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Dam water level prediction system utilizing Artificial Neural Network Back Propagation

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Abstract

For flood and drought disasters, Reservoir dams are the one of the best protection mechanism. While in time of flood like conditions, the gate of the dam must be open sufficient to make sure that the reservoir potential will now not cross its limits and the discharges no longer reason for the overflow downstream. While at some point of drought the reservoir wants to impound water and launch properly to fulfill its purposes. Modeling of the reservoir water launch is fundamental to help the reservoir operator to make quickly and correct choices when dealing with each disasters. In this paper, shrewd selection help mannequin primarily based on Artificial Neural Network (ANN) Back Propagation is proposed. The proposed mannequin consists of state of affairs assessment, forecasting, and selection models. Situation evaluation utilized the temporal records mining approach to extract applicable statistics and attribute from the reservoir operation record. The forecasting mannequin makes use of ANN to operate forecasting of the reservoir water level, whilst in the choice model, ANN is utilized to operate the classification of the cutting-edge and adjustments of reservoir water level.

Keywords: *Artificial Neural Network (ANN), Back Propagation and Data mining*

1. INTRODUCTION

The forecasting of Reservoir water level is essential in reservoir management and operation. The reservoir decision support systems make use of the output of the forecasting model. This find out about demonstrates the utility of Artificial Neural Network (ANN) in growing the forecasting model for the alternate of reservoir water Level stage[5 6].

2. RELATED WORKS

This section gives details about the related work carried in this area.

[1] Mohmmad Azrol Syafiee Anuar*, Ribhan Zafira Abdul Rahman, Samsul Bahari Mohmmad, Azura Che Soh, Early Prediction System Using Neural Network in Kelantan River, Malaysia, 2017 IEEE 15th Student Conference on Research and Development (SCOReD)

The neural networks is in this system for the predicting the water level for next upcoming 5 hours. This system takes 5 inputs and give us 1 output prediction.

This prediction system focusses on comparing the conventional method and the Neural Network Autoregressive with Exogenous Input (NNARX) system in determining the possibility of a flood.

The method used in this paper uses the following steps

A. Data Collection & Used

- The parameters that take into consideration is as

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i. Rainfall value in the surrounding area,

ii. The flow rate of the upstream river and

iii. The water level of the targeted downstream river.

B. Water Level Prediction Model

- The communication with the exterior environment done by the input layer that offers a pattern to the neural network. Once a pattern is given to the input layer of the sysem, the output layer will produce some other type of pattern. The output layer of the neural network is can offer unique pattern to the external environment. The pattern introduced by means of the output layer can be at once traced lower back to the input layer[7 8]. The variety of output neurons need to be without delay associated to the kind of work that the neural network is to perform. The hidden layer is the series of neurons which has activation characteristic utilized on it as nicely as supply an intermediate layer between the input layer and the output layer the variety of neurons that need to be stored in every hidden layer want to be calculated.

[2] Muhammed Ali Sit, Ibrahim Demir, "Decentralized Flood Forecasting Using Deep Neural Networks", arXiv:1902.02308v2 [cs.LG] 21 June 2019

This paper explores synthetic deep neural networks' overall performance on flood prediction. While providing some models that can be used in the forecasting stream stage, this paper gives a dataset that can focuses on the connectivity of data points on river networks. It additionally indicates that neural networks can be very useful in time-series forecasting as in flood events, and guide enhancing present models thru facts assimilation.

3. PROBLEM STATEMENTS

To design and implement a model which can do the situation utilization temporary data mining technique to find out the relevant data and patterns from the reservoirs calculations (records) and predict the water levels.

4. PROPOSED METHOD

The steps for Software development of river water flood prediction system using neural network, are as follows.

A. *Collection of data and uses*:
While thinking about the floods and the disasters that can happen because of excess of water in dams and reservoirs in surrounding areas there are many things that we have to take into consideration like rainfall, Dead Storage, Live Storage and the float fee of the upstream river and the water level of the concerned downstream river and out flow. These units of facts are acquired from the irrigation department, Maharashtra. The branch is accountable for monitoring and measuring the enter parameters of the rivers for the whole state. These facts are received from 2008 till 2018. The pattern data is proven in table 1.

B. *Model for the Prediction of Water*:

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The input layer communicates with external environment and finds patterns and that patterns (Sample) given to the output layer. Output layer finds other type of patterns that can be very useful to the external environment. The sample given via the output layer is without delay copied returned to the enter layer. The range of output neurons need to be without delay associated to the kind of work that the neural community is to perform[9 10]. The hidden layer is that the assortment of neurons that has activation function utilized on that moreover as supply AN intermediate layer between the enter layer and additionally the output layer the range of neurons that ought to be unbroken in each hidden layer have to be compelled to be calculated.

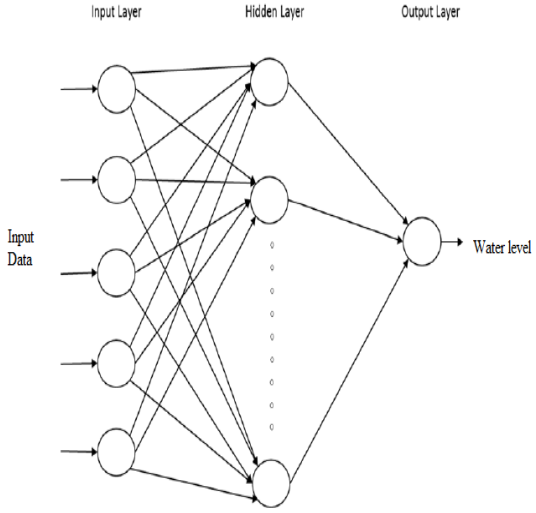

Fig. 1: ANN

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Date	Water Level	Corresponding Storage			Inflow in this weak in MM3	Outflow / Use					
		Dead Storage in MM3	Live Storage in MM3	Gross Storage in MM3		Over flow MM3	Irrigation Use	Non Irrigation Use	Evaporation	Other	Total outflow/Use
1	2	3	4	5	6	7	8	9	10	11	12
Jan-08											
01-01-2008	349.500	2.76	18.76	21.52	0	0	0.655	0	0.020	0	0.67
02-01-2008	349.450	2.76	18.40	21.16	0	0	0.714	0	0.019	0	0.73
03-01-2008	349.400	2.76	18.03	20.79	0	0	0.714	0	0.014	0	0.73
04-01-2008	349.350	2.76	17.66	20.42	0	0	0.714	0	0.016	0	0.73

Table 1: Sample data

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Nonlinear Autoregressive Network with external inputs (NNARX) is nothing but an Nonlinear model derived from Autoregressive with External input(ARX). RNN is uses the loop named as feedback loop and that we can add to the feed forward neural network. Amount of Predicted values is degenerate on the recent values of the output parameters and external input parameters. This NARX model has two layers 1].Feed Forward Network (sigmoid function on hidden layer) 2]Linear Function in the output.

Formula for the NARX is as following :

$$Y_{(n+1)} = f\left[y_{(n)}, \cdots, y_{(n-d_y+1)}, u_{(n)}, \cdots, u_{(n-d_u+1)}\right]$$

u : dataset to predict

n : past predicted values by the model

d_y: input orders

d_u: output orders

y : exogenous variable

$y_{(n)}$ and $u_{(n)}$: external output and input of network at time n

f: nonlinear function

Figure 2. This Fig.2 clearly explains/shows the nodes which are connected to each other as well as to the nodes of the next layers. NARX is having the major feature as delay structure that can create embedded memory within the similar network.

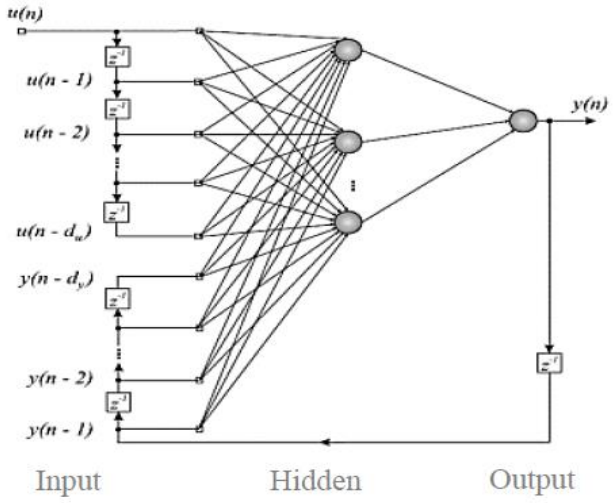

Fig. 2: Structure of NNARX model

5. RESULT

The system calculate accurate result, when adjusted via biase-correction method. We have tested the model using the data available.

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For Testing of this model we have taken input starting from 1st Jan. 2008 to 7th of Jan. 2008 and target data is taken from 8th Jan. 2008 to 10th Jan 2008. The data for the 8th Jan to 10th Jan are already available, since the validation of the output and the model is easier task. We Compared the data manually and based on the comparison, we commit the accuracy of model is equal and above 98%.

6. CONCLUSION

This developed network (Neural Network) or you can say model were successfully able to predict the level of water with accuracy of about 98% for Vishnupuri Dam (Reservoir) for 10 consecutive days after from given day to the data for next 10 days (consecutive) prior to our given day. Therefore This NN does high quality and well timed approach for predicting the water levels in the dams, reservoirs. This NN can be very helpful in estimating the water uses for domestic, municipal and agricultural uses on daily basis. This can also be assist in catastrophe management, response and manipulation in the areas where floods are the major issue.

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