A System for Dam Automation and Safe Flow

Akhila Suresh[1], Fini Joby[2], Mable Mary Paul[3], E. S. Sudheesha[4]

[1,2,3,4]*B.Tech. Student, Dept. of Civil Engg., Sahrdaya College of Engineering and Technology, Thrissur, India*

Abstract: **We are in an innovative and interconnecting world with advancing technologies. Our societies have to evolve in sync with new technologies. However, still there are lots of areas yet to reach technology. One of the major areas is water control and management. Mass hydraulic structures such as dams are still operating manually. Dams represent a risk to public safety while providing tremendous benefits ranging from flood control to power generation. It is time consuming and excessively risky in times of bad weather when operated manually. Climatic change is expected to affect the water supply-demand balance and challenge existing water management strategies. The vulnerability of water resources systems to floods and droughts will increase. This is the main reason of why most of the water supply companies and governments are still facing the problem of controlling dams. This paper is to present a new solution to attain great success in monitoring and controlling of dams meanwhile saving time as well as human lives during extreme climatic conditions through dam automation. The successful implementation of dam automation system is an important step towards developing a convenient and efficient water management strategy. The system will allow the users to control the flow of dams by proper monitoring which will reduce a lot of efforts, time and also increases the quality rather than using manual system.**

Keywords: **Arduino, Level sensor, Dam automation system**

1. Introduction

The changing environmental conditions require an efficient water control and management in reservoir, so we introduce an automatic monitoring and control of dams. Inarguably all countries in the world have dams. However, a very few operate on automated systems, which is more effective and efficient than manual ones. The flood that happened in Kerala on August 2018 led us to thought of automating Idukki Dam, for its smooth and safe functioning. From 8 August 2018, severe flood affected one sixth population of Kerala, due to high rainfall during monsoon season beyond expectations and predictions of experts. This scenario created a huge confusion among the government as well as the concerned authorities on controlling the water flow. Hence, it would be useful for all countries to start to use automatic systems for their dams as this will reduce the amount of effort that they are already putting towards dam maintenance. Automatic system for maintenance of dams will ensure quality of water supply and reduction in the number of lives taken by overflows and flood waters. It is not only complex to control a dam manually, but also time-consuming and excessively risky especially in times of bad weather. Many of the countries among the world are facing a good number of difficulties due to manual operation of dams in case of controlling and monitoring the levels of water and receiving danger warnings and alerts. The biggest benefit of automation is that it saves labour however; it is also used to save energy and materials and to improve quality, accuracy and precision.

2. Literature review

Automatic closing and opening of door is a very important part regarding the dam. This automatic opening and closing of dam door is also depending upon various types control system. Project work done by Zeyanna et. al. (2017) gives an idea about installation of new system using electronic devices. Automatic water level indicator working system could detect the rise in water. It can effectively pass signals. Using this system, one can save manpower and reduce risk. We concentrated not only on water control but also safety of human and environment. Wireless communication system provided with opportunities of satellite communication.

A. Water level indicator

Water level is an alarm circuit to detect and indicate the level of water. It transmits the signals according with water level. As per circuit it functions can vary (fig. 1).
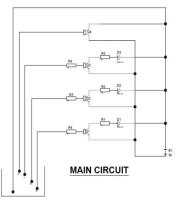

Fig. 1. Circuit of water level indicator

B. Arduino

Arduino is an open-source hardware and software. Arduino consists of both a physical programmable circuit board and a piece of software, or IDE (Integrated Development Environment) that runs on computer, used to write and upload computer code to the physical board (fig. 2)
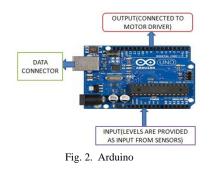
3. Methodology

In our project we are automating Cheruthoni dam, Idukki

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using a control system. Cheruthoni dam is a 138m tall concrete gravity dam located in Idukki district of Kerala in India. This dam was constructed as part of the Idukki Hydroelectric Project. Water impounded by Idukki, Cheruthoni & Kulamavu has formed a single reservoir spread over 60 sq.km on a height of 2400 feet above Mean Sea Level. Cheruthoni Dam is located 1 km west of Idukki dam. The spill way of the Idukki Reservoir is situated in the Cheruthoni dam and hence the control is at Cheruthoni. It is having 7 spillways, among which 5 are radial flood gates and 2 are vertical flood gates. We are automating the dam by monitoring and controlling the water flow especially during extreme weather conditions. The dam is automated with the help of Arduino board.

In this project, we propose the idea of controlling & monitoring the water supply using an embedded system with Arduino.
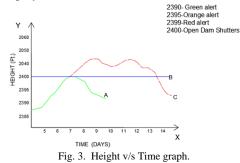

Fig. 2. Arduino

The embedded system is the combination of both hardware and software which contains an automated process that makes easiness for the staff. This system includes sensors, Arduino, etc. which can provide the information signals to the hardware unit. In this project we mainly concerned with the levels of water, which is detected using different components of the system.

A. Embedded system for monitoring and controlling water flow

The embedded system for monitoring and controlling of water flow consists of following:
   a. Water sensor
   b. Arduino
   c. Display

Fig. 3. Height v/s Time graph.

The first sensor is placed at 2390ft & at every successive

levels sensors are placed. These sensors are named as L1, L2, L3,….., Ls,….,Ln, where Ls is the level of water fixed by the system operator to open the shutter & Ln is any final level up to which the maximum capacity reach. These levels are connected to the Arduino as input in respective slots of Arduino as A1, A2, A3,…, An. The resulting values are fed to the processing unit where the graph is plotted and respective gates are operated. Five motors are connected to the Arduino. Since the Arduino can supply a maximum of 5V, we provide motor drivers which can increase the voltage to 230 volts.

Fig. 4. Alert board

When the water reaches the level of first sensor placed at the L1 level, Millis function starts to count automatically and the rate of increase in water level is measured by the computer system along with that the green alert is provided to the operator. The time till it reaches the next level (where sensor is placed) is recorded. Similarly, the time for water to reach the successive levels are recorded, using these values along with the levels of water in feet, the points in the graph are plotted (fig.3). When water level reaches 2395ft orange alert is provided, similarly when the water reaches 2399ft red signal is indicated, these signals along with the necessary alert messages are projected at the important station near to the drainage path (fig.4). As water reaches the Ls, the Arduino send information signal to the motor which initialize the gate opening. After studying the variations in graph the height of opening is determined.

4. Conclusion

In India, still now dam control is done manually and has not been automated yet. In manual operation there is human invention required in measuring the water level, opening the gates and controlling the gates. In our project we focus on automating all these works and makes easy operations of dams. By using various components, the entire system is implemented and controlled in accordance with the level of water present in the dam. These levels are sensed with the help of detector and signals are send to the controller where the opening and closing

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of corresponding gates are done effectively. Automation of dam fastens government procedures by passing information to the authorities at right time and reduces the confusion regarding opening and closing of gates, thus there is no scope for risk. The necessary alert messages are send to the public which help them to make precautionary measures.

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