A Model Based Approach to Simulate Excess Water of Reservoirs in Sri Lanka

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INTRODUCTION

The research is focused on the risk of floods due to spilling of reservoirs in Sri Lanka. Through this research we expect to illustrate how ICT can effectively address the above scenario and to create a number of significant avenues to continue researches to build a perfect system.

A. Motivation

In the recent past, lots of flood incidents were reported by mass media, due to spilling of reservoirs during heavy rainy seasons, in most areas of Sri Lanka. This has caused tremendous damages to both lives and properties of human as well as other living beings.

This motivated us to explore the problem in an ICT perspective.

B. Background

We interviewed and carried out discussions with irrigational engineers of Nachchaduwa Reservoir, Anuradhapura. Through these discussions we identified, non availability of proper mechanism to predict the water level of a reservoir while raining to the catchment is a significant problem in reservoir operation management. Further this leads to the difficulty of managing excess water of the reservoir within a very short period of time without damaging downstream.

We gathered operational records of Nachchaduwa reservoir, available in daily basis from 2005- 2011 and relevant rainfall data from Meteorological Department for carrying out the research.

C. Methodology

Generally, local reservoirs are operated according to the reservoir standing orders. These are predefined set of rules and do not facilitate real time decision making in dynamic situations.

Therefore we propose a model based approach which consists of two sub models as "Water Level Forecasting (WLF) Model" and "Water Release Optimization (WRO) Model".

The WLF model forecasts the reservoir water level according to the catchment rainfall. For this, we have identified neural network and physics based approaches to develop the WLF model. In the neural network based model, a relationship will be built among rainfall to the catchment, rainfall to the reservoir, other inflows, total outflows and reservoir water level. The Physics based model will be used to derive the expected increase in water level, using the same parameters with existing physics equations.

The WRO model will optimize the release of excess water of the reservoir by incorporating all the out flow channels available. In doing so, the importance will be given not only to the safety of the dam, but also for the threat of flood consequences. The optimization model will take the excess water amount, generated through the forecasting model, and calculate different combinations as to how the water can be release with available out flows.

D. Evaluation

Evaluation is focused on validating two aspects of the research outcomes. Mainly it focuses on evaluating the underlying WRO model used for excess water release and the WLF model used to predict reservoir water level.

Evaluation of the WRO model is carried out by comparing the results generated through this model, with the feedback of reservoir engineers. To evaluate the neural network model, a separate test data set will be used.

The other evaluation aspect focusses on the acceptability of this kind of solution for reservoir operation. In this regard, prospect users will be given the system interfaces to interact with and get their feedback to measure the acceptability.

E. Discussion

Main discussion avenues opening through this research are considered here. As a concept, how successful the ICT approach to address the identified problem is considered. In doing so, if we are to come up with a final software product, what sort of sub modules, namely reservoir water level forecasting (WLF), reservoir water release optimization (WRO) etc. are to be considered, will be discussed. Further, the validity of the approaches used to design the models and their appropriateness will be discussed. Finally in order to get more accurate results through the models, data collection processes and quality of the data required will also be discussed.

Through this research we are expecting to enhance the reservoir operations in ICT perspectives which will be helpful to mitigate the risk of floods in Sri Lanka.