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A REVIEW ON FUZZY LOGIC BASED HYDROELECTRIC POWER DAM CONTROL SYSTEM

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ABSTRACT

This review paper presents the construction design of Hydro-Electric Power Dam Control System using Fuzzy Logic. This paper is information is helpful for engineering at the time of designing control system for the Hydro-Electric Power Dam. The major part of the paper is related work, which provides the survey on existing system.
KEYWORDS: Fuzzy Logic, Hydro-Electric Power Dam, Control System. Professor.

INTRODUCTION

According to the environmental concept the renewable energy sources are best as compare to the conventional energy sources. Renewable power generation sources such as Hydroelectric power, wind energy, solar energy, wave energy, geothermal energy etc. pollution is generated by the conventional energy sources, so that the renewable energy use is a global trend. In the renewable energy types, hydroelectric energy is mostly used by the different industries. The largest source of renewable electricity is hydroelectric power and allows the nation to avoid 200 million metric tons of carbon emissions which is done by the conventional energy sources each year. The small hydro power stations have higher capacity factor and efficiency, high level of predictability, varying only with the seasonal rainfall patterns. The hydro-power technology is a lifelong, long-lasting and robust technology. Turbines are used to generate the electricity in the hydroelectric plant and turbines are useful for long years depending on the water specifications [4, 5].

RELATED WORK

M. Abbas *et al.* [1], provides Hydro-Electric Power Dam Control System using Fuzzy Logic works on two input as well as two output parameters. Input parameters are water level and flow rate where as two output parameters are release valve control and drain valve control. This proposed system uses Water level and flow rate devices, which are used to monitor the status of water in the Plant. These two devices are connected with the two fuzzifiers of the fuzzy logic control system. Defuzzifiers are used for releasing control valve and drainage valve. Fig 1 shows block diagram of hydro-electric power dam fuzzy control system. Fuzzifiers are nothing but the algorithm designed for the water level and flow rate. This system consists of two fuzzy input variables and five triangular membership functions. These functions are equally determined over a scale range of 0m to 20 m for the water level and 0(m3s-1) to100000(m3s-1) for flow rate inputs. The five fuzzy membership functions for water level input are given in the Table 1 and Table 2.

Table1. Membership Functions and Ranges of Input Variable Water Level (m) [1]

Membership Function (MF)	Ranges	Region Occupied
Very Low	0-5	1
Low	0-10	1-2
Below Danger	5-15	2-3
Danger	10-20	3-4
Above Danger	15-20	4

Table 2 Membership Functions and Ranges of Input Variable Flow Rate (m3/s) [1]

Membership Function (MF)	Ranges	Region Occupied
Very Slow	0-25000	1
Slow	0-50000	1-2
Normal	25000-50000	2-3
Fast	50000-100000	3-4
Very Fast	75000-100000	4

Fig. 2 shows proposed hydro-electric power plant in which water level and flow rate devices are used to monitor the status of water in the plant. These devices are connected with the two fuzzifiers of the fuzzy logic control system after suitable amplification and voltage adjustment unit. Two outputs of defuzzifiers are the releasing control valve and drainage valve.

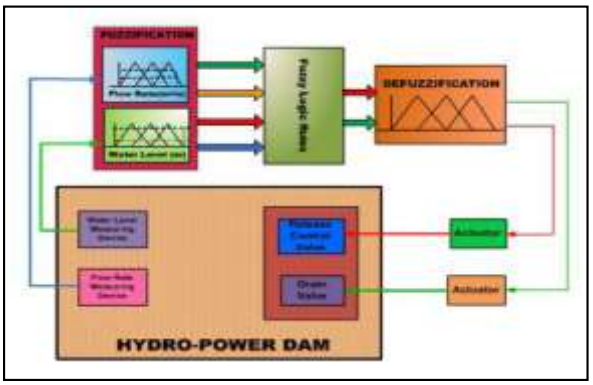

Fig. 1 Block Diagram of Hydro-Electric Power Dam fuzzy control system [1]

Priyabrata Adhikary, Pankaj Kr Roy, and Asis Mazumdar [2] developed safe and efficient control of hydro power plant by using fuzzy logic. This paper presents a new Fuzzy Logic Controller (FLC) method for safe reservoir control of dams through spillway gates. This paper provides FLC method for turbine valve to control the water flow through turbine. This paper used Tabu Search Algorithm, Fuzzy Delphi Method and Mamdani Inference Method to evaluate using manual C.O.G. Defuzzification and MATLAB FIS editor validation. This paper present three different methods; first method is **Fuzzy Logic**, which provides fuzzy control method. These methods control the processes that are too complex to be mathematically modeled. Some time it is difficult to quantify type of process such as Water Level or Depth is at "Below Danger Level-Danger Level-Above Danger Level". Also fuzzy logic provides Fuzzification; Converts the Classical or Crisp Values to Fuzzy Sets, Fuzzy Logic Rules and Fuzzy Inference Methods (Mamdani Inference Method) and Defuzzification; Converts the Fuzzy Set to Classical or Crisp Values. Second method is **Tabu Search Algorithm.** In this algorithm meta-heuristic local search algorithm is used for solving combinatorial optimization problems. Third method is **Fuzzy-Delphi Method.** This method provides semi-structured communication method, developed as a systematic and interactive forecasting method. Interactive forecasting method relies on experts, engineers or managers. In this proposed system it was found that FLC rule base is intuitively constructed by firing optimum no. of rules using "Delphi Method" and "Tabu Search Algorithm" (TSA) is used to choose the most appropriate parameter values characterizing the fuzzy membership functions.

Thae Thae Ei Aung et al. [3] designed fuzzy logic to control flow of liquid. This proposed system provides fuzzy logic controller for Hydro-Electric Power Dam. This dam is Control by using simulation package which is Fuzzy Logic Toolbox and Simulink in MATLAB software to design a Fuzzy Control. The paper presents Fuzzy Logic Controller (FLC) method for safe reservoir control of dams through spillway gates and it presents FLC method for turbine valve to control the water flow through turbine for hydro power generation. Fig. 3 shows the basic Arrangement of proposed hydro–electric power system. This arrangement contains penstock (The lake water travel through a large pipe), Controllers (are used to adjust dam lake level in set point only within shortest time by adjusting valve openness), Sensors (to detect water level and flow rate, here ultrasonic sensor transmits ultrasonic waves into the air and detects reflected waves from an object) and drain valve (control can be utilized further for land irrigation according to the need).

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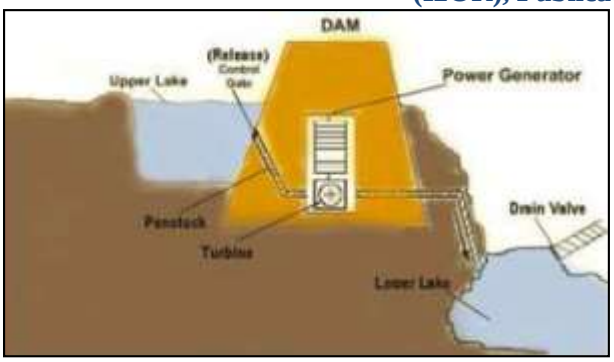

Fig.2 Arrangement of proposed hydro–electric power system [3]

CONCLUSION

Hydroelectric power is nothing but the conversion of potential energy of water into electricity. Hydroelectric power captures the energy released from falling water, which causes kinetic energy to be converted into mechanical energy, which in turn can be converted into a useable form of electrical energy. This paper presents the overview on construction design of Hydro-Electric Power Dam Control System.

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