (also known as dikes) are used to manage or prevent water flow into specific land regions. There is a great number of hydropower dams and they are the greatest power produces nowadays. So they will have excellent qualities such as high strength, high durability and resistance to earthquakes, which will also yield very low life-cycle cost (LCC).

Advanced technologies can also rehabilitate and upgrade existing dams under operation. These technologies can increase reservoir volume and discharge capacity, improve operations, control sediment, and other benefits. We will represent ways

how to keep these dams in good performance, and one of the most important is Internet of things coming in 2020.

It is important to first clarify that the Internet of Things means different things to different people. In the information technology and security world, it carries with it implications of consumer grade internet enabled devices, minimal security, and high risk to data security. But for a working definition, the Internet of Things represents the internet today, and is defined by

the transition from an internet where the majority of the connections are people to an internet where more things or objects are connected.

Technology and hydropower systems

Do technology and hydropower system come together as one nowadays?

Technology has become a very important part of every kind of profession nowadays. Technology makes the hydropower system more efficient, helps them work in higher speed, increases the output power etc. For example, expanding the operating range of the plant can increase the income from that plant by 61 percent. In layman's terms, "expanding the operating range" just means altering the technology to serve lower loads and higher peaks, as a percentage of capacity. Upgrading plants to have variable or adjusted speed drives also alters the ability of those units to meet different kinds of demands, including more rapid response and variability management. This change could increase each plant's income by around 85 percent. Finally, plants can be constructed to be "closed-loop" (or adjacent to waterways) to cut down on permitting time and minimize environmental impacts.

Except the profits that technology brings for hydropower systems, it has an important role on natural flow of rivers. Millions of fish that migrate annually between the ocean and rivers can't get to their native spawning grounds, contributing to drastic reductions in the populations. The major issues addressed by authorities include protecting fish from being entrained into the turbines or impinged on the trashracks, providing upstream and downstream fish passage past the dams, providing adequate base flows downstream from the projects, reducing impoundment fluctuations, providing flows in dewatered reaches, reducing impacts to wetlands and nesting birds, and providing public access. Also there will be new technologies in existing hydropower system. Relicensing is a great opportunity to alter licenses to enable this renewable energy to be produced in a more environmentally-sound fashion, with protection and enhancement for a variety of fish and wildlife resources.

One real example :

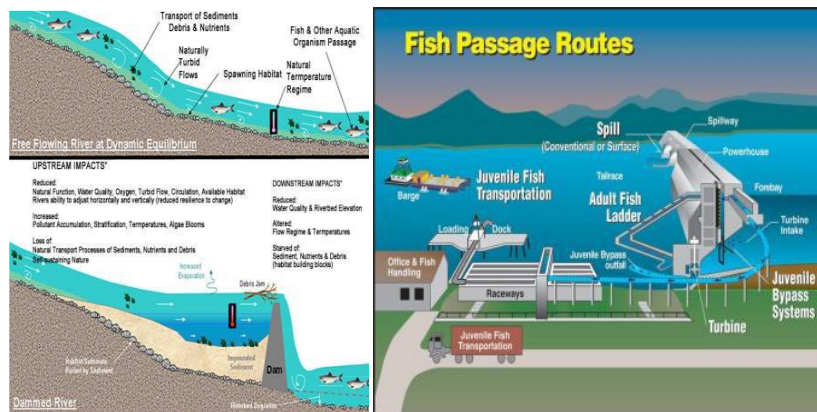


Fig. 1. Developing fish passage in hydropower dams

Improving hydropower systems using Internet of Things

Dam safety management is a long-term and continuous process that has to be improved permanently. In this respect, procedures and processes of dam safety management must continually be improved in all aspects, both in terms of measuring equipment, as well as in the management and use of data in the procedures for determining safety facilities.

The modern concept of dam safety management should be based on the physically based and software-supported technical system. The physical foundation of this concept relates to the provision of data of importance to the safety of the dam and the accurate measurement of relevant physical quantities, which are to be tracked on the dam with installed equipment for technical monitoring. Today's level of information and telecommunication infrastructure enables implementation of the advanced systems for measuring, acquisition and archiving data. These systems should be able to automatically collect monitoring data, to perform data validation and to securely archive them as to provide users with data in unified and efficient manner.

With long-term monitoring of the instruments operation, database obtained by reliable instruments could be formed.

Implementation and use of IoT on dams: enables creation of databases of reliable instruments which can give more precise evaluation of the dam safety. Internet of Things (IoT) is a network of physical objects in which electronics are incorporated, as well as software and sensors that allow users to obtain timely and accurate data through services for data exchange between manufacturers, users or other connected devices. Reliable data could enable users to react in the right way at the right time, in case of critical situations or natural disasters and in some cases to predict events.

The aim of paper is to describe possibilities of the Internet of Things application within a specific system for dam safety management.



Fig. 2. Internet of things : connecting the unconnected

Numerous works related to IoT application in system for observing have been published. For instance in the authors deal with the localization system, based on ZigBee technology in real-time in order to provide prompt support for safe management of the dam construction sites. The system is based on the tracking technology using wireless sensors and a set of servers that run software for processing the collected data, visually monitoring the condition of the site in real-time and remote communication with other systems such as ERP, CRM. A low-power tracking technology is network hardware based on ZigBee technology, which uses the technology of fingerprinting software. The proposed system for observing in real time for employees was successfully implemented in the Xiluodu arch dam construction site.

Implementation and development of the Internet of Things (IoT) is closely connected with the construction of smart grids. Generally, using the technology of wireless communications and observations all electrical devices can be connected in IoT, in order to make the smart grid become interactive electricity network in real time. Qiaoming Zou et al. summarize the current state in that area, analyze the current structure and characteristics, as well as key technologies that enable the implementation of the IoT. Authors brought up some concrete analysis and discussion on the implementation of IoT in asset management and in the automatic reading meter system of smart grid and gave conclusions about the perspective of the application of IoT in smart grids.

Operating state tailings ponds, which are an important production area in the mine, directly affect the safety of people and property, as well as production at the mine [14]. To build a system for the security surveillance of tailings ponds, using GIS technology we cannot only manage the data and information of tailings scientifically and effectively, but also give full play to the advantage of computer's storage of massive data. The interactive operation of GIS spatial query and analysis facilitates accurate and convenient search management, alteration and statistics of data. With the observation of the height of the seepage line of dam body, the water level in the tank, the index of dry coast, deformation and deviation of the dam body, we can promptly obtain information such as the fluctuation of the water level, which is important for timely forecasting stability of the dam body, thus achieving safe management of tailings ponds, as well as early warning of danger.

Lately, much attention has been paid to climate changes, control and management of the environment, so IIS (Integrated Information System) is gaining on importance. The paper described in [15] presents a new IIS that combines IoT, Cloud Computing, Geo-informatics (remote sensing - RS, geographic information system - GIS, Global Positioning System - GPS) and e-Science for monitoring and management of living environment, with a case study of regional climate change and environmental impact. In order to collect data and other information to a perception layer, multiple sensors and Web services have been utilized. Both networks, private and public, were used to access and transport mass data and other information in the network layer. The result of this case study shows that there is a visible trend of the increase in air temperature in Xinjiang in the past 55 years and an apparently growing trend in rainfall since the early 1980s. Besides the correlation between environmental indicators and meteorological elements, the availability of water resources is a decisive factor in the terrestrial ecosystem in the area. The study shows that the IIS greatly contributed to the study, not only in terms of data collection using IoT, but also in the use of web services and applications that are based on the cloud (Cloud) platform and e-science, and that effective evaluation and monitoring can still be improved.

Internet of Things (IoT) is a concept that includes all the objects around us as part of the Internet. Coverage IoT is very large and includes a variety of smart devices such as smart phones, digital cameras, smart rain gauge, an outside temperature sensor and a variety of other types of sensors. When all these devices are interconnected, they provide much more intelligent processes and services that can be used in various areas. Such large number of devices and sensors on dams connected to the Internet provides a multitude of services and produces a large amount of data (big data). Cloud computing is a model for on-demand-access to repository of configurable resources (budget, networks, servers, storage, applications, services, software, etc.), which can easily provide such infrastructure, applications and software. Platforms based on a cloud help us to connect to the things that surround us, so it is possible to access them from anywhere at any time. Cloud acts as a front-end to access the IoT. Applications which interact with devices, such as sensors, have special requirements for massive storage to record big data, a huge power computation that would provide data processing in real-time and high speed Internet to allow high speed data throughput.

Conclusions

As we discussed about the importance of dams in our everyday life we need to keep them always updated and always in good performance. In this paper we gave examples of latest technologies like WSN, IoT etc for managing dams safety. And by using the tools made available by the standardization of the internet as the information repository of choice, we can begin to offload what used to be specialized civil engineering functions to data analytics and security professionals. We also need to recognize the importance of other specialized fields, including electronics technicians, sensor specialists, and software providers as team members with the civil engineer to help us to bring the vision for a comprehensive dam safety system to a reality. We saw that using information technology elements like sensors and IoT, we can improve the dams efficiency and avoid damage of dams occurring. Especially Internet of Things will change the way we manage hydropower dams in our everyday life for better.

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